LEARNING SCENARIO Tinkering: Nurturing Scientific Minds

Educational level: Primary | **Age:** >6

Author: Christina Adorjan and Hermann Morgenbesser, Future Learning Lab Vienna

LEARNING OBJECTIVES/ ASPIRATIONS

Tinkering is an important element of the maker movement that is sweeping the country in schools, libraries, makerspaces, and museums. This movement is driven by people's desire to create something with their hands. The objective is to teach to work together on solving small dilemmas, operate with various materials and engage in a playful experiment. In this scenario, the children work in teams of 2 to design, build, understand, test and improve very simple vehicles that should be able to roll as far as possible (down a ramp).

NARRATIVE OVERVIEW

Children initially use their senses to explore the physical properties of materials. They tinker as they take things apart, put things together, figure out how things work, and attempt to build and make creations using tools. When they are faced with a problem, children ask questions, make plans, work together, test their ideas, solve problems, improve their ideas to make them better, and share their ideas and creations with others.

These are the thinking processes and actions that scientists and engineers use. These professionals, when faced with a challenge, solve real-world problems that often come with constraints, including limited materials, time, and funds to develop solutions.

Children are engaged in open-ended tinkering experiences and practice skills they will use throughout their lifetime. The product of tinkering and making experiences is not as important as the process. As children grow and mature, their ability to use tools, collaborate with others, experiment, observe, make discoveries, tap into prior knowledge, communicate, and persevere will continue to develop and flourish.

Children love to take things apart—a process known as deconstruction. When children take things apart, they see how the parts work together and gain insight into how to put components together in ways that create something new.

Old, small appliances (with cords removed), a computer and keyboard, and broken mechanical toys are all ideal for taking apart. Provide child-size, real tools such as screwdrivers and pliers. After children take apart the objects and investigate them, sort the parts and save them for repurposing and reusing. For example, children might create a self-portrait or a picture by using a low-temperature glue gun to attach computer keys and other loose parts onto a piece of cardboard.

In this scenario, in a playful and creative environment, children follow their own ideas working with inviting materials and tools and creating something tangible. Tinkering activities give broad goals, but allow children to add their own goals. This gives the work personal meaning for them. Children try things out, improvise, discard, improve, etc. It is an iterative process, and results can be all different.

APPROACH TO TEACHING AND LEARNING

The tinkering approach is characterized by a playful, experimental, iterative style of engagement, in which students and teachers are engaged in a joint activity - continually reassessing their goals, exploring new paths, and imagining new possibilities

Three core principles lie in the pedagogical approach:

immediate feedback, fluid experimentation, and open exploration. Construction kits and computation can be used for different genres of projects.

ASSESSMENT

- Informative Assessment
- Rating of models, the products are evaluated on predetermined criteria.

ROLES

TEACHERS: design contexts for tinkerability. Teachers need to emphasize the process and engage students in thinking about the tinkering process. Students are given clear and structured guidance and given immediate feedback. Teachers propose themes to explore rather than challenges to solve. They pose questions rather than answers and encourage engagement with other students, teachers, experts. Students are extensively prepared for the tasks

LEARNERS: Students decide what they want to build and with whom they collaborate. Different products are developed in parallel running. Students use their prior knowledge and acquire information and knowledge in context.

OTHERS: External experts

LEARNING ENVIRONMENT

A flexible room arrangement is key for tinkering, making, and engineering challenges. It is important to consider how space can be rearranged to open new possibilities for exploration and collaboration.

Some challenges may occur at a table with one or two children, while others might require rearranging the furniture to accommodate larger projects and more children. Some teachers with larger classrooms set up a dedicated space for making and tinkering. These areas typically have a shelf for storing and displaying materials and tools, a power source, and a large table.

The materials used in the design challenges are typically found in the art area or in the science area of the classroom. Positioning these two areas in close proximity to each other helps children access the tools and materials more easily. What is most important is that children know where to find the materials they need to accomplish a task.

As you observe children working on a challenge, you might suggest and help them locate a material that is not on display but that would be helpful in solving the problem. It is also helpful to arrange tables and screens in such a way so that students could see each other's work.

LEARNING ACTIVITIES

1. The teacher **interacts** with the students: asks the students to think about a theme. Students **exchange** by brainstorming ideas. They decide on the projects.

2. The students **develop** their projects: they gather materials randomized out of different boxes, offered by the teacher, make a plan, draw or sketch their ideas.

3. The students **create** and try their works. The students should design everything themselves - number of wheels, material, size (should fit on the ramp) and think about the number and length of the axles and cut the bottom plate - then the teacher checks the axle length and possibly makes correction suggestions, only then is cut. Some questions for this **interaction** to guide the students in their process could be:
- What did the car do? - Why is it making a turn? - Why doesn't it continue? - What would you have to change to make it go further?
- The teacher and students **interact** by trying to find plausible answers together – the teacher explains theories; the students conduct a scientific "experiment" (improve the car and try it out) to test theories.

4. Students **reflect, r**evise or make it better.

5. The students **share** their creation, talk about how they made it. They listen to the peers' ideas about how they might improve it.

POSSIBLE CHALLENGES

There is a need to create a safe environment while setting up the space for creative free-flow work.

RESOURCES

- Min 1 piece of corrugated cardboard min A5
- Min 3 wheels (with 4mm hole)
- Min ½ paper straw
- (pencil, scissors, ruler)
- Additional per class: - 5 pcs. 4mm round bars (wood)
- Additional cardboard or leftover corrugated cardboard
- Hot glue + cartridges, pad for hot glue
- Measuring tapes

LITERATURE TO SUPPORT

- Making and Tinkering With STEM Solving Design Challenges With Young Children
- Tinkering in STEM education
- Artificial Tinkering

Material:

- Hands on material
- Tinkerer Box

LEARNING SCENARIO VIDEO

Tinkering Nuturing Scientific Minds - YouTube

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

The learning scenario is created by the DesignFILS project (http://designfils.eba.gov.tr), funded by EU's Erasmus+ KA2 (grant agreement 2019-1-TR01-KA201-076567). The contents of the publication are the sole responsibility of the authors, and the EC or Turkish National Agency cannot be held responsible for any use which may be made of the information contained therein.