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PLASTEAM: STEAM education for plastic-free primary schools
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STEAM Box & Labs

METHODOLOGY

Intellectual Output 3
A1. STEAM BOX methodology
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CONTENTS

ACRONYMS

APP	Application
EBL	Enquiry Based Learning
EC	European Council
ESD	Education for Sustainable Development
NGOs	Non-Governmental Organisations
SD	Sustainable Development
SDGs	Sustainable Development Goals
STEAM	Science – Technology – Engineering - Arts- Mathematics

STEAM BOX SCOPE & AIMS

Plastics are an important material in our economy and modern daily life is unthinkable without them. At the same time however, there can have serious downsides on the environment and health due to prevailing production and consumption patterns and from how we deal with our plastic wastes. So, action on plastics is a priority of the EC Circular Economy Action Plan, to help European economies, societies and individual consumers to use resources in a more sustainable way. In this line, the European Strategy for Plastics in a Circular Economy (2018) is transforming the way plastic products are designed, used, produced and recycled in the EU. Europe acknowledging also the huge threats posed to ecosystems and humans by the excessive production and disposal of Single-Use Plastics (SUPs) through the EU Single-Use Plastics is gradually banning a list of 10 SUPs products such as plates, cutlery, straws, stirrers, cotton swabs, etc. It is evident that when it comes to SUPs, as citizens and consumers, we have a decisive role to play through the choices we make.

In this context, the PLASTEAM project aims to contribute to the awareness raising, sensitization and education of students and teachers of primary schools about the plastic pollution problem, and in particular, SUPs and the sustainable ways of managing them at school level. In this context, one of the project's Key-outcomes is it's the STEAM-Box.

Even if we call it a "Box", and physically it could have the form of a Box, where all its lessons plans are gathered in a hardcopy form, however, the STEAM-Box is, in fact, e-toolkit, or educational material with activities or lesson plans. The "Box" concept serves us one more purpose: In contrast with the strict sequence that usually permeates the design of a formal school curricula, this toolkit instead proposes a "menu" to choose from, allowing only parts of its content (learning activities) to be used according to the teachers' and the learners' needs.

4R+1 APPROACH

Refuse
Reduce
Reuse
Recycle
& Rethink

The STEAM-Box aims to increase the awareness of the educational community about the environmental impact of plastics they use and how they can responsibly manage their plastic waste (especially SUPs), through the 4Rs+1 approach: Refuse, Reduce, Reuse, Recycle and Rethink.

More particularly, the objectives of STEAM-Box for its target users – teachers and students- are to:

- Discuss challenges posed by the unsustainable plastics' consumption and production patterns in modern overconsuming societies.

- Understand their attitudes/behaviours associated with plastics, particularly SUPs, so as to best confront them.
- Increase their knowledge of the impacts of unsustainable disposal of plastic waste and SUPs.
- Become aware of good practices / policies of plastic minimization and waste management at school, household, and community level.
- Make informed decisions and be motivated to act about proper management of plastics at the school and at home level.
- Be interested in progressively becoming "agent of change".

The overarching goal of STEAM-Box is for its users, to adopt an informed and responsible behavior regarding plastic use and management.

The teachers that will apply it can adjust it to best fit their contexts. They are welcome to pick activities that suit them, extend, or change the order of activities in order for the material to best to their class, time-plan, goals, etc.

TARGET GROUP

The STEAM BOX is designed to primarily be used by teachers of primary school that teach students aged 9 - 12 years old, however it can be adapted for younger or older ages. In this respect, its target audiences are:

- Teachers, acting as multipliers of the STEAM-Box.
- Students, through their teachers, acting also as PLASTEAM ambassadors.
- Non-formal educators (outside the formal schooling system, e.g. in NGOs, Museums, Science or Environmental Centres, etc.)
- Parents, families indirectly through the students.

Is STEAM-BOX an educational "box", "toolkit" or "material"?
The STEAM-Box is actually an online material with a series of proposed learning activities, that can be run at the level of a class, a small group, or individuals.

