

Designing learning activities on computational thinking in public transport environments: some preliminary thoughts

Lamprini Chartofylaka, Areti Damala, Antoine Delcroix

▶ **To cite this version:**

Lamprini Chartofylaka, Areti Damala, Antoine Delcroix. Designing learning activities on computational thinking in public transport environments: some preliminary thoughts. Academia Letters, 2021, 10.20935/AL2988 . hal-03357115

HAL Id: hal-03357115
https://hal.science/hal-03357115

Submitted on 28 Sep 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

ACADEMIA | Letters

Designing learning activities on computational thinking in public transport environments: some preliminary thoughts

Lamprini Chartofylaka
Areti Damala
Antoine Delcroix

Contemporary urban environments offer great opportunities for culturally rich, informal, situated learning. It is expected that two-thirds of the world's population will be living in cities by 2050 (United Nations, UN, 2019). Our paper explores the conception of using public spaces as active learning and knowledge-building spaces through playful activities taking place in public transportation. We are particularly interested in the potential of including public transport information and its signaling system into the design of learning edutainment activities for children that focus on the development of computational thinking (CT), perceived as a fundamental skill for tomorrow's actors, children.

Theoretical framework

The term CT has been brought up and explained in particular in Wing's work (2006, 2008, 2014) as a human problem-solving method for breaking complex issues down into their simplest form and expressing solutions, just like computers do. This concept initially emerged as "procedural thinking" in Papert's work (1996). Nowadays, there is an interest in integrating CT activities in children's education curriculum in a way that can be enacted and applied across various disciplines (Grover & Pea, 2018). CT is linked to numerous 21st century competencies (such as problem solving, collaboration, creativity, to name a few) which need to permeate the child's learning in everyday situations (eg. Balanskat et al., 2018). Cansu and Cansu (2019) summarize the main components and performing activities related to it as being

 ©2021 by the authors — Open Access — Distributed under CC BY 4.0

Corresponding Author: Lamprini Chartofylaka, lamprini.chartofylaka@gmail.com
Citation: Chartofylaka, L., Damala , A., Delcroix , A. (2021). Designing learning activities on computational thinking in public transport environments: some preliminary thoughts. *Academia Letters*, Article 2988.
https://doi.org/10.20935/AL2988.

shown in the existing literature. Our focus is put mostly on four main parts of CT:

- Abstraction: Reducing the complexity of a problem and focusing on a specific concept.
- Decomposition: Separating a problem into smaller parts to make it more manageable.
- Pattern matching: Recognizing similarities into different problems.
- Algorithm thinking: Creating a sequence of steps in a logical way for solving a problem.

Children, just like adults, encounter many problem-solving situations in their everyday life and especially when they are present in public spaces. Over the years, the role of public space has also been studied as the physical place which can be linked with human well-being and invoke positive feelings to individuals. Fenster (2005) has disclosed the various meanings of the "sense of belonging" into the public area, putting principally into question the gender identity. The work of Rivière (2012) investigates the connection between children's autonomy and urban areas. While McEvoy-Levy (2012) evokes the idea of using local points as conflict management and peacebuilding tools between individuals. Playing and more broadly speaking any activity upholding the principles of free expression can be a means of fostering a sense of ownership of a space in communities. The location-based game P.I.G.S. (Roinioti & Saridaki, 2013) for example, showcases how playing into the urban areas can be an effective outlet for expressing and examining power politics and societal norms.

Materials and methods

Following the above, our paper addresses a closer understanding of the ways that public transport information, signaling systems and their general structure and components (visual elements, sounds, social interactions that occur) could be further integrated into their children's active learning processes. To do so, we first present some unpublished data collected in an online survey back in 2019. This survey investigated in an overall sense children's attitudes and behaviors when using public transport, their general knowledge and perceptions from a parent's perspective. Secondly, we provide some simple hands-on examples, taking as a case study the Parisian transport system, that could be further developed to propose learning activities based on CT principles.

Owing to the personal background of the authors, our respondents concerned families who live or have lived in France or/and in Greece. The questionnaire, drafted in two languages, included a total of 23 questions. Some of them were open-ended questions, for the rest of

©2021 by the authors — Open Access — Distributed under CC BY 4.0

Corresponding Author: Lamprini Chartofylaka, lamprini.chartofylaka@gmail.com
Citation: Chartofylaka, L., Damala , A., Delcroix , A. (2021). Designing learning activities on computational thinking in public transport environments: some preliminary thoughts. *Academia Letters*, Article 2988. https://doi.org/10.20935/AL2988.

them participants had to choose between possible answers of categorical type (*"Yes", "No"* or *"I am not sure"*) and only one possible answer was authorized.

For the purpose of this paper, we present participants' demographic data and we selected two questions from this questionnaire, the ones related to CT concepts, that obtained a score which was statistically significant (more than 60% of the total responses). We then coupled our analysis with some concrete examples elicited from observations in the Parisian urban context.

Results and analysis

In the aforementioned work, we received 41 questionnaires in total completed by 39 parents and 2 child-care professionals. We decided to keep our sample homogeneous, so we withdrew the responses from the 2 child-care professionals.

