MAKE IT OPEN

Deliverable 2.1

Template and Criteria for Learning Scenarios

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1. Learning Scenarios criteria

1.1. What is a Learning Scenario (LS)?

A Learning Scenario (LS) is a roadmap for open schooling, consisting of various activities (Learning Units) and steps that schools can choose and follow. Unlike traditional pedagogical methods, *Make it Open* LSs are based on different, open schooling dimensions- they utilize varied physical settings, modified teaching roles, and unique learning formats to promote a richer, more open, learning experience and create long term, sustainable connections with the community. The LS should be seen as a supportive framework for teachers, allowing them to try out an open schooling approach by giving them content, tools, and context. These tools can also enable them to perceive the community as an asset and a partner.

Make it Open LSs focus mainly on students aged 9-15, an age range in which children develop their identity, motivation, and interests- all of which are major factors in future educational and career choices.

The LSs use the concepts of “Maker education” and “citizen science” to place inquiry and problem-solving at the centre of the learning process. They allow for student-centred, self-directed learning, in which participants build on curiosity, gain agency, and begin to perceive themselves as an integral part of the world around them.

An interdisciplinary approach is achieved by stepping away from traditional school subjects, and rather focusing on community challenges. Interacting with different actors in the community, such as local scientists, experts, and engineers, empowers students and their parents to be more engaged with their community and play a more active role in addressing the science-based challenges that affect it.

1.2. Development of the LSs

Make it Open LSs aim to provide effective tools that make it easy for novices to get started (low threshold) and give new users immediate confidence that they can succeed, while also allowing a wide range of exploration (wide walls) and enabling experts to work on increasingly sophisticated projects (high ceiling).

Co-creation methodologies will be used to ideate and develop the LSs together with schools, partners, and other stakeholders, equipping and empowering schools and their partners to tailor the programme to their own needs. This user-centred approach- which is built into service design methods (WP1)- is intended to deliver a practical accessible and scalable approach to how different places, roles, tools, and platforms can be combined in innovative in ways that will best support and encourage teacher and community take up. This co-creative approach will ensure the relevance of the end product, agency and ownership among the people for whom it is designed, and a sustainable implementation of the process.

A LS can be developed from different entry points- the entry points can be a result of the school's vision, available opportunities, or content/curriculum based. The challenge of creating a LS is for it to be both rooted in the local community (specific to school, neighbourhood, opportunities, and needs), and transferable and adaptable to other cultures, countries, and schools across Europe.

The first phase of the LS development process was **Map and Define**: researching, selecting, and reframing open schooling frameworks and criteria. It will now move to **Ideate and Develop** the LSs in co-design with teachers from 8 pilot schools in the UK, Israel, Netherlands, and Poland. The LSs will be based on best practices from the partner's Maker education and citizen science programmes, and will place personal and societal challenges in the centre of the learning process. Simultaneously, the open schooling navigator (WP3) will be developed as a guide for teachers using the LSs. The 16 LSs will then **Pilot and Test** by teachers in the 8 schools in two rounds, **Iterate and Repeat** for fine-tuning throughout the hubs in 10 countries (4 practice partners + 6 third parties) (WP4), evaluated through **Proof of Concept** (WP5) to demonstrate feasibility and viability, and finally, **Scale-** delivery to hundreds of additional European teachers (WP6).

At the end of M4, a kick-off workshop initiated the co-creative process. All the teams – consisting of teachers and practice partners- met online to begin to develop and define the general structure of a LS. Over the next 2 weeks, local teams (practice partners and pilot teachers) will meet to start placing the criteria and the templates of the LS into local context, before reconvening again with the larger group to share insights. Following these workshops, each partner, together with their partner schools (one elementary and one junior-high), will continue to work on a selected topic, chosen according to local needs and opportunities, to develop the first LSs to be piloted this school year. Over the summer, after getting feedback from the Proof of Concept process, the partners will refine the LSs before translating and sharing them with another country, where they will be tested over the next school year. Over the next school year, each local team will repeat the process and develop two more LSs based on the experience gained from the first round.

