

# Learning Computer Science at a Fair with an Escape Game

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**Abstract.** There exist several pedagogical devices to introduce computer science (CS) concepts to young pupils. No matter the resource used and the targeted age group, the learning can be done in an autonomous way with books or videos, at school with a teacher, during an event/fair with animators, etc. The challenge is always to keep the learner interested and involved with the activities. This paper presents how an *escape game* has been used to foster attendees of a fair to learn CS concepts. They were told a story in which they are locked in a strange bunker. To escape, they have to solve riddles needing basic understanding of CS concepts, such as binary numbers, text ciphering, or bubble sort algorithm, for example. Stands managed by animators allow the visitors to learn the CS concepts through interactive animations. Informal feedbacks from participants and stand animators were good.

**Keywords:** Escape Game · Computer Science Concepts · Fun learning

## 1 Introduction

Computer science (CS) concepts are not only taught to higher education students, but also to younger pupils [2,8]. Not all CS concepts can be taught to younger pupils, at least not in the same way than with higher education students. Specific pedagogical devices have been developed, focusing on computational thinking, digital literacy, etc. but they are not always easy to find, unless using a specialised digital library [4]. The *Computer Science and IT in Education ASBL* is a nonprofit organisation whose goal is to promote computer science at large. It regularly organises the *Computer Science Day* (CSDay), a fair where children and adults with no prior CS knowledge get the opportunity to be introduced to several CS concepts. The visitors of the fair can visit stands to learn CS concepts thanks to a team of animators, teaching them these concepts.

### 1.1 Related work

Particular pedagogical devices and resources must be selected to teach CS concepts to people without any CS background. For example, *CS Unplugged* activities [1] or the *Computer Science Field Guide* can be used to grow algorithmic thinking and encourage programming [5]. The place of learning is also important: it can be a classroom or other dedicated places, such as computer science fairs [7]. Such a place is perfect to allow its visitors to try different things at their own pace, following their own preferences. One challenge is to make sure that everyone gets the opportunity to take part to all the activities.

Using serious games to teach and learn CS concepts can be very effective, in particular for programming [9,3]. Learners enjoy playing game and are pushed to make progress and actively learn new things, if the design of the game is good. Also, the level of the game should be adapted to its audience, to not discourage its players. Finally, escape rooms and escape games provide challenging and motivating games. If well-designed, they can be used for educational purpose in the form of an escape classroom [6,10].

### 1.2 Motivation

This paper is about the *escape game* put in place during the CSDay 2019 fair to foster visitors to learn and be involved with the activities, in a fun and motivating way. Indeed, an observation made during the previous editions of the fair is that it was not easy to encourage its visitors to go through the different stands and animations. Just telling them to follow a route to learn several things was not motivating enough. Following the gamification process and taking advantage of the attractiveness of escape games resulted in a new way to organise a fair and

to naturally attract visitors to the stands, to teach them CS concepts, without computers, in a fun and challenging way and allowing them directly practice.

## 2 Escape Game Design

The visitors of the fair receive a sheet of paper with a story at the entrance, telling them they got stuck in a strange cave from which they want to escape! No timer, no pressure, they can collect and solve the riddles during all the day, knowing that the only constraint is to escape before the end of the fair.

The game takes place in several rooms, between which visitors were free to move. To help them solve the riddles, they had a log book they are receiving incrementally and clues they are collecting. To understand and interpret the clues, visitors should use some CS concepts. They can learn them hopping by a stand to ask an animator explain them. The riddle to solve is a pretext to learn a new concept, visitors are led where we want them to go.

### 2.1 Riddle

What kind of riddles do the visitors have to solve? For example, at some point in the game, visitors were directed towards an old computer in a hallway, whose keyboard was altered, some keys being highlighted. After a visit to the stand about data ciphering, where visitors can learn about the Cæsar cipher, they manage to find a meaningful word from the highlighted letters of the altered keyboard. How are the visitors helped? Words written in bold in the log book are used to attract their attention to guide them towards the riddle they have to work on or the stand they should visit to make progress. Another riddle is a drawing of a strange circle cut in six parts, with digits from 1 to 6 placed on these parts. Visitors have to find a number from this drawing, and must visit the algorithm stand to understand how to solve the riddle.



**Fig. 1.** A turntable is used during the fair to teach visitors the notion of algorithm and understand how a computer can sort numbers with the bubble sort algorithm.

### 2.2 Activity

What kind of activities are proposed? They are similar to CS Unplugged pen and paper activities to involve learners and to interactives from the Computer Science Field Guide to allow learners to experiment with the problem to solve. For example, visitors can understand the bubble sort algorithm thanks to a strange turntable with digits, shown on Figure 1. They have to follow instructions on a flowchart to manipulate it, and observe that the digits get sorted in ascending order. They can then make the link with the riddle with the drawing of a strange circle and understand that the number to guess is the number of loop iterations.

### 3 Conclusion

The escape game of the CSDay attracted more visitors to the event and to the activities organised during the fair. Visitors were happy and, in particular, the goal (a) to make them go through all the stands to learn CS concepts, (b) to be interested and involved in their learning by practicing and experimenting directly, (c) and to have a good time with a fun activity was clearly achieved. No formal survey about the game has been conducted yet, but informal feedbacks from the attendees show that the three objectives have been met. Some children refused to leave the fair until they solved all the riddles. Some participants to other events that took place during the fair told us that the escape game was an excellent idea to spend time between the other events.

Some drawbacks have also been observed. The level of difficulty of the escape game was not adapted to all the accepted age groups. A more guided path in the game should have been proposed for younger children. Also, the pedagogical device requires a lot of human resources the day of the fair. The team of the 2019 edition had 10 full-time people for the whole day, which was not enough.

To conclude, this first edition of the fair with an escape game, which managed to attract more than 34 persons and make them busy for a whole day learning CS concepts, was a big success. The combination of activities without computers, mixing the philosophies of the CS Unplugged and the Computer Science Field Guide activities with an escape game, fostered the learning of CS concepts thanks to the gamification process. Future improvements should include a multi-path story to better accommodate the different age groups and the design of new riddles and activities for uncovered CS concepts.

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