Blended Intensive Programme – Erasmus+

# Outdoor Mathematics with MathCityMap


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Escola Superior de Educação
Instituto Politécnico de Viana do Castelo


**Supporting curriculum through integrated STEAM Education practices**

Instituto Politécnico de Viana do Castelo

erasmus+ PORTUGAL
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MASARYKOVA UNIVERZITA
UNIVERSITÀ degli STUDI di CATANIA
USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

Agenda

# Outdoor Mathematics with MathCityMap

## Part I Let´s try a math trail with MathCityMap

**Some ideas about:**

Outdoor learning and math trails in mathematics education

MathCitymap – students' perspective

## Part II Design a trail with MathCityMap

**Some ideas about:**

How to create a task and a trail with MCM – teachers' perspective

## Recommendations

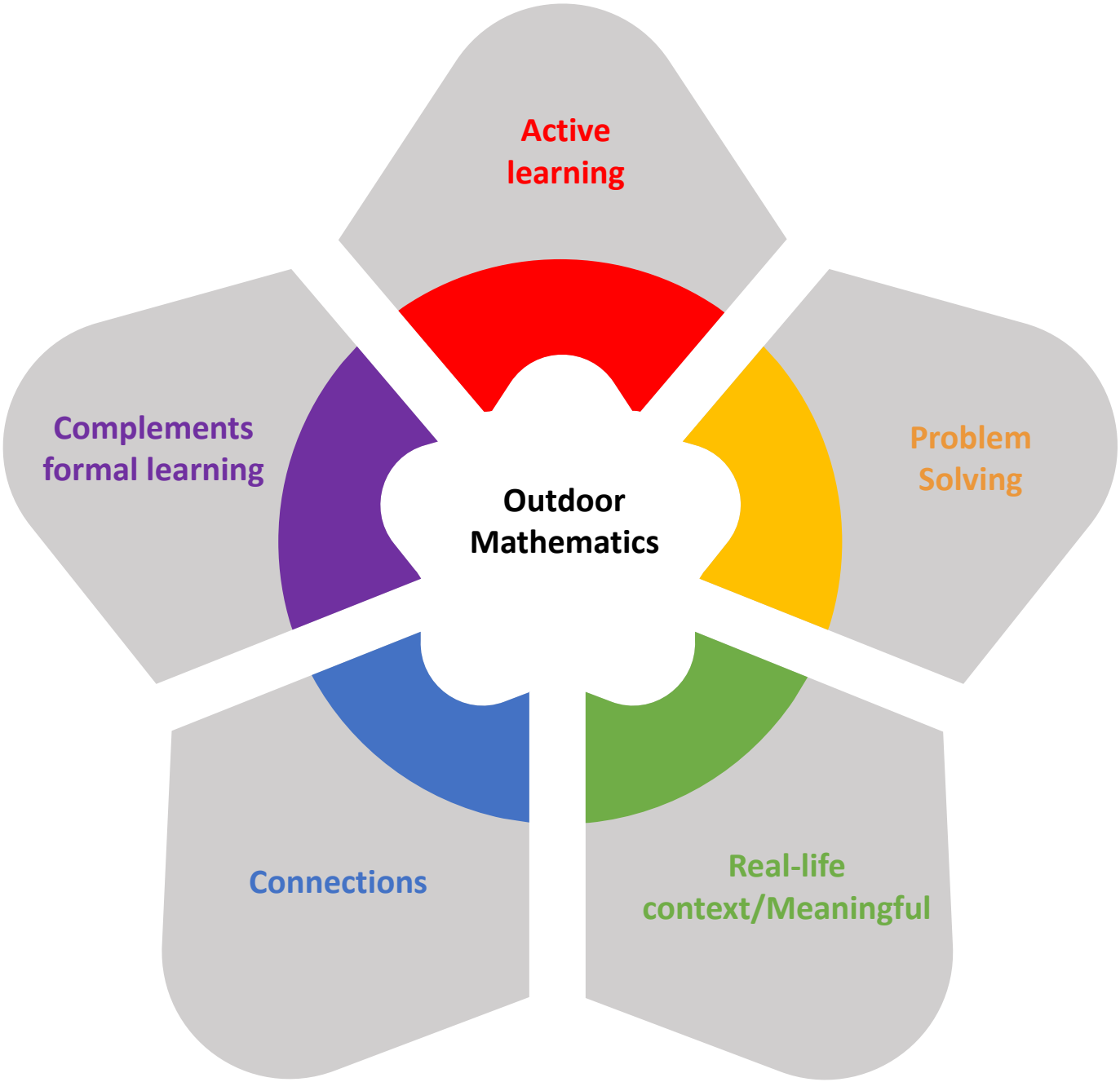
- Engagement of all students in individual and collaborative experiences.
- Development of the ability to think mathematically and to make sense of mathematical ideas.
- Promotion of a positive attitude of students towards mathematics.
- Establishing connections between ideas, between ideas and mathematical procedures, between curricular areas and between school mathematical contents and situations of the students' reality.

(DGE, 2021; NCTM, 2000, 2014)

Learning is a process that takes place on a daily basis, in a more or less organized way and in different contexts, not being confined to the classroom or the time students spend there.

(Kenderov et al., 2009)

Outdoor Mathematics




(Barbosa & Vale, 2016; 2018; Barbosa et al., 2022; Vale et al., 2019; Vale & Barbosa, 2020)

# Math Trails

**Math trail**

Sequence of tasks, along a previously planned route (with beginning and end), consisting of a set of stops at which students solve tasks in the surrounding environment. (Cross, 1997; Vale & Barbosa, 2016)

# Math Trails

**Through a Math trail students:**

- solve problems in real context;
- understand connections between mathematics and daily life;
- show positive attitudes towards mathematics;
- develop abilities like problems solving, communication, reasoning, critical thinking, collaboration.

