Facilitator's Guide

TINK@School

Co-funded by the
Erasmus+ Programme
of the European Union

A3.2 Facilitator's Guide

Index

1. Introduction

a. The Tink@school project

The aim of Tink@school is to help teachers integrate sustainability into their lessons in an innovative and creative way. Within the project, the methodology of tinkering is combined with the theme of sustainability. Tinkering is an inspiring experiential learning approach where students have to use their creativity and resilience to create something physical. We designed three outputs to support teachers and educators in their efforts to develop and apply tinkering to sustainability issues in their classrooms.

1. **Methodology Toolkit**
   This toolkit serves as a guide for anyone who wants to start developing Tinkering activities on sustainability. It consists of a brief description of the Tinkering methodology, ideas how to infuse Tinkering with sustainability education and how one can get started on developing their own Tinkering activities.

2. **Activity Plans**
   Eleven comprehensive plans for tinkering activities aimed at students from upper primary and lower secondary school level.

3. **Facilitator's Guide**
   This guide provides additional resources for the eleven activity plans. In this document we included general information and extra tips for the facilitators, for example: additional tips on guiding the activities, a glossary and suggestions for materials.

b. The activities

Eleven learning activities on tinkering for sustainability were developed by the partners within the project. In the methodology we distinguish three ways in which tinkering activities can be used for sustainability education: Tinkering solutions, Re-Use & Re-duce and Tinkering for change. The activities are listed according to their main category below:

1. Tinker a bird scarer (bArtolomeo) - Tinkering solutions
2. Scarecrow with solar panels (bArtolomeo) - Tinkering solutions, Re-use & Re-duce
3. Tinker a rain collector (bArtolomeo) - Re-use & Re-duce, Tinkering solutions
4. Old toys to new toyw (MIO-ECSDE) - Re-use & Re-duce
5. Shadow-Art with Marine Litter (MIO-ECSDE) - Tinkering for change
6. Balancing sculpture (HI) - Tinkering for change
7. Sustainable Stop Motion (HI) - Tinkering for change
8. Tinker a sustainable calendar (CRES) - Tinkering for change
9. Save the planet bag (CRES) - Tinkering solutions, Re-use & Re-duce
10. Tinker a kinetic sign (NEMO) - Tinkering for change
11. Tinker sustainable decoration (NEMO) - Re-use & Re-duce

Each activity consists of the following elements:

- Outline of the activity
    - Duration
    - Target group
    - Connection to the curriculum
- List of materials and tools
- Preparation
- Activity plan (Step by step instructions)
    - Introduction
    - Managing the activity
    - Conclusion
- Appendix with examples of results

In this facilitation guide we give some general tips and insights that you can use when preparing the activities.

2. Guiding the activities

a. Introducing the prompt

A tinkering activity always starts with a prompt or a goal. Unlike the processes followed in designing or making, this goal is not a fixed point, but an open invitation to get started with the materials and tools available. You can think of the prompt as a first step for exploring with the tools and the materials. During this exploration, learners can set their own goals or create new prompts for themselves.

Example of personal goals that learners set themselves during the pilot implementation:

- *"I wanted it to be stylish, to find a way to keep the battery and cables out of sight"*
- *"I wanted to make my [save the planet] bag using only one material, the inner tube, so I had to cut our stripes out of it and use these as connector"*

In each activity, we give one or more suggestions for the prompt. Depending on the goal, time and materials you have available, you can customize the prompt. If you are planning to do so, keep in mind that the way you formulate the prompt can be very determinative for how the activity is performed.

Let's use the activity No 11: ***Tinker Sustainable Decoration*** as an example.

Prompt: Create a decoration

Depending on the goal of your lesson this could be a starting point. The students will probably craft some nice decorations. But it probably wouldn't lead to a lot of experimentation and exploring. In order to invite students to really tinker, the prompt can be narrowed down a bit, for example:

a. Create a decoration that can move
b. Create a 3D decoration
c. Create a very big decoration

With the suggestions above, the students are invited to explore more. They have to conceive a way to create movement, or how 3D decoration can stand or hang in the room.

Prompt: Create a decorative garland

With this prompt the goal is also narrowed down, but in such a way that there is not much room for learners to create their own goals.

