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CLASSROOM GUIDE TO TEACHING ABOUT AND THROUGH 3D

DESIGN THINKING WORKSHOP



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Introduction

This resource provides guidance and templates for organizing a Design Thinking workshop with secondary school students. The workshop can be seamlessly integrated in STEM-related extracurricular learning activities. It would be particularly useful as a starting activity in relatively complex and long-term school projects involving 3D design and printing. The format allows bringing together students that are not willing to engage with 3D modelling and printing and students that are primarily interested in realizing 3D designs. It can thus promote team collaboration between students with different profiles.

The organization of the workshop requires the involvement of at least one teacher. However, the involvement of additional educators as facilitators (ideally, 1 facilitator per student team) will significantly enhance the impact of the workshop on student learning.

Overall goal of the workshop

The overall goal in this workshop is to help the participants design something useful for others using the Design Thinking approach. The participants will be guided in view of going through the five main stages of Design Thinking.

Duration

The indicative duration proposed for each stage of the work is calculated so that the whole workshop would take 2 hours, including a short break (15 minutes) after the completion of the first 3 Design Thinking stages: Empathise, Define, and Ideate. Before the break, the participants will have described the solution and they will be ready to proceed with creating and testing their prototype.

This very short version of the workshop is useful for demonstrating the methodology. The time dedicated to each stage is the minimum and will work if we have small student teams and experienced facilitators. However, the experience of the participants will be more rewarding if we allow for more time, perhaps double the time for each stage. This longer duration will allow us to finish the workshop within a day (4 to 5 hours, including breaks).

Another alternative, which is perhaps more meaningful for longer school projects, is to spend one academic hour (or more, if needed) for each stage of the Design Thinking Methodology.

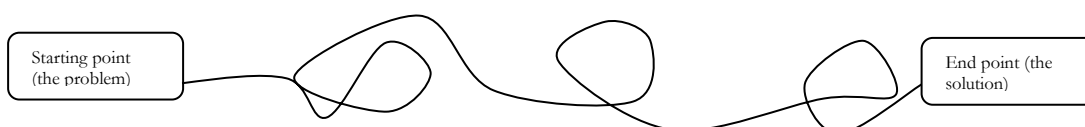
What is Design Thinking?

Design Thinking is a problem-solving methodology that aims to produce functional and innovative solutions.

Non-designers often imagine design as a relatively smooth and linear process - a problem is identified and a solution is found. This perception can be visualized as such:



In fact, design is usually much less straightforward. It can rather be visualized as such:



Design Thinking is an approach that allows for a non-linear understanding of design. The method has several key features:

- It is human-centred

The Design Thinking approach prioritizes the user's behaviour and needs above other factors. It is based on observing with empathy and obtaining deep understanding of the needs of the users of the solution. It can be focused on solutions needed by the general population or by a specific target group.

- It is collaborative

It requires the cooperation and communication of all stakeholders. It takes into account people's opinions, preferences, feelings, knowledge and experience.

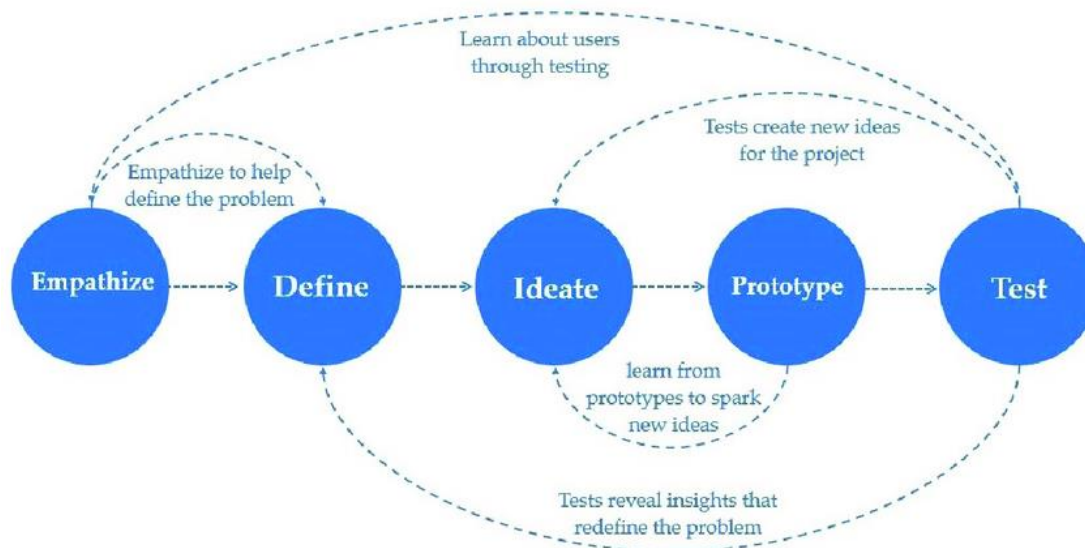
- It is empirical and iterative

Design Thinking requires that different solutions are tested until the most appropriate one is chosen. At all stages we reflect, learn more and revise our opinions and proposed solutions.