MathCityMap

Challenging Tasks

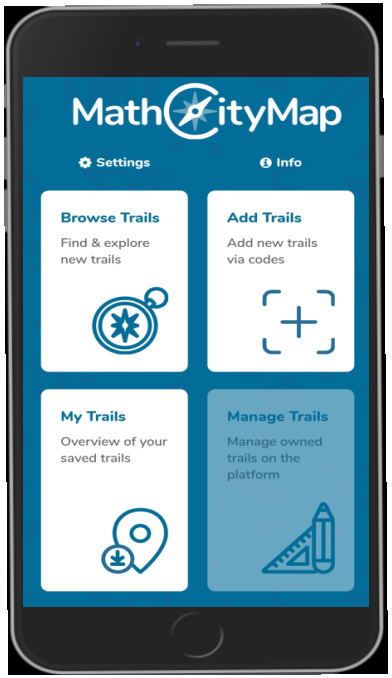
Math trails

Smartphones Tablets

MathCityMap

Collaboration

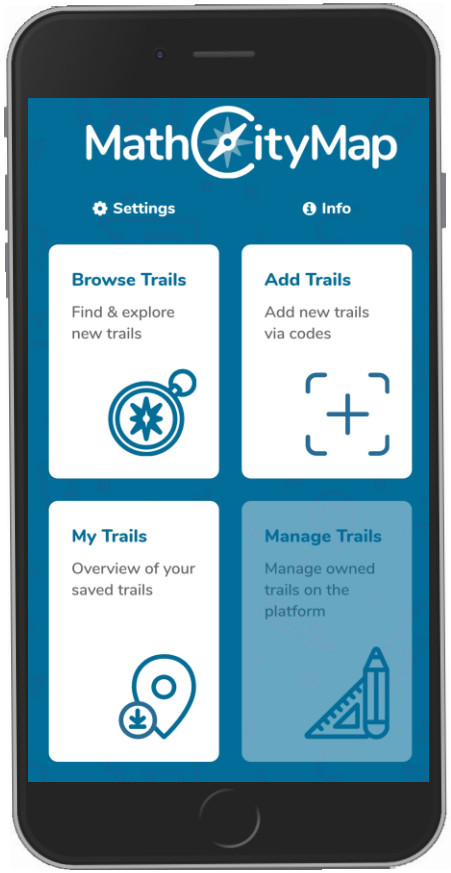
Learning outdoors



MathCityMap

## Webportal

## App

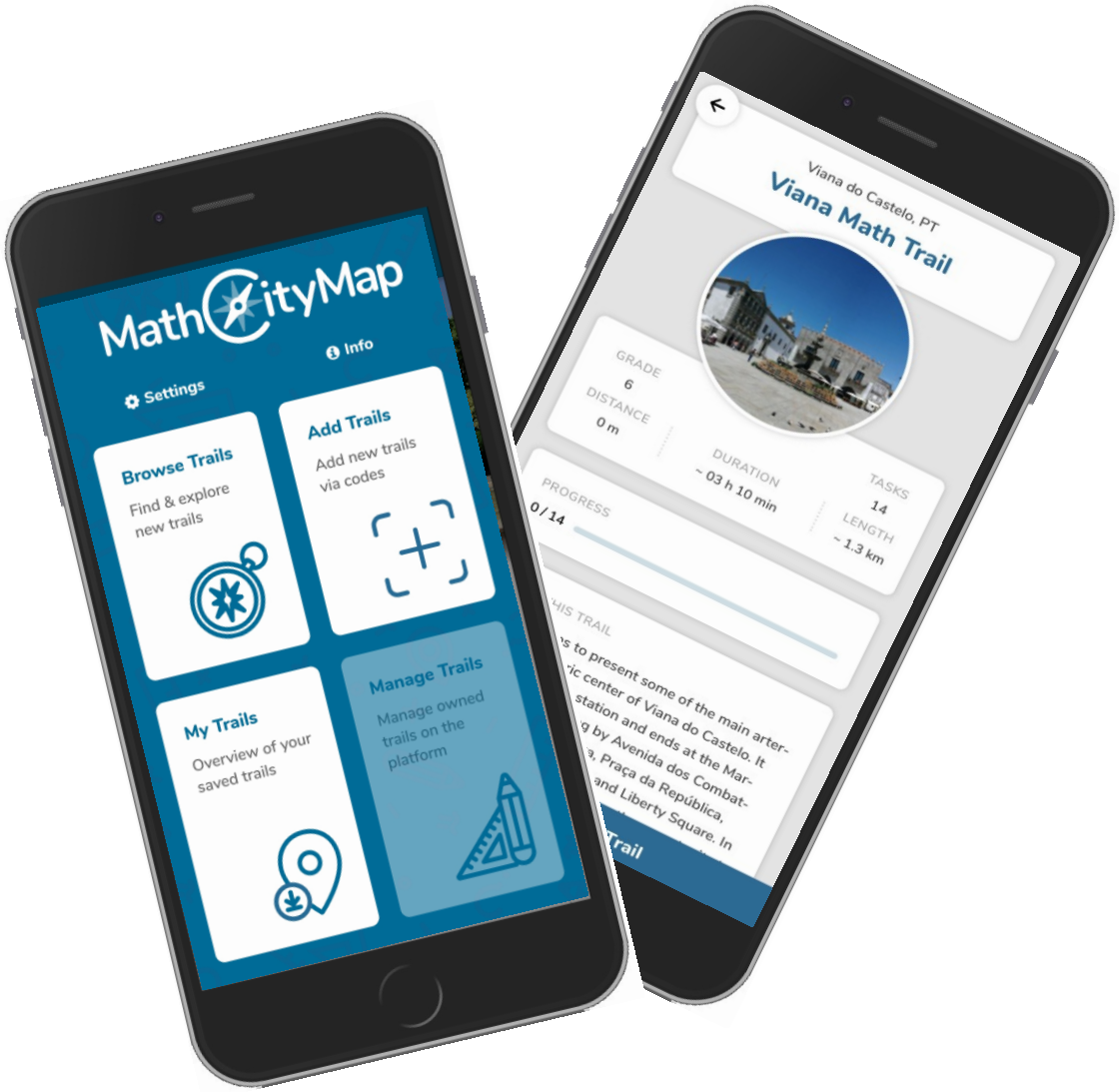



Tasks are marked through a pin in a map.

