

Maths is everywhere

Educational maths challenge package based on the design thinking method

Regardless of what we do, maths is always with us: at school, at work, even in the local shop. Yet despite its ubiquity, many people openly admit that they do not know, don't understand or, worse still, don't want to understand maths. Unfortunately, this is accompanied by widespread social acceptance: after all maths is "not as crucial" as reading or writing. Or is it really so?

It is clear that maths needs a new opening. And the best place to start is school! Here, we need to take a fresh look at the school curriculum, introduce modern teaching methods and show how maths is used in everyday life. These are the goals of Added Value — an international project addressed to teachers. Hopefully, we can make educators feel that teaching maths makes sense and that they can have a real impact on society by showing the practical side of mathematics. We would like students to see that this knowledge is useful because "maths is everywhere!"

We have prepared a publication dedicated to teachers who work with students aged 10 to 14. We believe that everyone will find something for themselves on the pages of this guide. All activities are called challenges for a good reason: they show you how to face real-life problems with the use of mathematical skills. Everything that is needed is already included in the basic school curriculum. You can decide how to use the provided materials — you can use them as support at the beginning of a given topic or as summary activities. In our view, the materials provided in this publication will be a perfect addition to the teaching process you have planned.

Some of the challenges are quite simple — they take easy examples to explain key mathematical concepts or develop arithmetic skills. Other activities are somewhat more complicated and require the use of more advanced calculations. The challenges can be moulded according to the particular needs of a group or the chosen teaching method. In this way, each person can face the challenge based on the set of skills and amount of knowledge they have, and in the most realistic context, at an appropriate time.

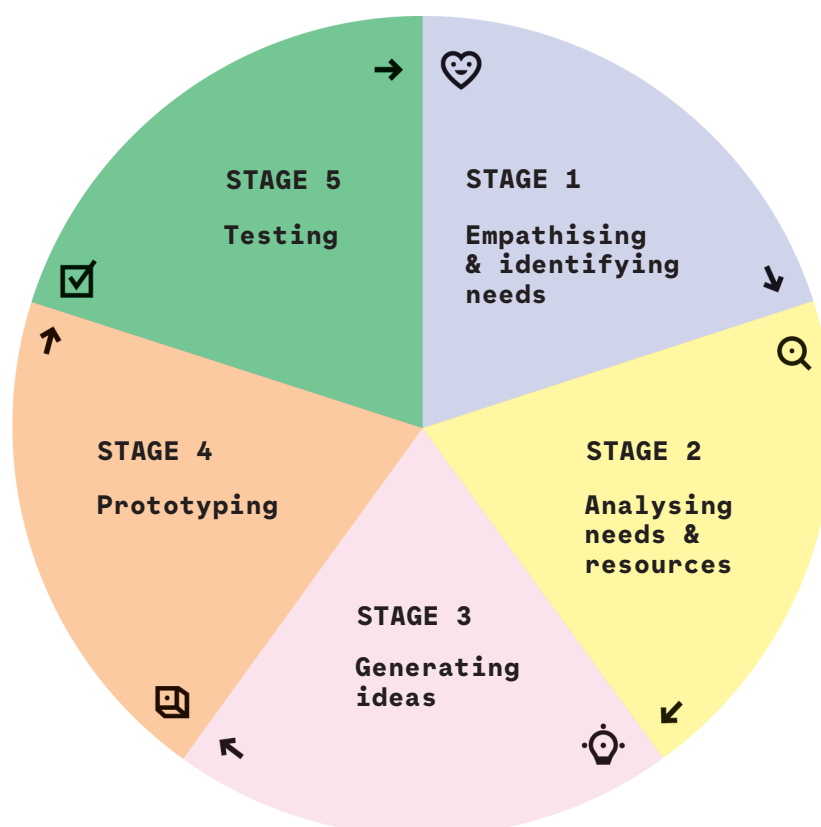
The challenges presented in this guide are based on the innovative **design thinking method, which consists in proposing innovative solutions based on an in-depth analysis of the recipients' needs**. Design thinking (DT) has its roots in the business world but its applications are universal and can be adapted to the field of education. Before you start to use this method at schools, it is worth going through some of its basics.

DT is divided into stages which constitute an intuitive but quite comprehensive way of addressing problems. **There are five principal stages:**

- 1. empathising and identifying needs,**
- 2. analysing (or defining) needs and resources,**
- 3. generating ideas (ideating),**
- 4. prototyping,**
- 5. testing.**

The borders between the subsequent stages are flexible. Some of them can repeat in a given process. When using this method, we need to allocate more time for any given task and refrain from introducing pre-established solutions. DT is a way of organising the creative thinking process. The proposals generated by the participants are tested and modified before the optimal solution is found.

Design Thinking Circle — stages



The first stage of DT, **empathising and identifying needs**, is aimed at learning about your own and your group's expectations, both related to the subject of your work and not. Sometimes answering questions that seem not to be related to the topic we are dealing with can result helpful at subsequent stages. Here, the aim is to get better at identifying the expectations of those affected by our actions. It is a time for asking questions and gathering key information. The next step is to **analyse the needs and resources**, and therefore to process the gathered data and define some base assumptions necessary to address the challenge. The information and conclusions drawn from the first two stages help us **generate ideas** for solutions. It is the first moment in the process when particular solutions are proposed, based on the knowledge gathered beforehand. This brainstorming phase should not be restricted in any way. The feasibility of the ideas will be tested later on. **Prototyping** is a time during which we can make a first check of the generated ideas — here, we will decide which ones are possible to implement and which ones should be abandoned. It is a good time to prepare preliminary projects or models, and to modify or improve our ideas. From this stage, it is only natural to go to the **testing** phase in which, if possible, we will see how our solutions work in practice. We will then be able to decide to what extent they address the needs of the group and prepare recommendations for the future.

Each of the mathematical challenges prepared for this guide is based on the five-stage DT model described above. Because school lessons are limited in time, we tried to make our proposed activities possible to implement during a single school lesson, but we recommend extending them to at least two. With each challenge, we also provide recommendations on cooperation with teachers of different subjects. We believe that combining mathematics with biology or physical education, for instance, will be key in showing its usefulness in a broader context.

We also propose a tool that supplements the mathematical challenges: the Design Thinking Circle, which describes and guides you through the DT method. We encourage you to print it out together with the overlay that uncovers stages one at a time and helps students focus on a particular task. We believe that the DT Circle will help students imagine the whole process, as well as understand the method and the goals of each stage.

In the final version of the guide, you will find **8 ready-to-use challenges with detailed instructions for the teacher and student worksheets**. Additionally, we provide guidelines on the timing, the materials to prepare before starting the lesson, lesson extension options and additional activities. Each of the challenges can be flexibly adjusted to the needs and possibilities of the students, teacher's plans, as well as to the school setting and to the needs of the wider community. There is also one additional blank challenge. We hope that you get inspired by this guide and create your own proposal with the use of DT! Remember that apart from regular school use, our materials will also prove useful in extracurricular activities, during school excursions, at home, as well as in informal education and home education settings. Because "maths is everywhere."

Skills and competences developed with the use of a set of mathematical challenges

1. Creativity, non-standard approach to problem-solving and audacity
2. Efficient use of modern information and communication technologies
3. Information lookup, selection and critical analysis
4. Individual and group work, making use of the group's potential
5. Independence, drawing conclusions
6. Making use of the group's potential — graphic design, arithmetic, etc.
7. Presentation and auto-presentation
8. Planning and taking responsibility for the task