USING MATH TRAILS AS A TRAVEL GUIDE

Amélia Caldeira, Ana Júlia Viamonte, Isabel Figueiredo and Helena Brás
Instituto Superior de Engenharia do Politécnico do Porto, LEMA_ISEP, Portugal

Abstract. *This work proposes a different way of getting to know the cities. It is intended that the involvement with cities is done through a math trail. Using mathematics and technology, through the MCM App, we intend that people visit the emblematic places of the cities. Users get to know the city by solving mathematical tasks. These tasks are only possible to be solved with the data collected in the local. At the same time that people visit the cities, people are running a math trail that guides them along the route and turns the cities' visit into a game. We use, as an example, the city of Porto.*

Key words: MathCityMap, math trails, math tasks, cities, travel guide.

OUTDOOR EDUCATION AND MATH TRAILS

In 1986, Simon Priest defined outdoor education based on six points: is a method for learning; is experiential; takes place primarily in the outdoors; requires use of all senses and domains; is based upon interdisciplinary curriculum matter and is a matter of relationships involving people and natural resources (Priest 1986).

Math trails are an example of outdoor education. Running a math trail is one way of experiencing outdoor mathematics. Shoaf, Pollak & Schneider (2004, pp. 4) states that: "*A mathematics trail is a walk to discover mathematics. A math trail can be almost anywhere - a neighborhood, a business district or shopping mall, a park, a zoo, a library, even a government building. The math trail map or guide points to places where walkers formulate, discuss, and solve interesting mathematical problems. Anyone can walk a math trail alone, with the family, or with another group. Walkers cooperate along the trail as they talk about the problems*.".

Math trails can help to connect math content learned in the classroom with the real world and help to discover that math is everywhere. When we run a math trail, we establish connections between mathematics and the real world, we use tools such as diagrams and proportionality and algebraic thinking to solve problems, we update and revise our data collection methods to improve accuracy, and we collaborate to clearly communicate our thinking. The opportunities offered by math trails can help connect students and teachers, families or tourists to the local environment and, in doing so, support the development of rich and meaningful mathematical modeling skills (Druken & Frazin, 2018).

MATHCITYMAP - A TOOL TO ENGAGE WITH THE CITIES

The MathCityMap (MCM - https://mathcitymap.eu/en/) project was created at Goethe University in 2012 in an educational and technological context and aims to develop a central and global platform for the creation and simplified use of tasks that are part of a math trail. In its technical aspect, two components stand out: a web portal, as a tool to create and view tasks and routes, and an application for smartphones, as a tool to execute routes. MathCityMap App (MCP App) is to teachers, students and anyone interested in trying out mathematical routes in the environment around them. MCM App guides users to tasks via GPS, presents the tasks and gives an immediate feedback and a possible resolution. It also provides suggestions for solving tasks. MathCityMap web portal is to teachers and creative users, who want to create their own tasks and routes (Ludwig & Jablonski, 2019).

Caldeira, A., Viamonte, A. J., Figueiredo, I. & Brás, H. (2020). Using Math Trails as a Travel Guide. In M. Ludwig, S. Jablonski, A. Caldeira, & A. Moura (Eds.), *Research on Outdoor STEM Education in the digiTal Age. Proceedings of the ROSETA Online Conference in June 2020* (pp. 197-200). Münster: WTM. https://doi.org/10.37626/GA9783959871440.0.24

Firstly, the math trail idea was developed as a family vacation activity. Later, some schools took advantage of the trails, integrating them into their math learning programs. The success of this idea allowed this program to be adapted and applied in different locations, and the math trail projects later appeared in several cities (Cahyono & Ludwig, 2019).

In this work, we present an idea that combines tourism with math trails. Our scenario will be the cities and their emblematic places, and the objective is to get to know the cities with a special look - a mathematical look. The idea is to go through the main tourist points of the cities and, in each of these points, there is a mathematical task to solve. The task is only possible to be solved at the tourist point because there are data that can only be obtained at that location. This will make mandatory the trip to that local. A brief historical summary is presented in the App to better understand the place.