MathCityMap

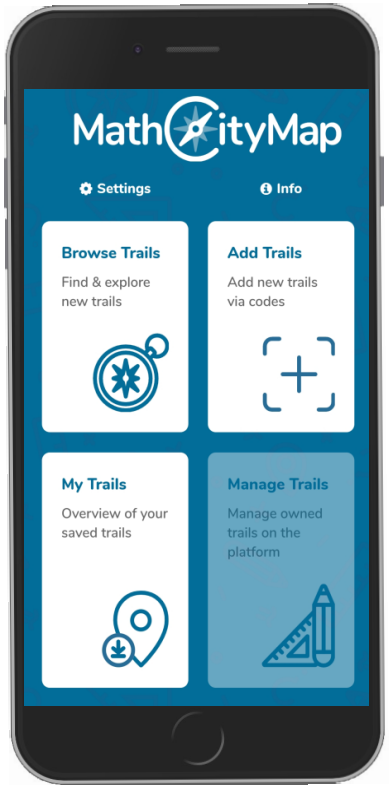
# The MathCityMap App

- The trails are **downloaded** to a smartphone or tablet.
- The MathCityMap app is **free,** ad-free and in compliance with the General Data Protection Regulation (GDPR).
- The app is **available** for Android and iOS.

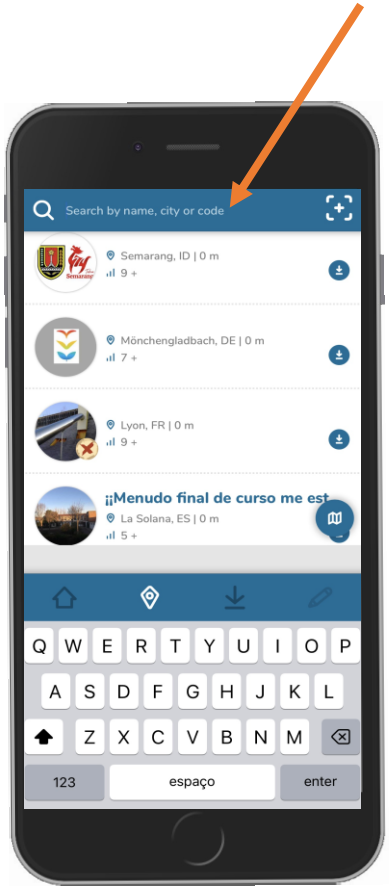


MathCityMap

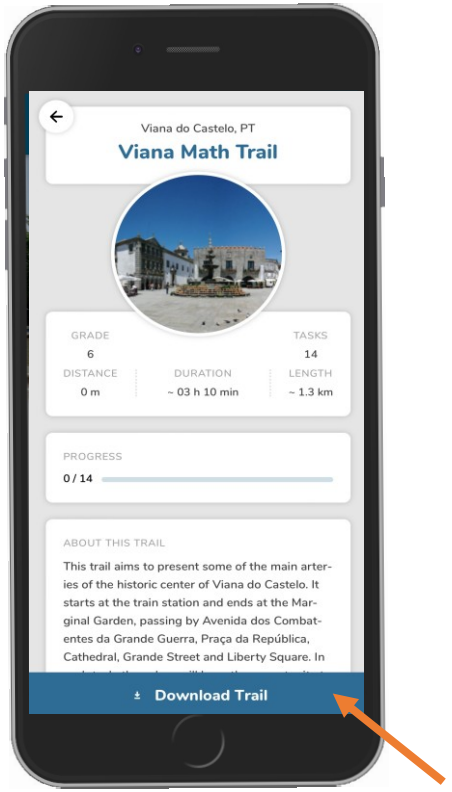
# The MathCityMap App




1. Open the app MathCityMap and select *Browse trails*



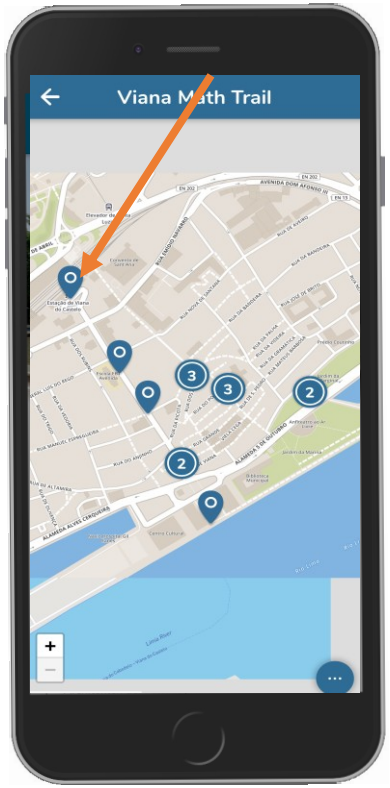

2. Insert the name, city or code of the trail to find it



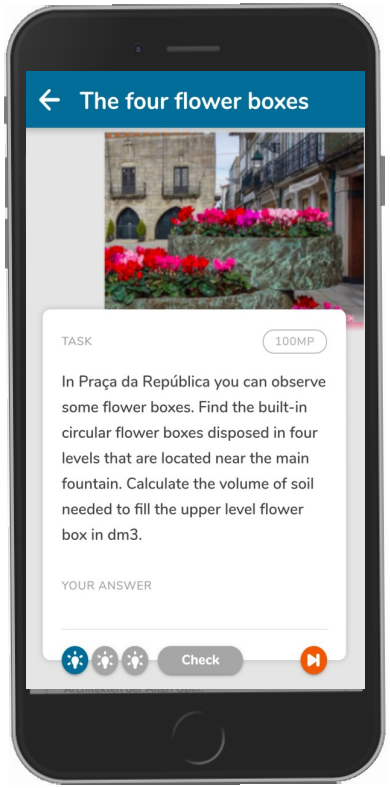

3. Download the trail to the mobile device and select *Start trail*.

MathCityMap

# The MathCityMap App




4. Select each task by picking one of the blue pins in the trail.




5. Each pin corrresponds to a task in the trail that the user has to solve, introducing the answer in the correspondent field.