The Design Thinking process passes through **5 main stages**:

1. **Empathize**
2. **Define**
3. **Ideate**
4. **Prototype**
5. **Test**

In view of the iterative and non-linear nature of Design Thinking, these stages do not usually flow smoothly one after the other. In practice, we often need to go back to an earlier stage to refine either our ideas or our solutions, as visualized below:



Source of the diagram: Li, Wen-Tao, Ho, Mingchyan and Yang, Chun. 2019. "A Design Thinking-Based Study of the Prospect of the Sustainable Development of Traditional Handicrafts." In *Sustainability*, vol. 11.

Preparation

What is this stage about?

The preparation stage is focused on forming student teams and allowing each team to decide on the topic on which they will be working.

Indicative duration

5 minutes

Instructions

It is preferable that the teams be formed in advance in order to avoid the commotion of team formation on the spot. It would be even more effective if the teams have already thought about the topic that they would be interested in working on. We should ask the teams to choose a name in order to create a team identity.

When choosing the topic of their Design Thinking task, the teams should complete the following template:

A. Decide on the topic you will deal with

Your issue may be:

- A new topic that you have not dealt with before (a problem you want to address, a product or service you would be interested in designing).
- A topic you have already worked on and want to revisit it to evaluate what you have done so far and discover what changes and improvements you could make or how you could make use of something you have already created.

B. Identify the target groups that are affected by your topic. Is it the general population or a specific group?



Design Thinking Stage 1a: Empathize (listen)

What is this sub-stage about?

This stage is focused on **listening** to the target group's needs and problems. It should involve carrying out a **survey** of the potential users' needs, usually through interviews with the target group.

Indicative duration

10 minutes

Method

Role-play: we divide the participants into two groups - designers and users. Users are the people for whom we want to create or improve a product or service. The designer group interviews the users in order to identify their needs and the problems they face. After completion of the interview the participants can switch roles.

Instructions

The aim of the interviews is to find out as much as we can about the users: what they need; what they say; what they do; how they feel.

- We should listen carefully to our interlocutors without judging them. We should try to put ourselves in their shoes and understand their needs, opinions, expectations and feelings. The idea is to understand the users' own perception of the problem. This perception may differ from our own.
- We are trying to discover the root causes of the problem, as perceived by the users. One technique that can be used is to repeatedly ask "Why?".
- At this stage we are interested in describing the needs of the users, not in finding a specific solution. E.g. students want to be transported safely to school (at this stage we do not care whether this is done on foot, by bike or by bus).

Design Thinking Stage 1b: Empathize (learn about the problem and the users)

What is this sub-stage about?

This stage is focused on **creating an Empathy Map**.

Indicative duration

10 minutes

Method

We create an empathy map. We use post-it notes to record what the interviewed users said, what they believed, what they did, how they felt about the topic.

Instructions

The teams complete the following template:

What do users say?	What do users believe?
What have the users been doing so far?	How do users feel?

Design Thinking Stage 2: Define

What is this sub-stage about?

This stage is focused on **describing the problem** (e.g. by developing a problem statement).

Indicative duration

15 minutes

Method

At this stage we will build on the conclusions and knowledge gained in the previous stage. We follow the human-centred approach. We try to describe the problem from the perspective of the people concerned.

Instructions

The teams complete the following template:

- A. Describe the problem from the users' perspective,** using concrete examples.
Give at least three examples.

Example: Peter is a high school student. He would like to eat healthy at school because he knows the importance of healthy eating. However, he is afraid of being targeted and ridiculed by some of his classmates if he brings food from home.

- B. Formulate the questions to be answered by the designers.** One technique is to try to complete the sentence. Give at least three examples.

Example question: How could we make healthy food choices in school appealing to students so that those students who want to eat healthy are not targeted and ridiculed for bringing food from home?



In order to address the right problem and formulate the right questions for the designers, it is important to make sure that we have asked and found the answer to the right questions: Who, What, Why, Where?

- *Who*: we need to understand who is actually experiencing the problem
- *What*: we need to understand exactly what problem the target groups are facing. This information can be derived based on the findings in the Empathize phase
- *Where*: we need to define the problem space and know where this particular problem is being faced
- *Why*: we need to understand why this problem is important to solve and how it will bring value for the users and for us as designers.

Tip: Sometimes, what we believe the problem is, or how the users initially define their problem, turns about to be misleading, and the problem is really about something else. For example, many elderly people mention problems related to their limited mobility. Upon closer investigation, the actual problem is that some elderly people feel lonely and would like to stay in touch with others more. Their limited mobility is less of a problem in and of itself. It is problematic primarily because it limits their ability to engage in social interactions. A viable solution therefore need not be to improve their mobility (e.g. with a walking stick) but rather to create better opportunities for them to meet others closer to their home.