To exemplify our idea, we used the city of Porto (Portugal). The *Jardins do Palácio de Cristal* (Gardens of the Crystal Palace) are a pleasant green space located in this city. We present a math trail in order to get to know these gardens more intimately. As a tool, we use the MCM.

A TOURIST MATH TRAIL

To visit the *Jardins do Palácio de Cristal*, we use the public route of the MCM App with the code: 141980. This route has a length of 700 meters and an estimated duration of 2 hours and 10 minutes, and includes 10 tasks. Gamification is used in this route, it is displayed sample solutions and hits, and the user' solution is validated (see Gurjanow et al., 2019).

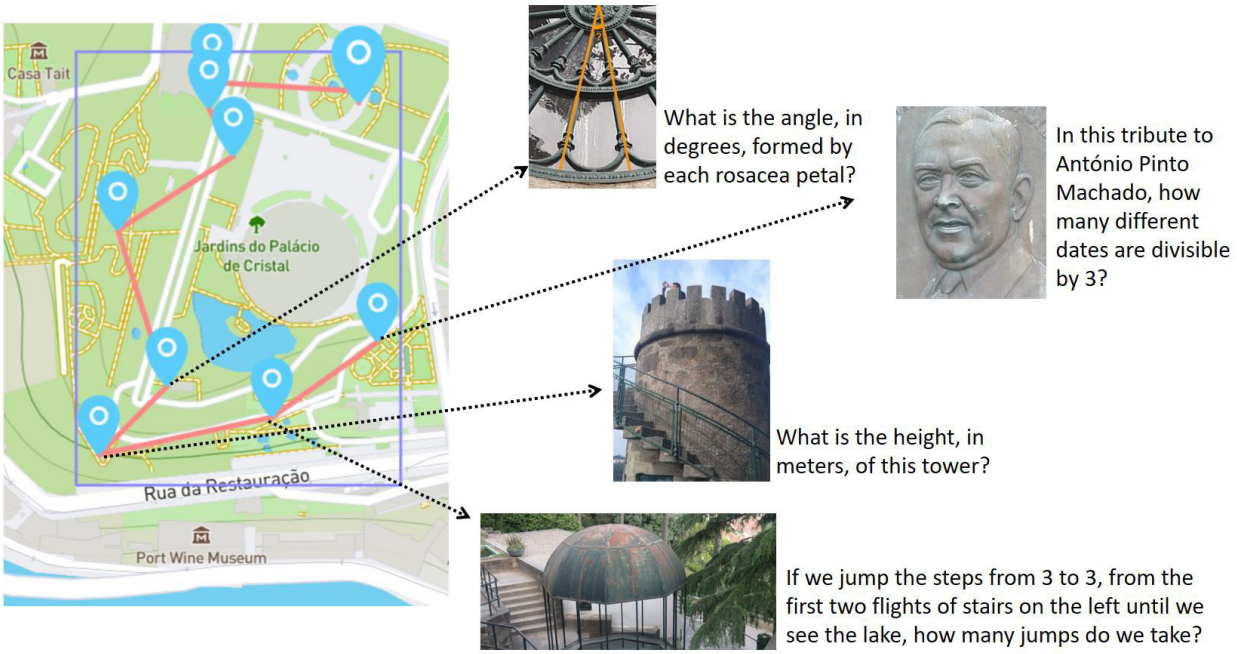


Figure 1: A tourist math trail in *Jardins do Palácio de Cristal*, and example of some tasks.

In Figure 1 it can be seen tourist math trail in *Jardins do Palácio de Cristal* and examples of some tasks.

In the MCM portal, it is possible to put information about the object or the place where the task is and also information about the route. It is possible to take advantage of this field to put historical information, or some funny information, or some feature of the place or

object. Thus, it is possible to build a tourist mathematical route. It is also possible to create narratives on the MCM portal. Currently, the only possible narrative is the *Pirate narrative*.