MathCityMap

# The MathCityMap App

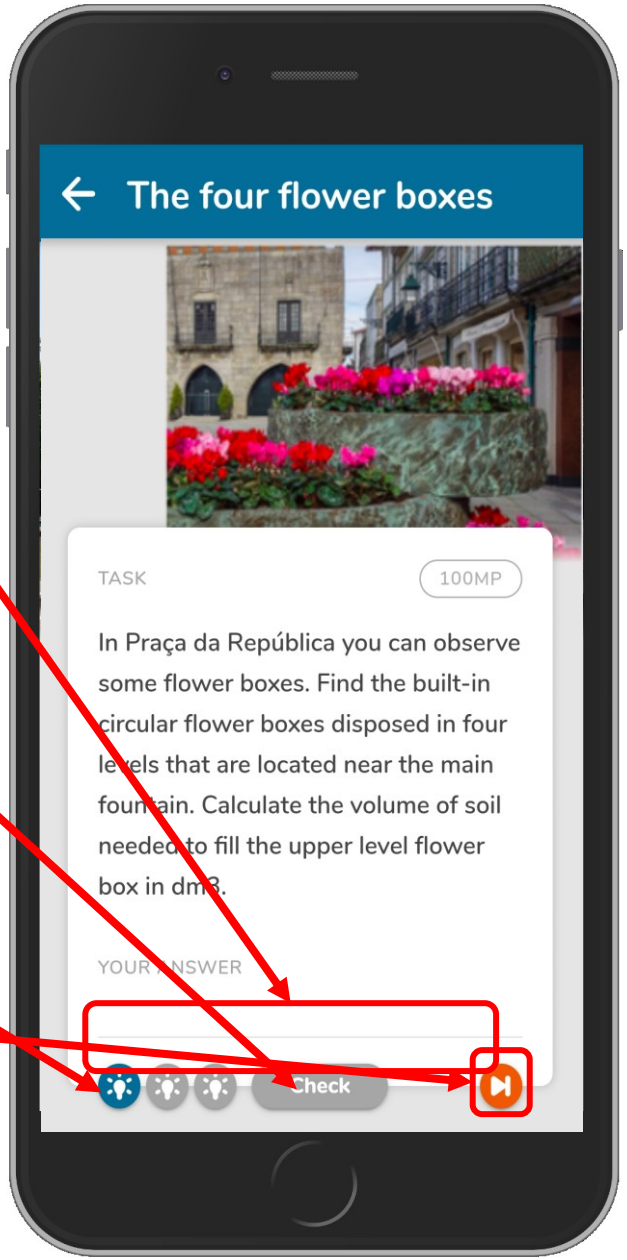
**Select to introduce the answer**

**Verify the answer:**

- Excelent solution
- Good solution
- Wrong solution

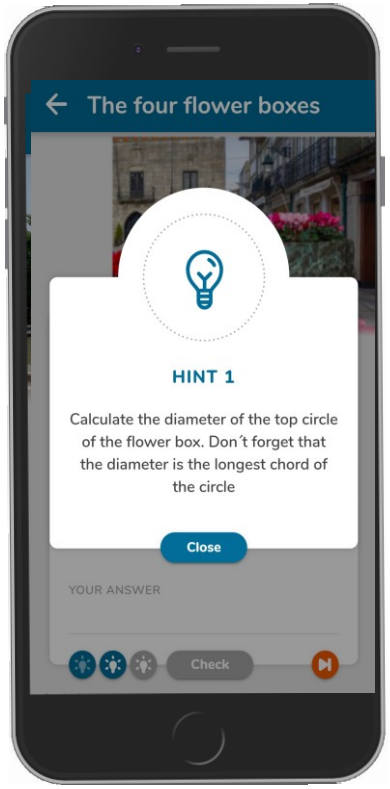
**Hints**
**(text, image, video)**

**Skip the task**

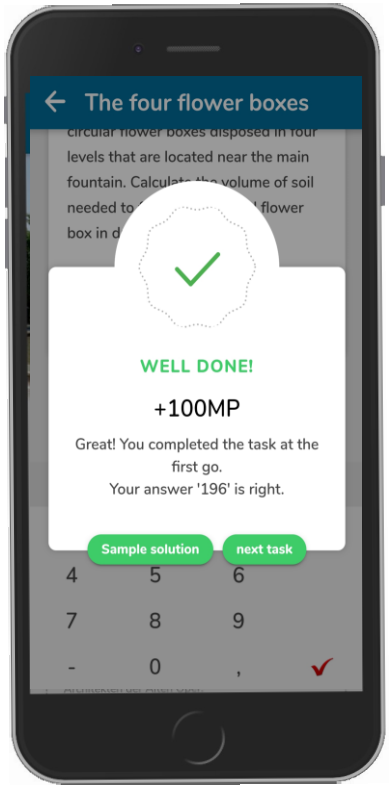


MathCityMap

# The MathCityMap App




6. Hints on demand. Up to three hints per task.




7. The solution is confirmed by the app

MathCityMap

# Prepare for a trail with MathCityMap

- Form groups of three elements.
- There are 3 roles:
  - Navigation -operates the app, helps find the tasks
  - Data collection -responsible for the tools and measurements
  - Written records -makes a record of the data/measurements and solutions
- Give a math trail kit to each group:
  calculator, measuring tool, writing material, …
- Each group needs a smartphone/tablet with the app MCM.