Some more information on prompts in this extract are taken from 'Tinkering a Practitioner's guide':

1.2.2
THE IMPORTANCE OF THE ROLE AND OWNERSHIP OF THE GOAL

This leads us to a very important feature of Tinkering, which is perhaps one of the key ways that it differs from other STEM education approaches: the **role and nature of the goal**. Engineering is often focused on a clear and externally defined (objective) goal such as building a specific object (e.g. make a remote controlled car) or responding to a set challenge (e.g. build a bridge from only 50 pieces of newspaper that supports a fixed weight). In the case of Tinkering, a broad, long-term goal may be set at the beginning, but this is viewed only the starting point or 'springboard' from which the personal activity begins. In Tinkering, there is a high degree of **personal ownership** of the goal. The long-term goal set by the facilitator at the start does not necessarily govern the outcome of the activity because the learner is given **freedom to change, develop or personalise the goal** as well as to **set short-term goals** according to their own interests and ideas.

Let us use the marble run activity as an example again. As already discussed, the broad long-term goal in the activity is usually given at the start as something along the lines of 'use any of these materials and tools to get a marble to move from the top of the peg board to the bottom'. From this goal, a whole host of different **personal goals** can emerge. These might be very closely related to the original goal, or they may differ from it completely. To give you a real-life example, at one workshop, our project team observed a group of participants deliberately selecting materials that could create high levels of friction to slow down the marble. This was a new shorter-term goal that they set for themselves: to find things, which created lots of friction. Another team wanted to explore how they could use induction to create resistance to slow down a lightweight foil ball (their new version of a marble which they had created from the materials on offer). Another group wanted to see how they could keep the marble in perpetual motion for as long as possible using a series of funnels. In this way, you can see that, given the freedom to take control of the goal, the learners were able to **negotiate their own goals** and to work on a project that **interested them personally**. The fact that learners can create their own goals, set short-term goals and also change long-term goals, means that they are able to **pursue and express their individual interests**. This results in a deeply **engaging experience**.

Some argue that tinkering activities do not always require a goal at the outset. For example, a learner might start by playing with the materials and a goal could emerge from their exploration (Resnick & Rosenbaum, 2013). Perhaps this is how we define 'Making' in its purest sense – where a range of materials is provided and the participants set their own goal for what they want to make by playing with and exploring the materials. We could call this 'completely open ended Tinkering'. The focus for such Tinkering might be implied by the context (such as the type of material and tools provided) but no long-term goal is set. The danger here, however, is that people do not know where to start and may then need a lot of support to begin to set their own long and short-term goals. Tinkering, for how it is being developed as a learning approach in this project, generally **uses the provision of a very broad, initial long-term goal to get people started**. Exploration of this long-term goal involves the learners setting their own interim or short-term goals, which, in a further cycle of exploration provides feedback. This can then lead to the setting of new short-term goals in an iterative way. And this can also lead the learner to decide to create a new long-term goal. Such setting of short-term goals is usually accompanied by thinking along the lines 'what would happen to...if I tried/changed...'.

Figure 1. Xanthoudaki, & de Pijper, (2016) A Practitioner guide for developing and implementing Tinkering activities.

b. During the activity

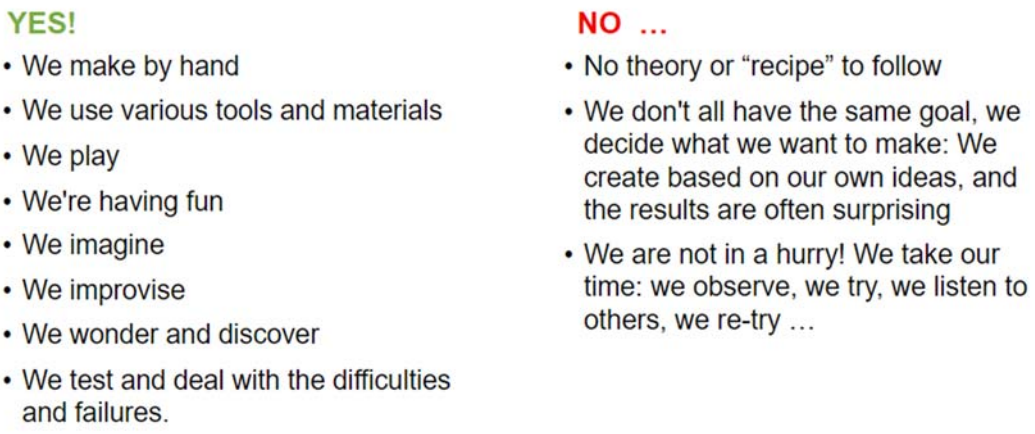
On page 7 of the [Tink@school Methodology Toolkit] you can find general information on guiding tinkering activities. In this chapter we give some extra tips.