Do we refer to teachers and pupils or educators and learners?
The STEAM-Box is designed to be applied mainly within the formal sector (schools) so we keep the terms "teacher" and "student". For application in non-formal settings the terms "educator" and "learner" may be more relevant.

Does the STEAM Box contain lesson plans or activities?
The STEAM-Box is comprised of both. Lesson plans have more strict objectives and content for learners, while activities with a more loose approach (e.g. energisers, games, reflection exercises.) can be also found.

How long does it last?
Some activities can be completed within the average class-duration (45 min) or less. Some are more demanding and require several class meetings to be completed.

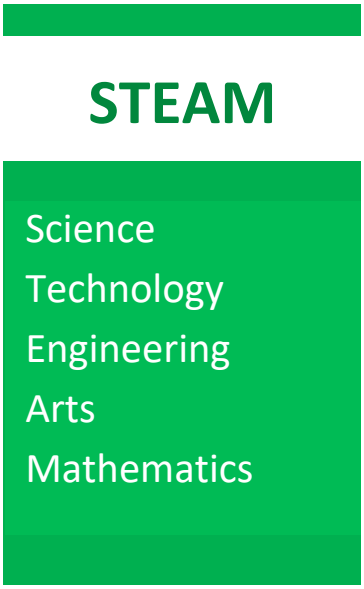
THE THREE-PILLARS OF STEAM BOX

The STEAMBOX is designed to serve as a flexible tool to raise awareness and promote responsibility on the plastic waste/SUPs issue in the European educational community - mainly primary school level - and beyond. It is planned to include playful, hands-on, experiential activities in the form of a "menu" that is flexible to be used in formal and non-formal settings and adaptable for other age groups e.g. secondary school level, parents, etc.

For students to adopt an informed and responsible attitude in consuming and disposing plastics, and waste un general, the STEAM-Box content will be developed based on the following pillars:

I. STEAM

The STEAM approach facilitates a learning environment that is flexible, dynamic, and relevant. It provides an integrated approach to learning which requires an intentional connection between subjects related to the STEAM fields and lesson design.



Moreover, a STEAM teaching mind-set recognises a broad range of experiences, skills and behaviours as having a legitimate place in the science classroom. It can be considered as an effort towards "broadening what counts", that is, towards creating a supportive and inclusive environment in which all students feel that they can contribute from their own lived experiences and that these are valid and valued. Integrating concepts, topics, competences and tools of the STEAM approach help students to foster critical and creative thinking and reflect meaningfully on their work as well as to apply cross-disciplinary learning, shaped by teacher collaboration and dialogue.

The STEAM-Box content will be based on STEAM fields, in order to enable teachers of STEAM related school subjects to more easily integrate it within their teaching. Moreover, the complexity of certain topics within STEAM-Box such us plastic waste, plastic pollution, SUPs, consumption and production patterns etc. require methods that STEAM can support.

II. Education for Sustainable Development (ESD)

Sustainable Development (SD) requires a profound transformation of our values, choices and actions. In order to assure that pupils can become change-makers who are able to engage with the complex sustainability-related issues as described in the 17 Sustainable Development Goals (SDGs), and in particular with the European circular economy agenda, they need to access knowledge, skills, values and attitudes that empower them to contribute to such a sustainable development.

Education for Sustainable Development (ESD) empowers learners to take informed decisions and responsible actions for environmental integrity, economic viability and a just society, for the present and the future generations, while respecting cultural diversity. To this end, ESD is a holistic and transformative "umbrella" type of education that addresses learning content, pedagogy and the learning environment.

ESD

Education for Sustainable Development

The STEAM Box will be based on the principles of ESD addressing the topic of plastics from an environmental, societal, cultural and economic point of view. Another feature of ESD, that is also valid for the STEAM-Box is that it can and is applied both within and outside formal education settings. Using as a "vehicle" the tangible issue of plastics in our lives the STEAM-Box aspires to be useful in dealing with overall lifestyle issues and the prevailing production and consumption models.