MathCityMap

# Let’s try out a math trail with MCM

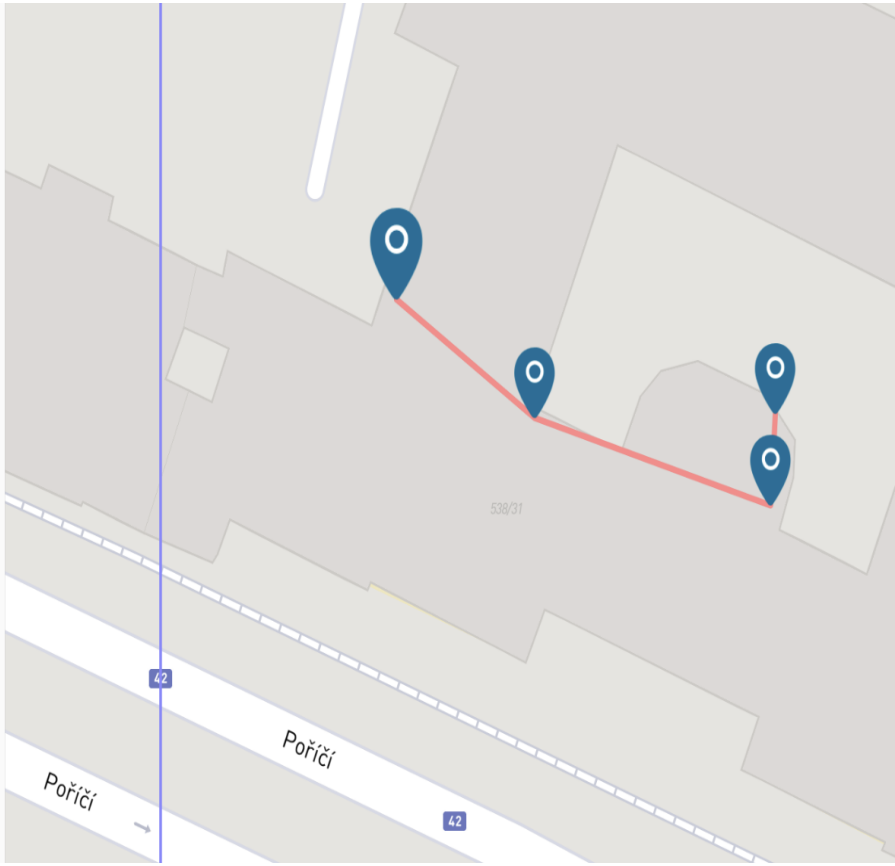
MASARYK UNIVERSITY

BIP STEAM Education

Try out this short trail to get acquainted with MathCityMap. Have fun!