1.3. The LS Criteria

The LSs will be developed according to the following criteria:

Structure

- **Number of Learning Units (LU):** A LS will be comprised of at least 6 LU, with a total duration of at least 180 min.
- **Adaptable/Transferable:** While rooted in the specific, local opportunities that are available to the school in its community, a LS should be adaptable to different settings, curricula, cultures, and countries.
- **Modular**: Built so that teachers can have the freedom to choose all or part of a LS, or to mix-and-match Units from different LSs. Includes activities and tasks that are stand-alone (independent).

STEM skills and competencies

- A LS should be based on methodologies that impart an array of skills: STEM skills, such as asking questions, defining problems, using models, conducting investigations, analysing data, using mathematics, constructing explanations, designing solutions, arguing from evidence, and communicating information; Soft skills including teamwork and collaboration, dealing with uncertainty, learning failure is part of learning, and growth mindset; and Management skills, including planning of work and use of resources, awareness of value of resources, and dividing tasks and roles.[1]

[1] Based on the Science and Engineering Practices in the NGSS

Open schooling dimensions

Using the open schooling dimensions, as defined under WP1- D1.1 *Set of user-centered delivery templates*, we emphasise the specific open schooling dimensions that are relevant for LSs:

- Location (where): Extending the learning environment beyond the school walls- learners engage with science in other settings such as science centres/museums, Maker spaces, or nature parks.
- Roles (who): Others taking on teaching roles, e.g., informal and non-formal learning providers such as science centre/museum guides, parents, experts from business and enterprise, civil society, other students.
- Components (what): The tangible elements which make up the open schooling project and enable it to happen through diverse means e.g., visits into schools, field trips, competition, festivals.
- Timing (when): Learning takes place during school hours and/or after-school hours e.g., events with parents in the afternoon, family activities during evening hours, or hackathons at night.
- Qualities (why and how): The particular features and benefits of the open schooling project include:

  Equity- everyone has equal opportunity to progress and perform to the best of their ability. Equity means relating and highlighting issues around: *Access*- being approachable and accommodating diverse needs; *Diversity*- showing and fostering diversity among participants by including a variety of activity formats, tools, and topics; *Inclusion*- including activities that are empathetic to diverse needs, culturally responsive and flexible, and that recognize social context, responsibility, and impact.[2]

  Real world relevance- addresses challenges that are relevant to the learner to encourage agency and increase motivation.

  Learning by doing- Integrates Make activities to enrich and deepen the learning experience.

[2] Based on SySTEM2020 Design principles toolkit

For the development of the LSs we add 2 more dimensions:

- **Curricular connections** (what): Interdisciplinary, inquiry-based, student-led learning, organized around topics instead of subjects. The LS has to relate to at least two core subjects (Life Sciences, Engineering & Technology, Earth & Space Sciences, Physical Sciences).
- **Engagement with the community**: Schools serve as a learning hub for students and others e.g., parents, members of the community, and experts from local businesses, enterprises, and institutions. The LSs address challenges that are relevant to the community and provide opportunities for collaboration with community stakeholders.

1.4. How did we develop the LS criteria?

All consortium meetings were done virtually because of the pandemic.

Between October and December (kick-off meeting M1, bi-weekly meeting, and M4 workshop), the consortium discussed: 1) **LSs STEM topics**: We gathered data from all partners about **STEM topics** for which they have best practices to offer, and presented a set of STEM topics to serve as a basis for the STEM content of the LSs. 2) **LS criteria**: We presented an initial suggestion for the criteria, and after receiving and integrating feedback, formulated the first version of LS criteria. 3) **LS and LU templates**: During subsequent meetings, which were based on topics and criteria, we presented the first version of LS and LU templates. We held several meetings around WP1 (service design), and WP3 (navigator), in order to embed the service design approach into the LS criteria, to build common definitions, and to learn from their specific know-how.

In order to test the LS criteria and the LS and LU templates, the team of the BSMJ developed a simple example of a LS around a Water challenge (see *Figure 1: Go with The Flow Learning Scenario*), which was presented to the partners and to the pilot teachers to get their feedback.

Following these meetings, we formulated a clearer, more practical, final version of the LS criteria and template.