The respondents (32 mothers, 7 fathers) who completed the questionnaire were parents of 1 child (N=22), of 2 (N=16) or 3 children (N=1). We had not set any age limit concerning their children. This enabled us to receive answers for 57 children in total with a mean age being 5 years old (minimum age: 5 months old, maximum age: 15 years old). From our observations, it is worth mentioning that when a respondent had two children, for example one aged 12 months old and the other one of 3 years old, their answers were mostly based on the behaviors and the attitudes of the older one. Interviewed parents are located in:

- Greece: Athens (19), Thessaloniki (1), Chania (1), Skiathos (1)
- France : Paris (12), Montpellier (1)
- United Kingdom: London (4)

We draw our attention to the following questions:

1. *"Have you already explained to your children, step by step, how to get to a destination?"* (Question No9 in the questionnaire)
2. *"Do they understand the differences between metro, tram, train, bus and trolleybus?"* (Question No10 in the questionnaire)

The values of respondents' answers are shown to the figure below (Fig.1).

©2021 by the authors — Open Access — Distributed under CC BY 4.0

Corresponding Author: Lamprini Chartofylaka, lamprini.chartofylaka@gmail.com
Citation: Chartofylaka, L., Damala , A., Delcroix , A. (2021). Designing learning activities on computational thinking in public transport environments: some preliminary thoughts. *Academia Letters*, Article 2988. https://doi.org/10.20935/AL2988.

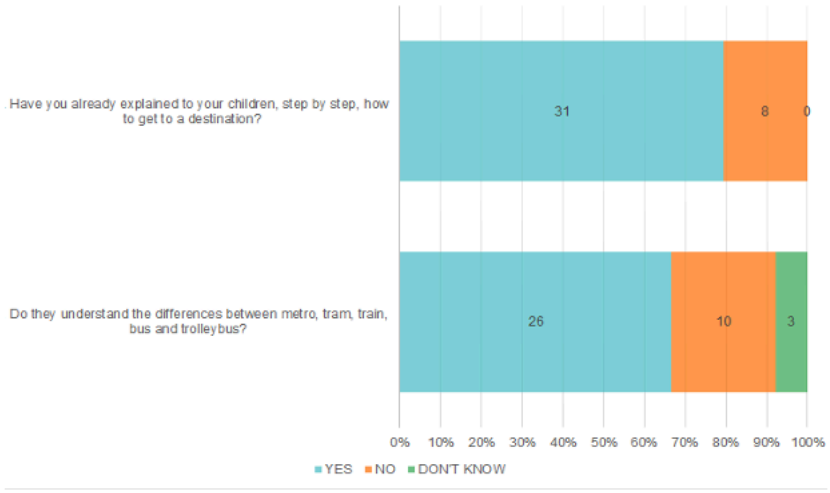


Figure 1: Results on questions linked to CT concepts

Regarding the first question, 31 out of 39 respondents (79%) confirm that they have already explained to their children, step by step, how to get to a destination. In our view, this result is encouraging as it is highly linked to what is known as "**algorithm thinking**" (a kind of procedural thinking) in CT. Concerning the second question, 25 out of 39 respondents (64%) provide evidence that their children understand the existing differences of public transports. These differences, as described by authors in the questionnaire, can be linked to differences in public transports' presence in an underground network system (like the metro) or in the use of electricity or fuel to operate. In a simplified view, understanding the differences and similarities of these elements could be linked to what is known as "**pattern matching**" in CT. We can not overlook that two of the parents had at that time only one very young child (5 and 18 months old), so it is logical that they answered negatively.

Examples inspired by the Parisian urban environment

We provide a few examples of activities on CT inspired by the public transport landscape of Paris.

©2021 by the authors — Open Access — Distributed under CC BY 4.0

Corresponding Author: Lamprini Chartofylaka, lamprini.chartofylaka@gmail.com
Citation: Chartofylaka, L., Damala , A., Delcroix , A. (2021). Designing learning activities on computational thinking in public transport environments: some preliminary thoughts. *Academia Letters*, Article 2988. `https://doi.org/10.20935/AL2988`.

The exit dilemma: Abstraction



Figure 2: Paris metro exit map (Source : seetheworld.travelforkids.com/)

Abstraction is the process of excluding unnecessary information and focusing on the details that matter. With the example of the metro map users should disregard information on the buses around the area and in first place find the street from the list on the right and in the second place identify the closest exit (exit's number) of their destination.

Choosing a metro line: Decomposition



Figure 3: Metro map connections in Paris (Source: travelsfinders.com/)

Decomposition is the process of breaking-down something in smaller parts. In some metro lines, there are bi-directional destinations: users should study the metro signs and define in which train destination they should step. Consequently, they decompose their travel itinerary in a simplified way so that they would choose wisely the metro lines that they should take.

Blinking-light: Pattern matching



Figure 4 : Information panel in Parisian metro

Blinking-light patterns on the metro station panels indicate that the train is approaching the platform (Figure 9). Even if the users who are far away and they cannot exactly identify the remaining time on the panel, when the light is blinking that shows that the train is almost there.