CODE: 2422862

1 9



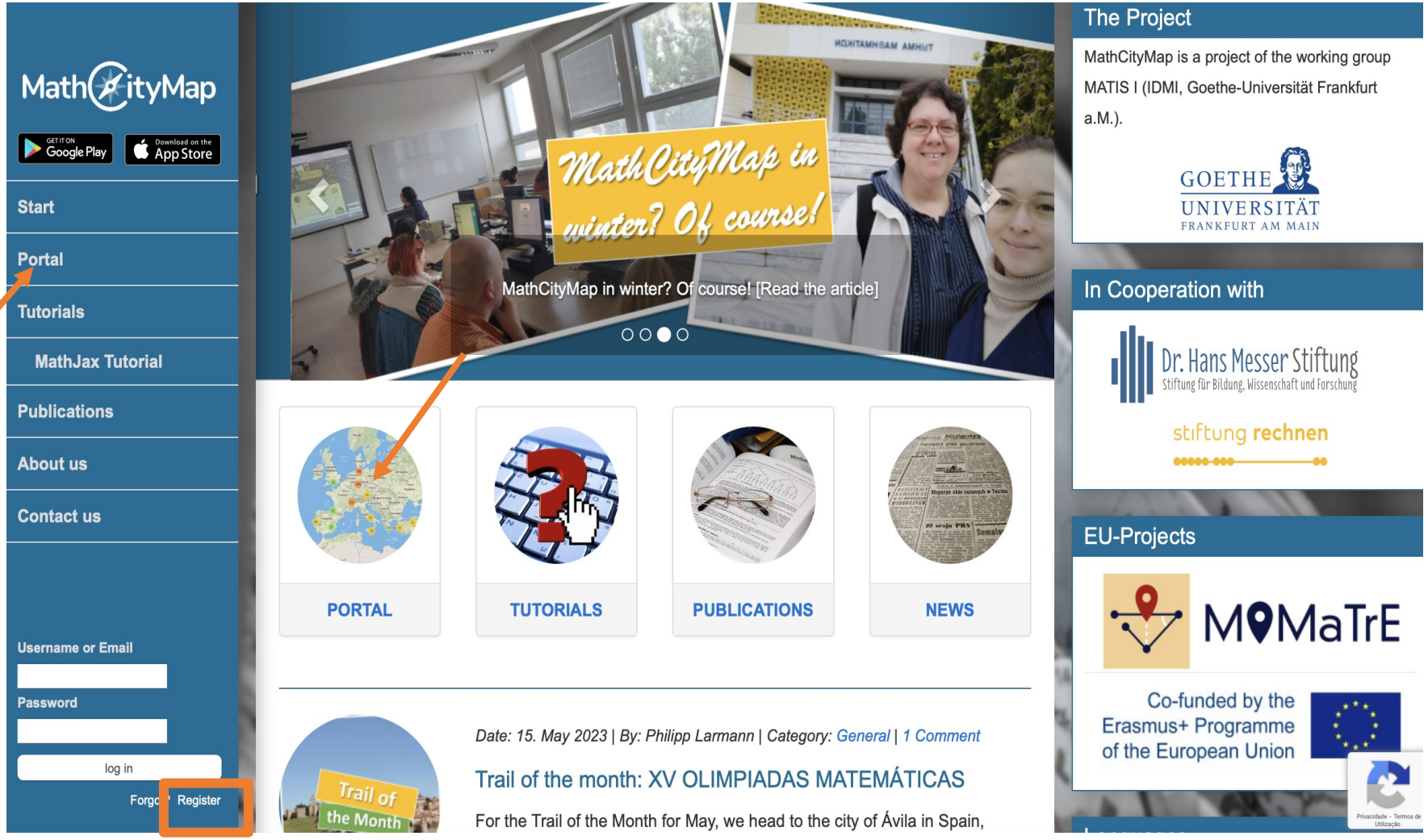
# Part 2

## Design a trail in MathCityMap

MathCityMap

# Design a trail in MathCityMap

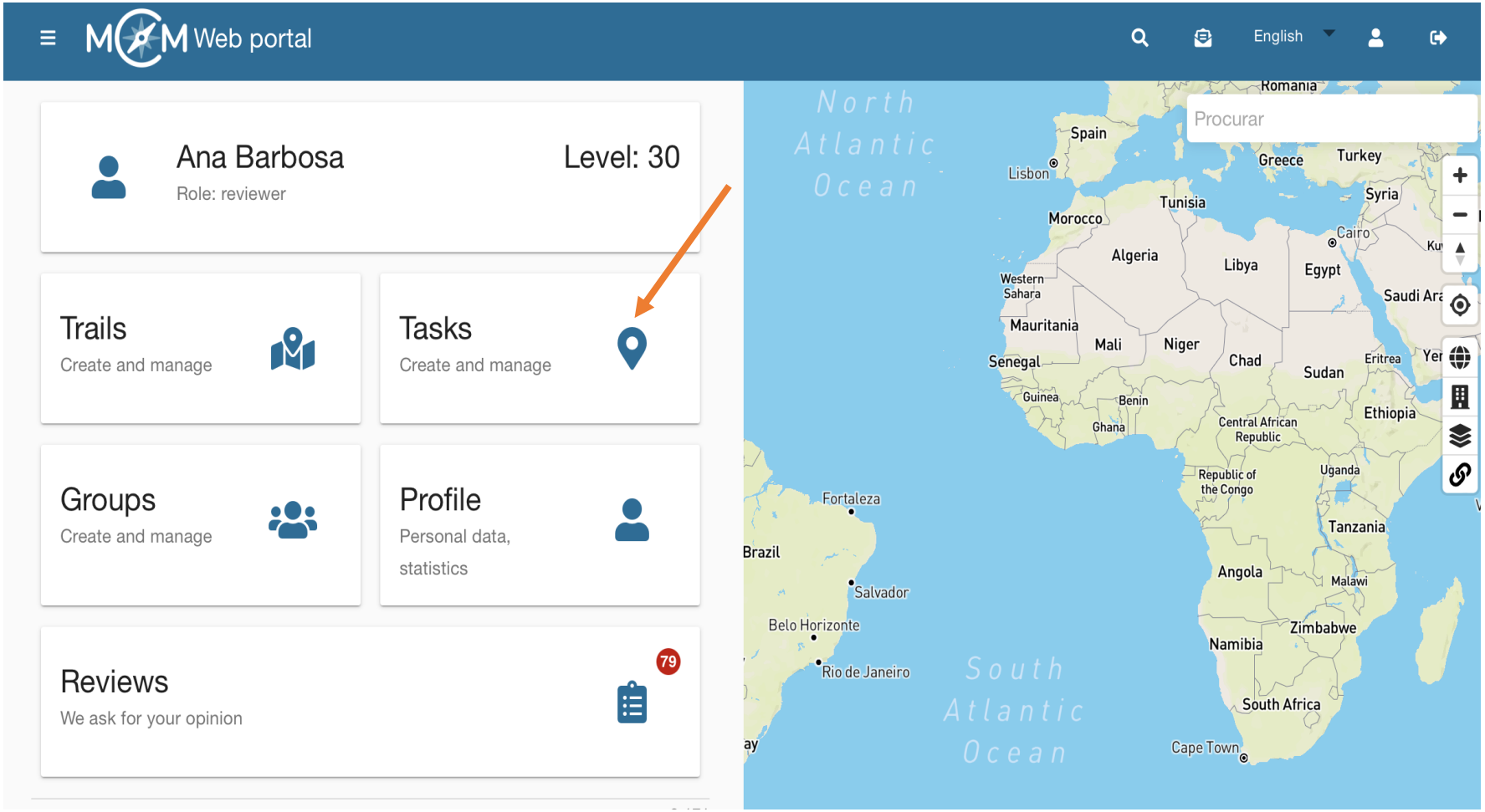
https://mathcitymap.eu



MathCityMap

# Design a trail in MathCityMap

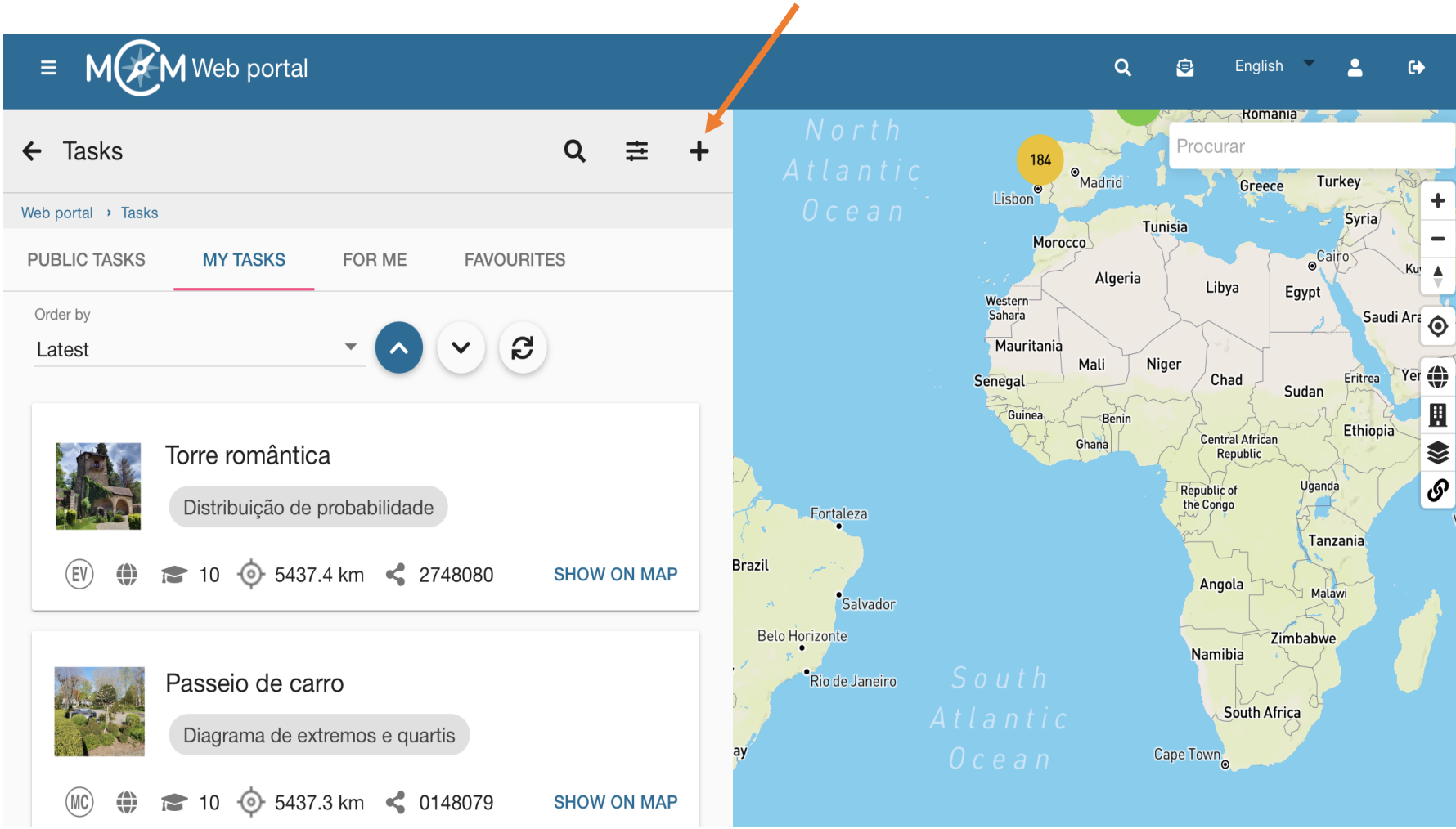
## Create tasks



MathCityMap

# Design a trail in MathCityMap

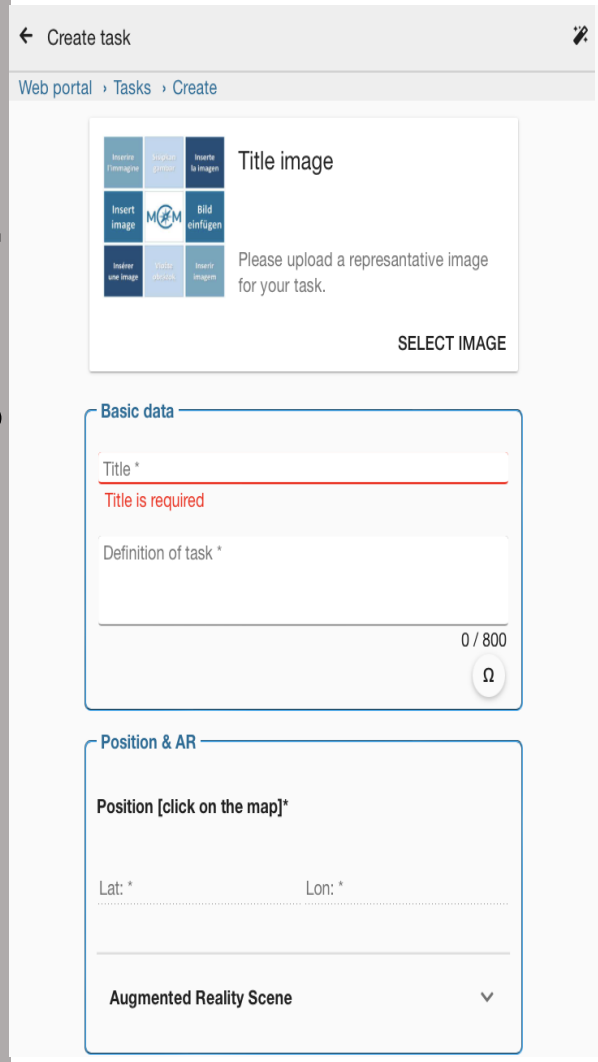
## Create tasks

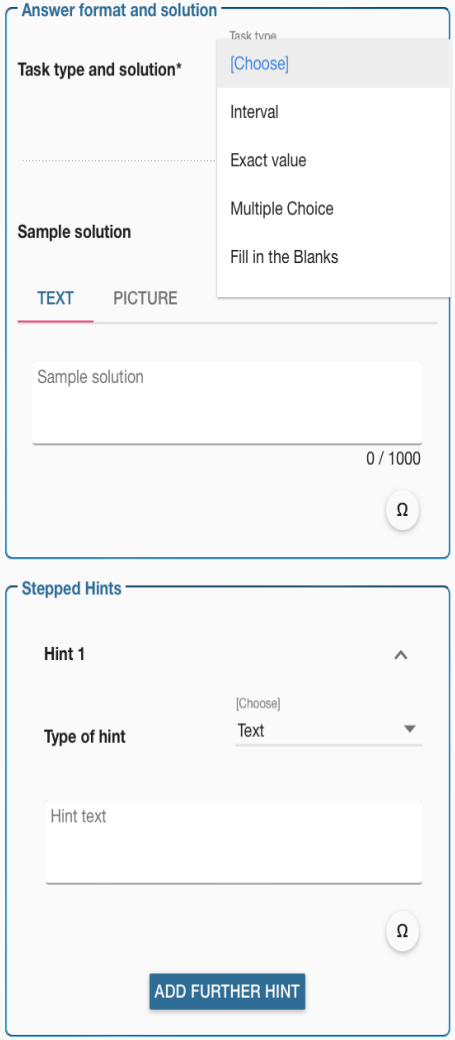


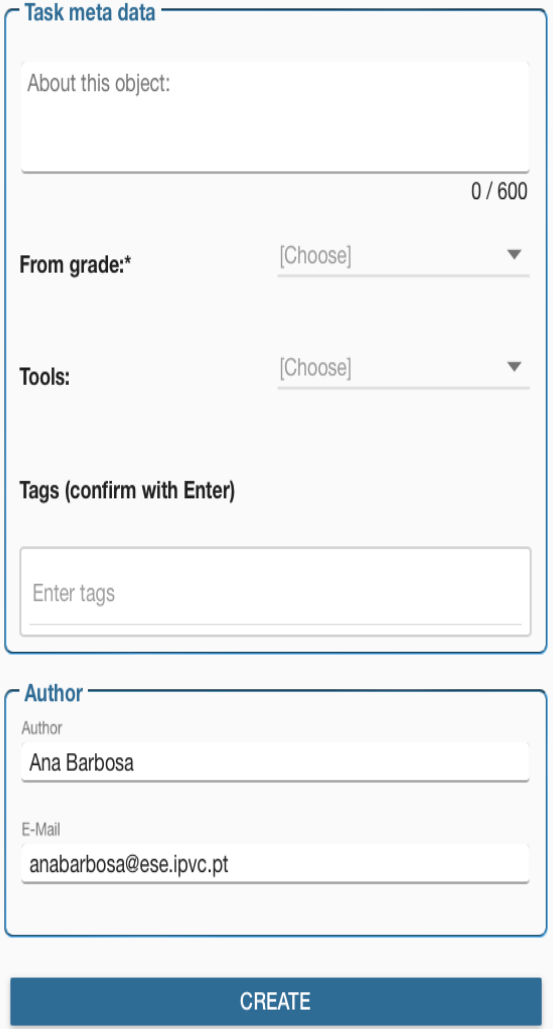
MathCityMap

# Design a trail in MathCityMap

## Create tasks



MathCityMap

# Design a trail in MathCityMap

## Create tasks – some answer formats

### Exact value

- When to use:
  - Combinatorics questions with an exact answer
  - Counting tasks in which the number can be determined exactly
- Example:

  *How many windows can you count on the south facade of the building?*
  Answer: 40

- **Author** defines a number in the web portal
- **User** introduces a number in the app

MathCityMap

# Design a trail in MathCityMap

## Create tasks – some answer formats

### Multiple choice

- When to use:
  - Tasks with multiple answers
  - Tasks that demand words or expressions as answer
  - Tasks with equivalent answers (ex. 3x2; 6)
- Example:

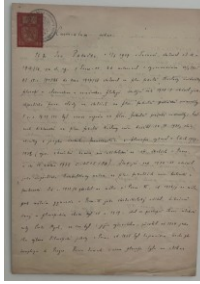
  *What solids and geometric figures do you identify in the Tower of Pisa?*
  Answer: cylinder; squares; triangles; circles

- **Author** defines at least 2 possible answers in the web portal, identifying the correct ones