Opt for questions and encouraging comments, instead of giving answers

- Ask questions and use comments to get students thinking and/or addressing possible solutions or to help them articulate their goals or problems.
    - ***Pose questions instead of answers:*** *how would you like to make the …?*
    - ***Stimulate curiosity:*** *how do you imagine the process and/or the final outcome?*
    - ***Create a supportive and inspiring environment****: I really like how you are….*
    - ***Help in case of frustration and failure in a positive and productive way:*** *why do you think this is not working?*
    - ***Encourage learners to pursue personal interest:*** *don't worry if you think it might not work, have a go anyway.*
    - ***Encourage collaboration:*** *maybe you can ask the other groups how that worked for them.*
    - ***Enhance communication and teamwork:*** *share inputs and ideas with your peers and try to share tasks and responsibilities.*

Create a supportive and inspiring environment

- If you work with a group that is not used to open-ended assignments, you can set the mood with the following slide.



- If applicable, indicate a possible material or a tool that you think could help a "stuck" learner move forward.

Help people to experience frustration and failure in a positive and productive way

- Make sure to test the activity at least once before running it with learners, so that you have physical examples to show during the introduction or use the examples from the Appendix.
- Indicate every 10-20 minutes how much time is left and let the learners know when the final 10 minutes start.
- Observe the group and see what learners are working on, and whether any of them are frustrated or stuck.

Encourage learner-negotiated goals and pursuit of personal interests

- Write down events or statements from participants (see below) and things that strike you to use when discussing the activity afterwards.
    - Funny remarks the students make
    - Overcoming frustration
    - Collaboration moments
    - 'Wow' moments
    - Funny moments
    - 'Aha' moments

Encourage collaboration with others

- Encourage students to look at other groups or the material tables for inspiration.

c. Evaluation

It is important to always take a moment at the end of the activity to share results and specially to discuss the 'exploratory journey' with the group. Sharing the results can be done by, for example, letting the students walk around to look at the other results or by letting them present their result to others. Use the notes you made during the tinkering process. Talking about the process and pointing out things you saw can be really valuable for the students: it makes them feel seen and proud of what they have done. You can point out actions or skills that they may have not noticed themselves. It is a very suitable moment to make students feel proud, even if their project failed. Point out, for example, how much perseverance they have shown, how many alternative ideas they tried and that this is a very important quality and at least as important as a "nice" or a finished result.

Also make some time in the evaluation for some self-reflection by the students. Discuss or let them write down:

- How they felt and why
- How/why they ended up on their "path" and outcome
- What did they enjoyed the most during the process
- What frustration they overcame
- What their 'aha' moment was
- What questions they still have.

3. Materials

a. From trash to treasure

When you start collecting 'trash' for your tinkering activity you might slowly turn into a magpie and see opportunities in materials everywhere: plastic for sale signs, scaffolding nets, glitter packaging, boxes, cardboard with beautiful prints etc. In the **Methodology Toolkit** you can find information where to find materials to tinker with as well as some examples.

You can help students see 'trash' as a useful and valuable crafting or building material, it helps to sort them, cut them to size and get rid of very tiny parts, parts with glue or greased paper: a good organization – according to shape, or colour, or size, or typology – adds value to any scrap material. See some additional examples below.

This concept is also known in Reggio Emilia pedagogy as one of the method's mantras: 'Care, not luxury'

Fruitnets: cut the labels off, this way it looks more like a material.

Clean plastic packaging and remove the labels to make it more attractive.

Inner tubes, to make the material look more attractive you could precut it in same size.

b. Examples of material tables

Appendix: Brief glossary of 'recycling' terms

In Tink@school we often make use of materials from the recycling bin(s), but some of the terms used to describe them (especially those relating to plastics) aren't always clear. Understanding and distinguishing the following terms can empower us -teachers and learners- to clarify misconceptions and to green our choices.

a. Terms about recycling

Biodegradability: The ease with which a material decomposes under natural conditions, due to microbe activity. Plastics rarely biodegrade in natural conditions, they usually require a high temperature to break down. Plastics made by fossil fuels can be made biodegradable (or not) while plastics made by natural material like corn (bio-plastics) can be made biodegradable (or not).