All roads lead to: Algorithm design



Figure 5: Landmarks in Paris (image created by Elli Sarrou)

In this case, the Parisian railway map is quite confusing as most of the big cities' public transportation maps (Figure 10). What users need to do for optimizing the way that they should take (from an A to a B point) is to identify a series of steps for reaching their goal destination (get into the station/first take the line x/stop at the metro station y/take the line z/then exit).

 ©2021 by the authors — Open Access — Distributed under CC BY 4.0

Corresponding Author: Lamprini Chartofylaka, lamprini.chartofylaka@gmail.com
Citation: Chartofylaka, L., Damala , A., Delcroix , A. (2021). Designing learning activities on computational thinking in public transport environments: some preliminary thoughts. *Academia Letters*, Article 2988. https://doi.org/10.20935/AL2988.

Discussion and conclusion

Our findings, yet limited but promising, should be validated by a larger sample size focusing on a specific age range. It is also more pertinent to run a study with more respondents per city to guarantee validity and generalization of results for a specific context. This could contribute to a more in depth understanding of the "relationship" between the user (in our case: child, parent) and the existing public transportation system. In a point of view, to illustrate, the Paris metro is an old transit metro system serving the French capital and covers a greater area (has many more lines than the one in Athens), so there is a strong probability that the user's attachment to this element of the urban environment is much more significant.

In conclusion, building learning activities for the younger ones linked with the public transportation system (general understanding, semiotics, social interactions for example) is possible and opens up new perspectives on how 21st century skills such as CT could be further introduced in their daily life. We believe that interrogating parents in the uses of public transport by their children is an interesting implication for framing the research questions alternatively. Finally, we believe that activities related to urban contexts of transportation, as the ones proposed above, could enable the development of CT skills in children and that is worth further investigation.

References

Balanskat, A., Engelhardt, K., & Licht, A. H. (2018). *Strategies to include computational thinking in school curricula in Norway and Sweden-European Schoolnet's 2018 Study Visit*. European Schoolnet.

Cansu, F. K., & Cansu, S. K. (2019). An Overview of Computational Thinking. *International Journal of Computer Science Education in Schools*, *3*(1), 17-30. https://doi.org/10.21585/ijcses.v3i1.53

Fenster, T. (2005). The Right to the Gendered City: Different Formations of Belonging in Everyday Life. *Journal of Gender Studies*, *14*(3), 217–231. https://doi.org/10.1080/09589230500264109

Grover, S., & Pea, R. (2018). Computational Thinking: A Competency Whose Time Has Come. In S. Sentance, E. Barendsen, & C. Schulte (Eds.), *Computer Science Education: Perspectives on Teaching and Learning*. London: Bloomsbury.

McEvoy-Levy, S. (2012). Youth Spaces in Haunted Places: Placemaking for Peacebuilding

 ©2021 by the authors — Open Access — Distributed under CC BY 4.0

Corresponding Author: Lamprini Chartofylaka, lamprini.chartofylaka@gmail.com
Citation: Chartofylaka, L., Damala , A., Delcroix , A. (2021). Designing learning activities on computational thinking in public transport environments: some preliminary thoughts. *Academia Letters*, Article 2988. https://doi.org/10.20935/AL2988.

in Theory and Practice. *International Journal of Peace Studies*, *17*(2), 1–32. JSTOR. Retrieved from https://www.jstor.org/stable/41853033

Papert, S. (1996). An exploration in the space of mathematics education. *International Journal of Computers for Mathematical Learning*, *1*(1). https://doi.org/10.1007/BF00191473

Rivière, C. (2012). Les enfants : Révélateurs de nos rapports aux espaces publics. *Métropolitiques.* Retrieved from https://www.metropolitiques.eu/Les-enfants-revelateurs-de-nos-rapports-aux-espaces-publics.html

Roinioti, E., & Saridaki, M. (2013, May). *P.I.G.S. and the city: Playing with guilt and truth in the streets of Athens*[Paper presentation]. International Biennale event of Hybrid City II: Subtle Revolutions, Athens, Greece.

United Nations, Department of Economic and Social Affairs, & Population Division. (2019). *World urbanization prospects: 2018: highlights*.Retrieved from https://population.un.org/wup/Publications/

Wing, J. M. (2006). Computational thinking. *Communications of the ACM*, *Vol. 49*(3), 33–35.

Wing, J. M. (2008). Computational thinking and thinking about computing. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *366*(1881), 3717–3725. https://doi.org/10.1098/rsta.2008.0118

Wing, J. M. (2014). Computational Thinking Benefits Society. *Social Issues in Computing New York: Academic Press*. Retrieved from http://socialissues.cs.toronto.edu/2014/01/computational-thinking

 ©2021 by the authors — Open Access — Distributed under CC BY 4.0

Corresponding Author: Lamprini Chartofylaka, lamprini.chartofylaka@gmail.com
Citation: Chartofylaka, L., Damala , A., Delcroix , A. (2021). Designing learning activities on computational thinking in public transport environments: some preliminary thoughts. *Academia Letters*, Article 2988. https://doi.org/10.20935/AL2988.