- **User** chooses the correct answers from the list in the app

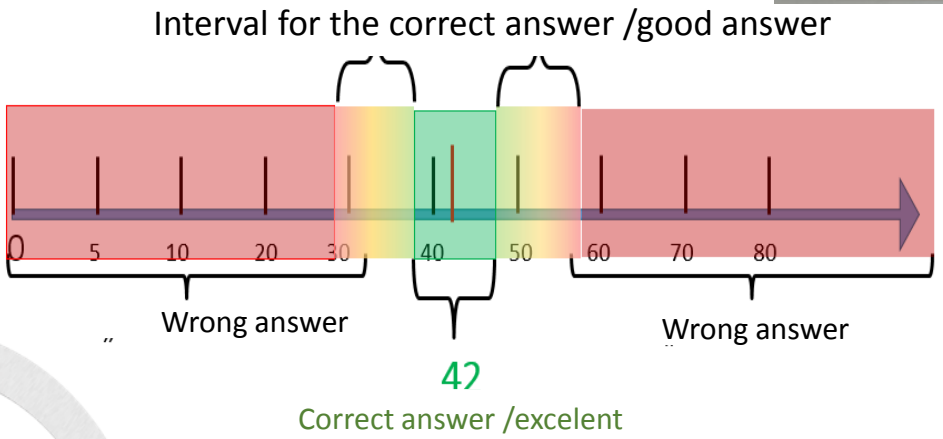
MathCityMap

# Design a trail in MathCityMap

## Create tasks – some answer formats



### Interval



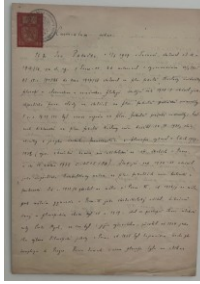

- When to use:
  - All the tasks that require measurements.
- Example:

  *Calculate the area of the school yard in $m^2$*
  Answer: Approximately 5000 $m^2$

- **Author** defines 4 numbers in the web portal, extremes of the green and orange intervals
- **User** introduces a number in the app

# Design a trail in MathCityMap

## Create tasks – some answer formats



**Interval**

- The deviation is defined for each measured value that is to be accepted.
  (e.g. 3%-green interval and 7%-orange interval):

| Acceptable measuring error | Measurement | Acceptable measuring error |
|---|---|---|
| $a_1 = 97m$ | $a = 100m$ | $a_2 = 103m$ |
| $b_1 = 48{,}5m$ | $b = 50m$ | $b_2 = 51{,}5m$ |
| $A = a_2b_2 = 4704{,}5m^2$ | $A = ab = 5000m^2$ | $A = a_2b_2 = 5304{,}5m^2$ |

- We proceed in the same way for the orange interval.

| | | | |
|---|---|---|---|
| 4325 | 4704 | 5305 | 5725 |

MathCityMap

# Design a trail in MathCityMap

## Create tasks – some answer formats

- **Fraction**

Tasks that require a fraction as answer.

**Other formats**

- **Vector (exact value)**

More than one question in the same task with the answer being an exact value.

(ex: Calculate the minimum and maximum values in a set of data; two or more questions of exact value about the same object)

- **Vector (interval)**

More than one question in the same task with the answer being an approximate value.

(ex: Calculate the area and the perimeter of the flower bed; two or more questions of exact value about the same object)

- **Fill in the blanks**

  Sentence with spaces to complete (words or numbers).

MathCityMap

# Design a trail in MathCityMap

## Create a trail

- In groups, you will go outside and choose three objects that inspire you to create MCM tasks: one of each type (choose 3 of the 4 types - exact value, interval, multiple choice, vector).

- Take a picture of each object.

- Collect all the needed data (counting, measurements).

- Complete the task creation template for each task before submitting it to MCM.

Mobile devices are becoming a resource with great potential both in classrooms but also in outdoor learning. Teachers should be more aware of this fact and try to follow this trend

(Sung, Chang, & Liu, 2016)

STEAM education can become more interesting, significant and enjoyable for students, enhancing the possibilities for their engagement in this type of subjects, inside but also outside the classroom.
(e.g. Sung et al., 2016)

The extension of the classroom to the outdoors is facilitated by the portability and wireless functionality of the mobile devices, which presents students with a more authentic and appropriate context, making it easier to explore the surrounding environment.
(Cahyono & Ludwig, 2019)