CONCLUSIONS

The concept of math trails has been greatly enriched thanks to the possibilities offered by mobile devices to provide automatic feedback and provide guidance throughout the route.

In this work we intended to present an idea that use math trails and combines tourism and family relationships with mathematics. We proposed that tourists took a trip around the Porto with a mathematical look. Our aim is that people visit the main tourist points of the city and that in each of these points they solve a task. The goal is to get to know the city in a playful way and using their mathematical knowledge. All activities were developed to be carried out only at the tourist spot itself. In addition, in each tourist spot a brief historical summary is presented so that the tourist gets to know that tourist spot better.

As a tool, we use MathCityMap, where users can create tasks and trails and share them amongst themselves or with the public to run through its App. MCM guides users to tasks via GPS, presents tasks and gives immediate feedback and possible resolution. It also provides suggestions for solving tasks.

References

Cahyono, A. N. & Ludwig, M. (2019). Teaching and Learning Mathematics around the City Supported by the Use of Digital Technology. *Eurasia Journal of Mathematics, Science and Technology Education, 15(1)*, em1654. https://doi.org/10.29333/ejmste/99514

Druken, B., Frazin, S. (2018). Modeling with Math Trails. Retrived from

https://www.researchgate.net/publication/334330282_Modeling_with_Math_Trails/citations

Gurjanow, I., Oliveira, M., Zender, J., Santos, P. A., & Ludwig, M. (2019). Shallow and deep gamification in mathematics trails. In M. Gentile, M. Allegra & H. Söbke (Eds.), *Games and learning Alliance - 2019: 7th International conference*, *GALA 2018, Palermo, Italy, December 5-7, 2018, Proceedings* (pp. 364–374). Springer International Publishing.

Ludwig, M. & Jablonski, S. (2019). Haciendo matemáticas al aire libre con MathCityMap. Presented at Jornadas para el Aprendizaje y la Enseñanza de las Matemáticas (19JAEM), 3 a 5 julio 2019, A Coruña, Spain.

Priest, S. (1986) Redefining Outdoor Education: A Matter of Many Relationships, *The Journal of Environmental Education, 17 (3)*, 13-15, DOI: 10.1080/00958964.1986.9941413

Shoaf, M., Pollak, H., & Schneider, J. (2004). *Math Trails*. Lexington: COMAP.

Using math trails as a travel guide

Amélia Caldeira, ISEP/IPP, LEMA-ISEP, SYSTEC-ISR, Portugal
Ana Júlia Viamonte, Isabel Figueiredo, Helena Brás, ISEP/IPP, LEMA_ISEP; Portugal

Abstract. This work proposes a different way of getting to know the cities. It is intended that the involvement with cities is done through a math trail. Using mathematics and technology, through the MCM App, we intend that people visit the emblematic places of the cities. Users get to know the city by solving mathematical tasks. These tasks are only possible to be solved with the data collected in the local. At the same time that people visit the cities, people are running a math trail that guides them along the route and turns the cities' visit into a game. We used, as an example, the city of Porto.

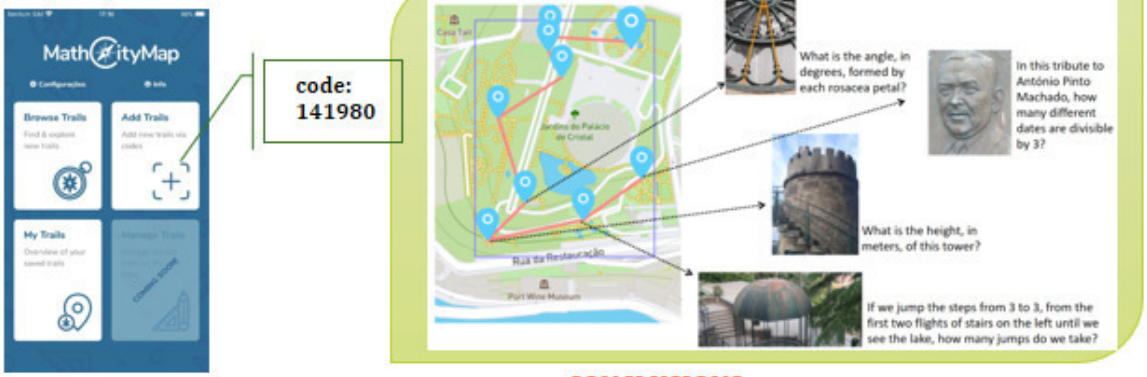
Keywords: *MathCityMap | math trails | math tasks | cities | travel guide*