Design Thinking Stage 3: Ideate

What is this sub-stage about?

This stage is focused on **generating ideas and choosing the most appropriate one to address the identified problem.**

Indicative duration

15 minutes

Method

We write down ideas for solving the problem. Our initial goal is to gather as many ideas as we can without evaluating them (brainstorming). Then we discuss and evaluate the ideas and choose the best one, which will finally be implemented.

Instructions

The teams work on the basis of the following template:

Note for organizers: It is advisable to provide teams with a large sheet of paper, colour pens or markers and post-it notes.

A. Brainstorm

Suggest as many ideas as you can. Let your imagination run wild. Do not limit yourself to the most common and feasible solutions. Do not judge and do not reject any idea.

If you do not have many ideas think about what the worst thing we can do is? And what is the best thing we can do? What is the easiest thing to do? Use words or simple drawings to describe your ideas. Work with post-it notes, one for each idea.

B. Discuss the ideas and modify them if necessary. Choose the one that seems best fitted to solve the identified problem. Which one is it? (You may offer 1-2 alternatives).



Brainstorming is not the only approach for generating ideas. Alternative methods, that may not be very practical to employ in such a workshop, include:

Method	Description
The 5 WH method	The method involves asking a lot of questions in order to arrive at a solution. The 5 typical questions are: Who, What, When, Why, How? They allow us to get a new perspective on a problem.
Listening	Teams looking for solutions to problems often wrongly focus on their own ideas and their own capacities. However, a useful approach is to listen to the solutions that the stakeholders are proposing. The approach is similar to co-creation.
Role playing	The method forces the participants to take on different roles and think about the problem from different perspectives.
Mind mapping	The technique is graphical. It involves generating ideas by association. We start from a central theme/main idea and generate sub-themes and related smaller ideas that branch out of the main idea in tree-like structures.



Design Thinking Stage 4: Prototype

What is this sub-stage about?

This stage is focused on **creating a prototype**.

Indicative duration

20 minutes

Method

We build a low-resolution low-fidelity solution (prototype), e.g. with cheaper materials or incorporating only the main features we want to test. Our goal is to build a prototype as soon as possible to test the effectiveness of the chosen solution with the users themselves.

Instructions

The teams work on the basis of the template below.

Note for organizers: It is advisable to ensure that each team has access to computer with a 3D modelling software installed (e.g. Tinkercad). However, if 3D modelling is not favoured by all participants, a low-tech makerspace can be arranged instead, with materials such as paper, sticks, glue, clay, etc.

A. Describe or draw the form of your prototype

How do you plan to build your prototype? What parts will it consist of? Will you use a 3D program to design all or some parts? Will you need a 3D printer to print something, and what will you print?

B. Use the materials at your disposal to make your prototype



Design Thinking Stage 5a: Test (prepare)

What is this sub-stage about?

This stage is focused on **preparation for presenting to users our solution and the developed prototype.**

Indicative duration

5 minutes

Method

In order to present to the users the solution we have developed, we need to think about how to describe it concisely and in a simple way.

Instructions

The teams work on the basis of the following template:

Present the project

Prepare a short presentation of your prototype for users. It should be no more than one A4 page. Don't forget to give a title.

Title.....

Design Thinking Stage 5b: Test (collect feedback)

What is this sub-stage about?

This stage is focused on **presenting the prototype and solution to the users and collecting feedback** from them.

Indicative duration

10 minutes

Method

After explaining what we have done, we bring the prototype to the user and give them time to use it or observe it. The users on their part give us comments and share their observations. Initially, during the workshop, the role of users can be played by members of the teams themselves. After the workshop, the teams should repeat the exercise with at least one other group of actual users.

Instructions

The teams collect and record the observations and the comments. They work on the basis of the following template:

What did the users like?	What can be improved?
Questions/Problems	Ideas



Conclusions

What is this stage about?

This stage is focused on **wrapping up the design process or planning further work.**

Indicative duration

5 minutes

Instructions

We will discuss what we have learned from the design process and from the solution that has been worked out.

Usually, the testing stage indicates that we need to go back to an earlier stage of the design process in order to either fine-tune the solution or change it drastically, based on the feedback from the users. The process is referred to as *iterations*. In this seminar, iterations are not possible due to time constraints. However, in this concluding session the teams should address any need for iteration and should plan further work on their projects.

Evaluation

What is this stage about?

This stage is focused on **evaluating the learning experience and reflection on what was learned.**

Indicative duration

5 minutes

Instructions

We should identify what was done well in the seminar, what was not done well, and what should be changed in the future.

We will use the following template:

How do you assess:

a) Design Thinking as a problem-solving method?

b) your experience in the current workshop?