Some of the characteristics of ESD which the STEAM-Box intents to follow is being learner-centered, allowing critical and systemic thinking, collaborative work and decision-making, as well as being transformative and action-oriented in order to motivate learners to adopt sustainable lifestyles.

III. Enquiry Based Learning (EBL)

The Enquiry-Based approach allows the creation of an environment where the learning process is driven by the student's enquiry and is facilitated by the teacher. Such an approach may allow for the gained knowledge to be more readily retained because of its experiential acquisition. It also allows for the development of key skills such as carefully observing, directing change, being curious, asking questions, imagining and proposing solutions, being creative, communicating ideas and working in groups.

The nature of the STEAM BOX activities should encourage the development of such 21st century skills for the learners and teachers that try them. This means that the BOX's activities will apply an active process-driven learning, that starts by posing questions, (or problems or scenarios) and continue through the chain of:

- FOCUS: identify the problem
- OBSERVE: document elements to further define the problem
- DISCOVER: research current solution
- APPLY: create new solutions
- SHARE: present solutions and ask for feedback
- REVISE: implement feedback.

EBL APPROACH

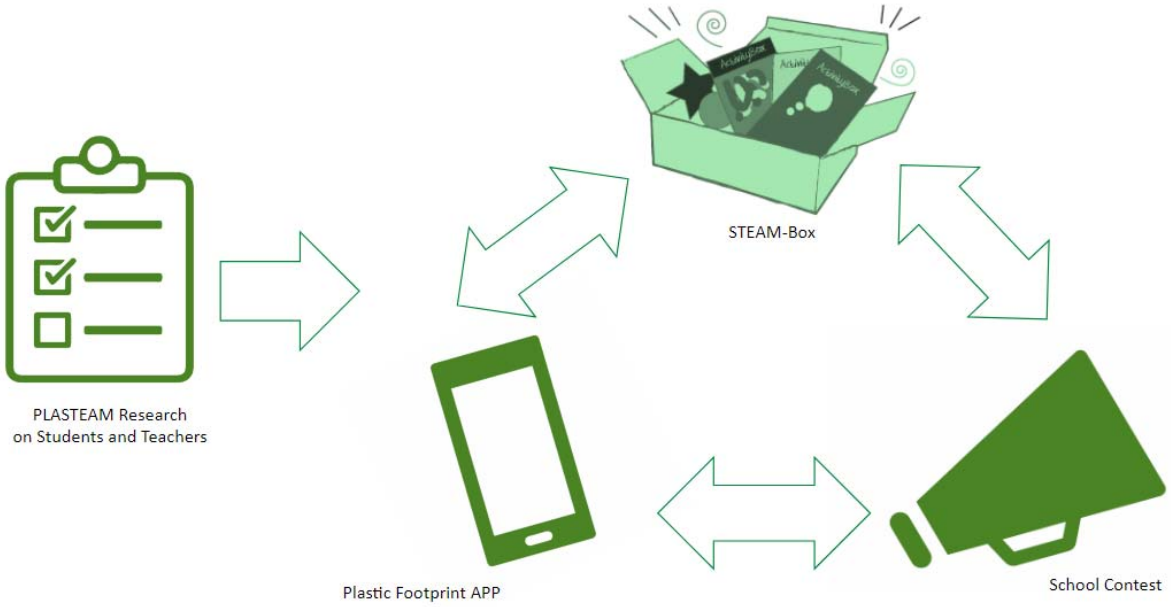
Focus
Observe
Discover
Apply
Share
Revise

LINKS WITH OTHER PLASTEAM OUPTPUTS

The STEAM Box is closely linked with all major key products and activities of the PLASTEAM project, and especially the Plastic Footprint APP and the Plastic-Free Contest. The possible interactions amongst these are analysed below:

- The research carried out on students and teachers of the Partner countries (NL, EL,IT,RO,MT) during the first year of the project has indicated a series of challenges that schools face in managing their plastics and in their efforts to limit them. These challenges were further elaborated by the partners in a form of a catalogue (mapping of challenges) The proposed activities that are included in the STEAM-Box are meant to address one or more of these challenges.
- The plastic footprint APP/ diary for schools provides a kind of audit of plastic use in the Partner schools (measuring 5 characteristic SUPs, namely the water bottle, the milk or juice container, the straw, food packaging and the plastic bag). These consumptions which are recorded for a certain period in the three Partner schools (NL, EL, RO), during spring of 2022 already show some trends in the use of plastics as well as in alternative “green” behaviors that are favored by students.
- The plastic free schools Recommendations and Contest (expected for Autumn 2022) will be an opportunity for the participating schools to apply the STEAM-Box or selected parts of it (at least those relating to the identified challenges for the school).

This way the APP, the Contest and the STEAM all together shape an ingenerated holistic approach for interested schools to be change agents with regards to plastic use.



Graphical representation of how the various components of the PLASTEAM interlink with another.

Mapping of Challenges in Schools

The research carried out on students and teachers in the Partner countries during the first year of the project as well as the extended discussions with partners has pinpointed to a series of challenges that schools face in managing their plastics and in their efforts to limit them.

This catalogue was reviewed by the authors of the educational material in order to design activities that can "match" them.

SCHOOLS' CHALLENGES RELATED TO PLASTIC WASTE:

- Lack of a proper plastic **recycling system** in schools.
- Low awareness how to **differentiate** between Single Use Plastics (SUPs) and Plastics in general
- Avilability of single use plastic (SUPs) in **canteen** (**NO reduction policy** in place e.g. for SUPs)
- Lack of **training courses for teachers** regarding the sources & impact of plastic pollution
- **Low awareness among pupils** regarding the sources & impact of plastic pollution.
- **Usage of Single Use Plastics** (SUPs) during the teaching process, especially in primary school.
- Lack of knowledge about **4R+1 hierarchy** (E.g. emphasis is put on recycling rather than reduction).
- Usage of **single use packaging** among kids to carry their lunches.
- Lack of **support from families** related to sustainable behaviors in using and consuming plastics (e.g. luch boxes, recyc;ing at home, etc.)
- **Lack of time** in class to discuss about the topic.
- Difficulty in **changing a bad habit** e.g. of using SUP items.
- Lack of knowledge on the **recycle chain of plastic** among pupils and adults.
- Prevailing **misconception** in pupils that all plastics can be easily recycled.
- Lack of knowledge how to interpret the **plastic labels (1-7 code)**.
- Lack of knowledge of **buying goods without plastic**.
- Low exploitation of **art** in projects dealing with plastis, despite its aknowledged motivating and transfomative power

ACTIVITY STRUCTURE

The STEAM Box is planned to include between 10 and 15 lesson plans or activities examining the sources, impacts, types and sustainable ways to tackle the problem of plastic use (especially Single-Use Plastics) at the school level. It will include:

- A "how-to-use" section with introduction on its scope and content, practical tips on implementing the activities, references and further readings.
- The lesson plans

The key components of each activity / lesson plan will be:

- Title
- Learning objectives
- Estimated Duration
- Materials & Equipment
- Key Facts / Useful Information
- Process Step-by-Step
- Reflection / Debrief
- Websites to learn more

Draft graphical layout of an activity

THE STEAM-BOX LABS

Once the STEAM-Box is translated in the Partner languages, teachers and students will have the possibility to practically use it. This will be crucial as in this way it will be possible also to gather feedbacks about the box and how to eventually fine -tune it.

During the Labs that will be conducted by the Partners schools, and eventually all the other PLASTEAM partners, teachers will select and pilot some activities and provide feedback on them. Apart form generating awareness, the piloting of the activities will interlink with the upcoming Contest by:

-addressing the school challenge(s) hat is raised by the Contest

-supporting students to the design of a solution to that challenge and participate in the Final Contest, where the best project will be awarded with a badge to be recognized as "plastic-free" school.

All the Partners will have the opportunity to pilot some or all of the activities of the STEAM-Box during also during their National Info Days (to take place before or after the School Contest).

Gathering Feedback! A suggested form to gather input on the activities that will be piloted during the

Which Activity did you try?