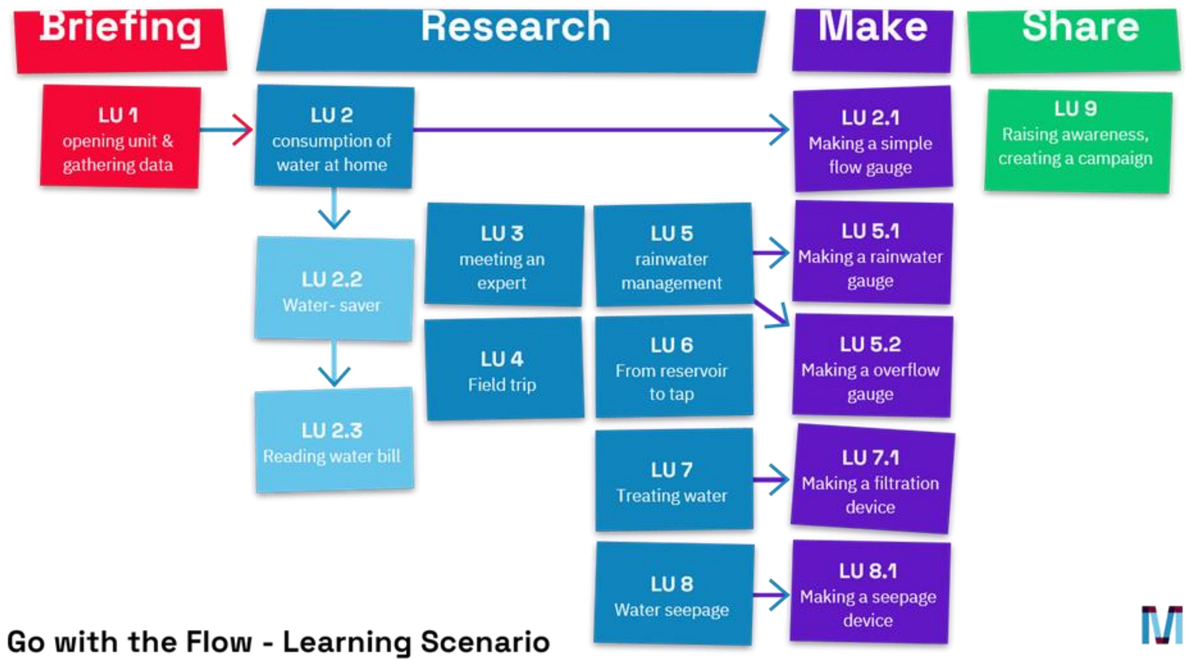

Figure 1: Go with The Flow Learning Scenario

2. Learning Scenario and Learning Unit templates

The templates for both LS and LU enable the pilot teams (practice partners and teachers) to develop the project in a structured and a unified way according to the criteria. The templates will be tested and evaluated though the development and the pilots of the LSs and the Navigator, and will be refined and expected to be combined with service design approach (WP1) before creating the final versions.

2.1. LS template[3]

The LS template consists of the following sections:

- Title
- The “Big Idea"
- The challenge
- A short abstract
- Core STEM subjects (Life Sciences, Engineering & Technology, Earth & Space Sciences, Physical Sciences)
- Main goals (3-5)

[3] See an example of a filled-in template in Appendix 1

- Main messages (3-5)
- Students' age
- Duration
- Brief of the Learning Units (name and short abstract)

  The future Navigator will include a link from each LU to the key sections, and from there it will be possible to reach the extended LU.

2.2. LU template[4]

What

- Title
- Abstract
- Students' age
- Curriculum connections (subject/s)
- Specific goals
- Specific messages
- Main concepts

How

- Duration
- Location: Yard/ class/ lab/ Make lab/ academy/ industrial plant/ field trip/ other
- Roles: Teacher/ expert/ parent/ peer/ students from different age groups/ facilitators from informal organizations/ other
- Engagement with the community: Other schools/ parents/ academy/ industry/ municipality/ small businesses/ community garden/ other
- Format/s: Discussion/ demonstration/ experiment/ survey/ Make workshop/ DIY experience/ working groups/ competition/ digital experiences/ event or festival / other
- Sources & resources: Downloadable resources/ tangible resources (kit/self-source)/ human resources/ other
- Preparation (organizing before the LU)
- Course of activity (detailing a set of activities)

