Mathematical Puzzles in Public Spaces on the Example of PoRachunki Warszawskie and PoRachunki w Łazienkach

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Abstract

PoRachunki Warszawskie and PoRachunki w Łazienkach are projects that introduce recreational mathematics to public spaces. These illustrated mathematical puzzles reference iconic locations, buildings, and monuments in Warsaw. For over a decade they have been presented in various locations and formats, targeting diverse audiences. Through this initiative I encourage engagement with mathematics outside of the school environment, offering the opportunity to interact with mathematical problems at one's own place, time (and risk!).

Introduction

Questions I asked myself both as a mathematician and an artist were: How can I evoke a sense of satisfaction in people as they engage with mathematics? What could a product that is up for such a tall task look like? This thought process began in 2013.

I knew that people can experience joy when they discover the solution to a mathematical problem. Research by P. Liljedahl (on AHA! experience) goes even further: it can change their attitude [6]. Given this potential, I set out to explore how to achieve it. However, considering factors such as math anxiety, I knew that my approach had to be fundamentally different from the traditional school experience. Since my goal was to elicit enjoyment from solving problems, I naturally turned to recreational mathematics—a non-formal branch of mathematics dedicated to this very aspect. The books and ideas of M. Gardner and R. Smullyan [3, 11] were particularly relevant to my approach. I assumed that good storytelling and a humorous component would benefit presenting mathematical problems effectively (Fortunately, years later I came across a book that confirms this theory: *Teaching Mathematics as Storytelling*, R. Zazkis & P. Liljedahl [13]). The setting in which participants would encounter my project was also crucial. I wanted it to differ from the school environment: people should engage with my project whenever and wherever they wished, and their participation should not be assessed or graded.

PoRachunki Warszawskie

What emerged from combining all these principles? I created PoRachunki Warszawskie (2013), a set of 24 illustrated postcards. Each postcard featured a single puzzle and an accompanying illustration. The puzzles were inspired by classic logic and mathematical riddles—from those by Gardner, Stewart, and Alcuin [3, 11, 1] to school-style problems. The content was adapted to reference buildings, monuments, and locations in Warsaw's city center. This choice was influenced by the source of project funding—an artistic scholarship from the City of Warsaw.

So (Figure 1), we have two Warsaw monuments: the goddess Nike (Figure 1(b)) and Zygmunt, the former Polish royal head (Figure 1(c)), along with a task involving converting units of length. I introduced the Roman foot as a unit of measurement to playfully wink at those who deliberately make exercises more difficult to discourage students from solving them. The humorous element lies in the idea that Nike and Zygmunt go to work. A simple illustration shows their struggles during their imaginary daily climb onto their pedestals.

(a) (b) (c)

Figure 1: (*a) Kopyt, M. PoRachunki Warszawskie, own work, 2013, (b) Unknonwn author, Nike Monument, National Digital Archive 1964, (c)* S. *Rassalski, Zygmunt III of Poland Monument, National Digital Archive, 1951.*

Another example is a puzzle from a series about liars and truth-tellers. There are many variations of this puzzle, though it is usually set on the *Island of Liars and Knights* (R. Smullyan, [11]). In PoRachunki, I take them off the island and place them directly into public transport, where—just like in real life—various characters may interact. The illustration shows a classic tram that runs through Warsaw and an equally classic scenario in which someone is riding without a ticket, someone else is checking the tickets, and in the end, everyone is accusing someone else, making it unclear who is actually telling the truth (Figure 2). The puzzle reads: *The tram driver claims that the ticket inspector is lying. The ticket inspector claims that the passenger is lying. The passenger claims that the ticket inspector is lying. The skateboarder claims that the tram driver is lying. How many people lied?* For those unfamiliar with Warsaw public transport, such situation is not unrealistic, to say the least.