On what age group?

What was the context? (Formal or non formal)

What worked well during the activity implementation?

What didn't work well and needs improvement in the activity

One comment or suggestion to improve the activity

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Labs (possibly through the use of an anonymous e-Questionnaire):

ANNEX - PROPOSED LIST OF CONTENTS

The following proposed list of contents was communicated by MIO-ECSDE to PLASETEAM partners in May 2022, for consultation before the authoring phase. The received comments enriched the content and educational processes within each activity, while one Partner NEMO proposed to author one more activity applying the tinkering methodology.

1) Burning questions on plastics

Introductory activity, in which we brainstorm on plastics, based on learners' questions. Some of the questions may be answered by a simple online search, some may require a rather thoughtful reflection, or an expert opinion. Crazy questions are very much welcome! Based on the collected questions raised, the educator may get some orientation as to which lesson plan to do next.

2) My plastic footprint diary

Have you ever wondered how much plastic waste you generate in only one week? Students are asked to record and keep the amount of plastic waste they and their families generate within a week. At the end of the week they compare their sums and reflect on whether they could have avoided or better managed a part of it. The activity can be linked with the plastic footprint APP of the PLASTEAM project.

3) Labels in Plastic products

Understanding the labels in plastic and other products we often consume can be a puzzlling exercise. What are they made of, are they recycled, recyclable, compostable and under what conditions? In this activity we learn to decode the labels in plastic products and manage them better.

4) Properties of Plastics

Plastic is actually a wonderful, versatile, cheap and easy to make material! What are the characteristics of plastics that have helped them in concurring the planet in just a few decades? When do these properties turn an otherwise advantage to a disadvantage? Are all plastics problematic?

5) Chemistry of Polymers

Plastics are polymers categorised in three gig groups a) thermoplastics, b) thermosetting polymers and c) elastomers. What are the differences in the way of making these and which one of them can be easily recycled? This is a STEM activity for older students.

6) Plastic Museum Curator

After studying the categories, characteristics and multiple uses of plastics, students are asked to become a curator of a museum of plastics. What objects would they pick for their exhibition and why? What would be the underlying narrative?

7) Bin auditors at school

Who is responsible for the waste management in any school? (Answer: all its users, including the students!) In this activity students are asked to investigate the operation of the bins existing throughout the premises of their school and to suggest improvements, if necessary, in the waste management.

8) Microplastic hunters

With the help of the sun, wind, rain and waves plastics quickly fragment to into smaller and smaller pieces, microplastics. Sadly, these days microplastics alongside pellets (the raw material for making plastics) are found in almost all sandy beaches. In this activity students living close to the sea are asked to do a field investigation looking for disintegrating micro-plastics. They also investigate hygiene products and cosmetics at home, learn to recognise microplastics among their ingredients and

9) Zero plastic Days

Plastic has invaded our lives to a point which living without it can be quite hard. In this activity students are asked to spend a couple of days without consuming any “single use plastics”. That means no packaging in their snacks, no take away food, no online purchases. What about detergents and personal hygiene products? How easy is it to find them in bulk? How creative and innovative one has to be to live today avoiding it?

10) The 4Rs+1 hierarchy

In the past a lot of environmental projects have been based on the 3R principles (Reduce-Reuse-Recycle) and several other “R” verbs have been added with the years, such as Refuse but also Rethink. In this activity students think of, prioritise and commit to several actions representing these Rs.

11) Plastic Free School Feasts

On the occasion of an upcoming school feast or a party, in which a lot of people are expected at school and snacks will be offered, we ask the students to help organize it without disposable plastics. Where do we find supplies? How do we do zero-plastic decoration? Who should we inform to support us?

12) Sustainability at school from A to Z

Students are asked to create a sustainability alphabet for their school. For every letter they think / write/ draw of a concrete action they can do form now on for a school that not only consumes less plastic, but is overall more environmental, in terms of waste disposal, energy and water consumption, etc. (Example for A: ADOPT the nearby park, to make sure it is waste-free).