[4] See an example of a filled-in template in Appendix 2

Why

- Practices, skills, and competencies

STEM Skills and competencies	Soft Skills	Management skills
Asking questions	Team-work and collaboration	Planning work and use of resources
Defining problems	Dealing with uncertainty	Awareness of value of resources
Using models	Learning failure is part of learning	Dividing tasks and roles
Conducting investigations	Growth mindset	
Analysing data		
Using mathematics		
Constructing explanations		
Designing solutions		
Arguing from evidence		
Communicating information		

3. Appendixes

Appendix 1: Example of a filled-in LS template

Go with the Flow

An example of a filled-in LS template

The Big Idea

The growing world population, climate change, and air, ground, and water pollution has the world careening towards a clean water shortage, compelling us to wake up to the fact that we have to change the way we manage water (SDG 6 Clean Water and Sanitation).

The challenge

How can we improve the management of water resources in our area?

A short abstract

In this LS, students will collect data about water consumption in their community, practice different ways to measure water flow, learn about issues such as groundwater management and treatment, develop and build technological devices for measuring and filtering water, and create a campaign to raise awareness about water conservation.

Core STEM subjects

Engineering & Technology, Earth & Space Sciences, Physical Sciences

Main goals (3-5)

1. Students will gather information about issues related to water consumption and gain awareness of consumption habits in their community.
2. Students will explore and discover issues related to the treatment, quality, and collection of water by using research tools such as the inquiry process.
3. Students will work as a team to build a technological device related to the treatment, measurement, or collection of water.
4. Students will share their knowledge about water management (on a specific topic of their choice) with the community.

Main messages (3-5)

1. Clean water is a resource that must be carefully managed, as there is shortage of clean water in the world.
2. Natural water (such as groundwater or surface water reservoirs) needs to be treated in order to be of drinking water quality.
3. Water quality can be assessed by a variety of parameters, including the degree of turbidity and hardness.
4. There are a variety of devices that can be used to measure the amount of accumulated rain, ranging from simple, scaled containers to machines that can use light to measure the size and speed of rain drops.

Students' age:

5-6th grade (age 11-12)

Duration

8-12 lessons (8*45min – 12*45min)

Brief of the Learning Units (name and short abstract)

LU 1: opening unit: Gathering data on water consumption

This activity focuses on the collection of data regarding residential water consumption habits, such as: the amount and length of daily showers, if dishes are done by hand or with a dishwasher, the utilization of greywater, etc. During the activity, the students will research common household water usage, build a questionnaire, conduct a survey, and gather information from the school community about water consumption habits. After gathering information, they will start thinking of ways to reduce household water consumption.

LU 2: Consumption of water at home

During this activity, students and parents locate their home (or school) water meter and try to understand what makes it tick. As part of the inquiry, kids and parents think about different questions, such as how they can tell if there is a water leak somewhere in the house.

LU 2.1: Making a simple flow gauge

Students take apart a water meter and learn how it works. Afterwards, they will construct a simple DIY water gauge, made from a vane that spins as water flows.

LU 2.2: Water-saving devices

A water-saver (or flow restrictor) is a technological device installed on faucets and showerheads that is meant to reduce water flow while maintaining a steady and forceful stream of water. This activity consists of taking apart a water-saver and learning how it works, including the scientific and technological principles behind it.

LU 2.3: Reading the water bill

Students will learn how to read the monthly water bill- which company operates the water system, what are the various sections of the bill, how much does water cost, and what units are used to measure water consumption?

LU 3: Meeting with a water expert

Meeting with a water expert, either from the municipality, local water supply company, or the community. The discussion will expose students to different aspects of water consumption and management in their neighborhood/city, such as the way sewage and excess water is dealt with, and/or other points related to conservation and reducing water consumption. In preparation for the meeting, the students will study the topic, prepare questions, and think about creative ways to disseminate their discoveries to the public.

LU 4: Field trip to water treatment plant

Visit to a water treatment plant (sewage treatment facility, desalination plant, pumping station, etc.) in the vicinity of the school. The activity will consist of a tour of the facility and meeting an expert on-site.