OUTDOOR EDUCATION AND MATH TRAILS

- Outdoor education is a method for learning; is experiential; takes place primarily in the outdoors; requires use of all senses and domains; is based upon interdisciplinary curriculum matter and is a matter of relationships involving people and natural resources (Priest 1986)
- Math trails are an example of outdoor education, and they can help to connect math content learned in the classroom with the real world and help you to discover that math can be found everywhere (Shoaf, Pollak, & Schneider, 2004).
- The opportunities offered by math trails can help connect students and teachers, families, or tourists to the local environment and, in doing so, support the development of rich and meaningful mathematical modeling skills (Druken & Frazin, 2018).

A TOURIST MATH TRAIL

- **Local**: *Jardins do Palácio de Cristal*. Porto, Portugal
- **App**: MathCityMap
- Public route of the MCM App with the code: 141980
- 10 tasks in a route of 700 meters
- Duration of 2 hours and 10 minutes
- With gamification



MATH CITY MAP A TOOL TO ENGAGE WITH THE CITIES

- The goal of MathCityMap (MCM - https://mathcitymap.eu/en/) project, was to develop a web portal (a trail management system), to create mathematical tasks and routes and an application for smartphones, to execute the tasks of the routes, related to mathematics on real world objects, and places.
- The App guides users to tasks via GPS, presents the tasks, and gives an immediate feedback, a possible resolution and suggestions for solving tasks.
- We intend to present a strategy that combines tourism with mathematics. Our scenario are the cities and their emblematic places, and the objective is to get to know the cities with a special look - a mathematical look. The idea is to go through the main tourist points of the cities where is a mathematical task to solve. The task is only possible to be solved at the tourist point and a brief historical summary is presented to better understand the place.

CONCLUSIONS

In this work we present an initiative that use math trails (outdoor education) and combines tourism and family relationships with learning mathematics. It is intended that they visit the main tourist points of the city and that in each of these points they solve a task! The goal is to get to know the city in a playful way and using their mathematical knowledge.

References

- Cahyono, A. N., Ludwig, M. (2019). Teaching and Learning Mathematics around the City Supported by the Use of Digital Technology. Eurasia Journal of Mathematics, Science and Technology Education, 15(1), em1654. https://doi.org/10.29333/ejmste/99514
- Druken, B., Frazin, S.. (2018). Modeling with Math Trails. Retrived from https://www.researchgate.net/publication/334330282_Modeling_with_Math_Trails/citations
- Gurjanow, I., Oliveira, M., Zender, J., Santos, P. A., & Ludwig, M. (2019). Shallow and deep gamification in mathematics trails. In M. Gentile, M. Allegra & H. Söbke (Eds.), Games and learning Alliance - 2019: 7th International conference, GALA 2018, Palermo, Italy, December 5-7, 2018, Proceedings (pp. 364–374). Springer International Publishing.
- Ludwig, M. & Jablonski, S. (2019). Haciendo matemáticas al aire libre con MathCityMap. Presented at Jornadas para el Aprendizaje y la Enseñanza de las Matemáticas (19JAEM), 3 a 5 julio 2019, A Coruña, Spain.
- MathCityMap https://mathcitymap.eu/
- Priest, S. (1986) Redefining Outdoor Education: A Matter of Many Relationships, The Journal of Environmental Education, 17:3, 13-15, DOI: 10.1080/00958964.1986.9941413
- Shoaf, M., Pollak, H. & Schneider, J. (2004). Math Trails. Lexington: COMAP.