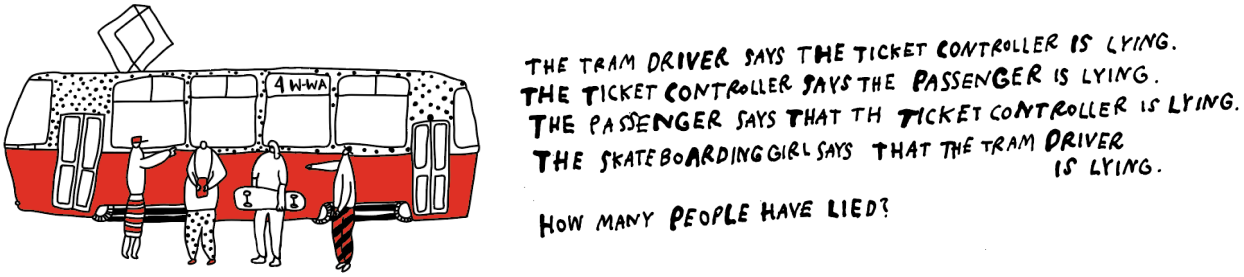

Figure 2: *M. Kopyt, PoRachunki Warszawskie (2013), own work*

The project was disseminated in several stages. Initially, postcards were placed in public spaces such as cafes, bars, cinemas, and administrative offices. I hoped that if people picked up the postcards, their visual appeal would entice them to read the puzzles, and perhaps even have a go at solving them. The postcards included a link to a Facebook page [10] where puzzles were posted for discussion, along with additional challenges. This provided a space for interaction, allowing me to moderate conversations, answer questions and receive feedback. I also organized a contest where participants could create a puzzle

based on a given illustration. The contest was supported by *Delta* monthly (a science magazine published by the University of Warsaw [2]), which featured selected PoRachunki puzzles on its cover.

In 2015, PoRachunki was invited to the *Mathematics Counts* festival, where visitors were given the opportunity to explore framed postcards, discuss solutions and tackle puzzles created specifically for the event. PoRachunki gained unexpected media attention, with articles appearing in lifestyle and culture magazines such as Activist and Kikimora. This suggested that there was space for mathematical projects in popular culture, which was encouraging.

One particularly notable publication of PoRachunki came to fruition thanks to a collaboration with a construction company. The company was about to begin a year-long renovation of a historic tenement house on a major Warsaw street. To improve its public image, knowing that the construction would annoy residents and passersby, it displayed puzzles on the construction fence. This time, the text was also in English, as the location attracts many tourists. The project caught the attention of more than just pedestrians—the architectural magazine BRYŁA [8] wrote an article praising the innovative approach of using construction fences for intellectual entertainment rather than just protection or advertising. The magazine suggested that other companies could/should follow this example.

PoRachunki w Łazienkach

In 2023, I was invited to collaborate with the Royal Łazienki Museum. The museum's brief was simple: to create PoRachunki w Łazienkach featuring puzzles related to the palace and garden complex, which could also be sold as a small product in the museum shop [4]. The result was a book (Figure 3(a)) with detachable postcards (Figure 3(b)), each containing a puzzle referencing animals, buildings, or historical events on the museum premises. The puzzle subjects were chosen after consultations with museum staff and a review of the site's history (P. Oczko & J. Pluis [8], G. Piątek [9]).

5 squirrels eat 5 nuts in 5 hours.
How many nuts will 30 squirrels eat in 30 hours?

(a) (b)

Figure 3: *Kopyt, M. PoRachunki w Łazienkach, 2024, (a) the book, (b) a page.*

This time, I conducted audience testing to arrive at the most adequate difficulty level of the puzzles. A small group of participants, unaccustomed to solving mathematical problems, provided feedback. As a result, I significantly simplified the puzzles and added hints. After incorporating hints, more participants attempted to solve the puzzles rather than giving up immediately. Nearly all found that hints did not reduce their satisfaction with solving the puzzles; in fact, they enjoyed understanding and applying them.

The book's layout was designed by *Dobry Skład Studio*, which also assisted in selecting the font. We chose *Sydonia Atramentiqua*, designed by P. Wardziukiewicz [12]. The inspiration for this font came from the typography used in the first editions of *Malleus Maleficarum* (a 15th-century book known as a *witch-hunting manual*). According to the designer, the font represents the spilled blood of the witches who perished at the hands of the book's readers. Not only does it match the book's illustrations and style, but it also adds an extra layer of meaning (in this case, supporting women, minorities, and acknowledging historical injustices). The book was published in the fall of 2024 and is available for purchase at the Museum's gift shop and selected bookstores.

Summary and Conclusions

The above examples demonstrate how the concept of presenting puzzles can be flexibly adapted to different events and institutions. The original and unconventional combination of intellectual entertainment—incorporating logical, literary, and cultural aspects—along with an appealing visual format keeps the audience engaged. This approach makes it possible to reach people who are not professionally connected to mathematics, offering them a unique intellectual experience and the satisfaction of solving a problem independently. For those interested in bringing PoRachunki to their institution, please feel free to contact me—I would be more than happy to assist.

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