LU 5: Rainwater management – collecting information

A workshop that consists of gathering information about the optimal usage of rainwater for the management of the water system. In the workshop, students will read a scientific journal article (https://kids.frontiersin.org/article/10.3389/frym.2018.00038) to learn about surface run-off, its effect on the population and nature, and ways to measure rainfall.

LU 5.1: Rainwater management – making a rainwater gauge

Students plan and construct a rainwater gauge. Further challenge for advanced groups – making a digital measuring device.

LU 5.2: Overflow gauge

Students design and construct an overflow gauge that indicates when water levels exceed a certain amount, and/or releases excess water. The overflow gauge can be based on a simple floating mechanism, such as the ones found in toilets and electric valves. It is recommended to consult with experts from the community (such as plumbers, home renovators, etc.)

LU 6: From reservoir to tap

Students learn about the different parameters for measuring water quality, such as turbidity and mineral concentration. Students encounter various ways of measuring the turbidity of lake water, see a demonstration/video of turbidity measurement for drinking water, and conduct experiments to determine water hardness.

LU 7: Treating water

Students research the different ways of treating water, such as sand filtering and reverse osmosis. Students experiment with filtering water through sand and active carbon, which are two methods that can be used to treat water, depending on the purpose.

LU 7.1: Making water filtration devices

Building a water filtration device for use in LU 7: *Treating water*

LU 8: Water seepage through the ground

Students learn about water seepage through different types of soil, and its effects on water collection, groundwater, and agriculture. Students will experiment with seepage through different types of soil and measure the seepage rate.

LU 8.1: Building water seepage devices

Students build devices for measuring seepage rates through soil, for use in LU 8: *Water seepage through the ground*

LU 9: Campaign to raise awareness about water conservation

Students create a campaign to raise awareness about water usage and conservation in the community. Students will promote different ways of saving water at home, as well as address the other topics that were discussed throughout the Learning Scenario.

Appendix 2: Example of a filled-in LU template

Making water filtration devices

An Example of a filled-in LU template (for LU 7.1 Making water filtration devices)

Abstract: Building water filtration device for use in LU 7: *Treating water*

Students' age: 9-12

Curriculum connections (subject/s): Engineering, technology

Specific goals:

1. The students will understand the fundamental concepts of water filtration
2. The students will build a working model of a filtration system

Specific messages:

1. Filtration is the process of cleaning water of impurities
2. Different sizes of impurity particles require different filtration processes

Main concepts: filtration, sealing

Duration: 45-90 min

Location: Classroom/lab/yard

Roles: Teacher, (parents, experts – optional)

Engagement with the community: Optional local Maker space or parents

Formats: Maker workshop, working groups

Sources & resources: Clear plastic tube, length 15-20 cm, diameter 3-7 cm (can be made of water bottles, different cylindrical containers); Gauze cloth or fine mesh; Rubber bands; Duct tape; Stand on a base; Sand (sea sand); Activated carbon (aquarium supply shop); Clay soil (building materials supply); Water; Food coloring.
Optional: CAD files for digital manufacturing (attached files); mobile phone for monitoring turbidity by light sensor

Preparation (organizing before the activity): Acquire materials (i.e. active carbon, sand, cylinders, etc.)

Course of Activity *(An outline of the course of activity)*

1. Opening (in plenary) - presenting the need for filtered water for tap water and for irrigation - 10 min
2. Presenting the challenge, "Design and build a water filtration device" – 2 min
3. Gathering information about water filtration– in groups/in plenary – 20 min
   Presenting the materials and equipment. Emphasize important principles for building (sealing, a appropriate amount of filtering material, mesh at the bottom that will allow only water to pass, etc.). Show an example of a device...
4. Dividing the class into working groups and starting to work:

- Choosing the type of filter (sand filter or active carbon filter)
- Brainstorming ideas for the design...
- Drawing two of the designs, choosing the final one with the help of the teacher...
- Starting construction...

5. Testing the device: how can we evaluate the device, and improve the prototype?
6. Presenting the final product. *Please note! it is worthwhile to attach pictures and videos.*

Practices, skills, and competencies:

- STEM Skills and competencies: asking questions, defining problems, conducting investigations, designing solutions.
- Soft Skills: team work and collaboration, learning failure is part of learning.
- Management skills: planning work and use of resources, dividing tasks and roles.

Figure 2: An example of a water filtration device