Biodegradation: Partial or full break down of a material mediated by microbe activity.

Downcycling: The process of breaking down a material to make something new but of a lower quality than the original product. This can be due to contamination or natural degradation over time. Examples: a mixture of different colors of glass can only be turned into brown glass, or turning plastic bottles into fleece or carpet fiber, or playground floor.

Recyclability: The ease with which a material can be recycled in practice and at scale. Recyclable products do not necessarily contain recycled content.

Recycled-content products: Products which are made totally or partially from recycled waste materials (e.g. paper, aluminium, plastics).

Recycling: The process of breaking down a product into its components or raw materials to be remade into a new product (usually of similar quality). Examples: glass, aluminium or PET bottles that can be remade into the same products. Attention: Unlike glass and aluminium, that can be recycled infinitely, PET cannot be recycled many times, as its quality downgrades (its polymer chain gets shorter).

Reusing: The process of repeatedly using a product or component for its intended purpose without significant modification. Examples: Refilling a water bottle or a detergent container, remolding soap slivers into a new bar of soap.

Upcycling: The process of reusing a product that no longer fits-for purpose into a new useful item (ideally of higher value). Examples: repurposing old furniture or turning an old tire into a pot for plants.

b. Terms relating to Plastics

Bio-based plastics: Plastics fully or partly made from biological raw materials (e.g. mais) as opposed to the fossil raw material (oil) used in conventional plastics.

Biodegradable plastics: Plastics designed to biodegrade in a specific medium (water, soil, compost) under certain conditions and in varying periods of time.

Bio-plastics: A rather vague term used sometimes in labels for plastics that are either 'bio-based' or 'biodegradable', or both. Given that these have very different properties, this term can cause misunderstandings to consumers.

Home compostable plastics: Plastics designed to biodegrade in the conditions of a well-managed home composter at lower temperatures than in industrial composting plants. Most of them also biodegrade in industrial composting plants.

Industrially compostable plastics: Plastics designed to biodegrade in the conditions of an industrial composting plant or an industrial anaerobic digestion plant with a subsequent composting step.

Microplastics: Tiny plastic particles, smaller than 5 mm in diameter. They are formed when larger plastic items wear and tear (e.g. bags and cups, clothes, tires, etc.). But they are also deliberately manufactured and added to products for specific purposes (e.g. as exfoliating beads in facial or body scrubs).

Oxo-degradable plastics: they contain additives that through oxidation make them break down easily, so they quickly become microplastics. Since 2022 they have been banned in the EU.

Recyclable plastics: Unlike what most people believe, not all plastic types can be easily recycled at scale. The most commonly recycled plastics are: 1 (PET, used e.g. in water and beverage bottles, 2 (HDPE, used e.g. detergent and shampoo bottles, and 3 (PP, used in yogurt and ready-meal containers).

Recycled-content plastics: Plastics which contain (totally or in part) recycled plastic. In the EU, by law the PET bottles should contain a minimum of 25% of recycled PET as of 2025 and at least 30 %, by 2030.

Single-Use Plastics (SUPs): Plastics produced to be used only once (e.g. bags, beverage bottles, most types of packaging, etc.)

Read more: https://www.eea.europa.eu/publications/biodegradable-and-compostable-plastic

c. iii. The EU Pyramid for waste management

The foundation of EU waste management is the five-step “waste hierarchy”, established in the Waste Framework Directive. It establishes an order of preference for managing and disposing of waste in the form of an inverted pyramid with the preferred options appearing at the top and the least desirable options at the bottom.

As we see in the pyramid, prevention, i.e. avoiding the creation of waste in the first place, is the preferred option, while energy recovery (burning) and disposal in a landfill is the last resort. Recycling is about halfway down the hierarchy.

Colophon

This publication is a product of Tink@school (2022-1-IS01-KA220-SCH-000087083), which was funded with support from the Erasmus+ Programme of the European Union. This publication solely reflects the views of the authors, and the Commission cannot be held responsible for any use that may be made of the information contained therein.

Project Coordinator

Háskóli Íslands, Iceland

Partners

Bartolomeo associazione culturale, Italy

CRES Centro di Ricerche e Studi Europei - future business, Italy

NEMO Science Museum, Netherlands

MIO-ECSDE,Greece

Co-funded by the Erasmus+ Programme of the European Union