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# 08 **Solving educational escape room games:** Group strategies and talk about educational content

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ABSTRACT

Escape rooms are a popular genre of physical games that have recently entered educational contexts. In these games, groups of players work together to complete a mission and/or escape from a particular situation. Despite their growing popularity, there is still limited research on the learning processes that occur within this environment. This study explores the learning experiences of participants in an educational escape game by examining the strategies adopted by different groups of players and the extent to which they discuss the educational content during gameplay. An educational science escape room was played by 24 MSc students at a UK university. The students were divided into groups, and each group was video recorded during the gameplay. The recordings were analysed to identify the strategies used by each group and to quantify the amount of science-related talk that occurred while solving the puzzles. Five types of strategies were identified: seeking, individual leadership, doing, collaborating, and working without a clear strategy. Analysis of the video data also revealed how much time was spent discussing the scientific content. Overall, none of the groups engaged extensively in science-related discussion. The "doing" strategy led to the fastest puzzle completion, whereas collaboration produced the most science talk. The paper concludes by discussing the implications of these findings and suggesting future directions for research on educational escape rooms.

KEYWORDS

Escape room, game-based learning, informal science education

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## 1. Introduction

1 Escape rooms are games in which players solve a number of puzzles to succeed in a mission and/or escape a situation (Nicholson, 2015). The escape room is an immersive experience which is played in groups and is a combination of luck (the group needs to find different items) and brain (the group needs to collaborate to solve intellectually challenging puzzles). A successful escape room game fosters a feeling of fun and accomplishment (Vidergor, 2021). Following a surge in popularity of recreational (aka 'commercial') escape games, the genre has made its way into a variety of educational settings with the aim of introducing specific knowledge, content related skills, general skills or fostering affective outcomes (Veldkamp et al., 2020) which are achieved by successful teamwork, communication and delegation (Peleg et al., 2019; Nicholson, 2015). Yet the assertions made in the literature often have little or no empirical evidence since many academic reports on educational science escape games were driven by practice rather than research; thus, little is known about the theoretical underpinning of the experience (Veldkamp et al., 2020).

2 In this paper we take a deeper look at the game experience in an educational escape game in order to try and provide empirical evidence for assertions in the literature. Specifically, we ask (i) what strategies are adopted by different groups in an educational science escape game, (ii) to what extent do groups talk about the educational content of science during the game, (iii) do different puzzles effect the solving strategies and the science talk?

## 2. Literature Review

3 Escape games have been utilized for various educational purposes, such as recruiting students and helping them become familiar with institutional services. Researchers also used educational escape rooms to observe participants behaviour, learning processes in teams, and the use of teamwork and leadership skills (Veldkamp et al., 2020). Escape rooms have been designed to foster domain-specific skills and knowledge in a variety of fields like nursing, medicine, pharmacy, physiotherapy, chemistry, physics, computer science, mathematics, history, and English, as well as to support the development of generic skills (Veldkamp et al., 2020). Yet, most escape games in the literature were primarily driven by educators who adapted recreational escape rooms into their teaching (Veldkamp et al., 2020). As a result, there is limited research on their theoretical foundation in educational literature. One outlier is Yachin and Barak's (2024) study that applied situated learning theory to analyze the experiences of teachers and game

design experts. They identified four situated learning components: authentic situations, scientific contents, collaborative learning, and self-reflection.

4 To base our study, we resort to theories of Game-Based Learning (GBL) as a starting point. GBL is an instructional approach that incorporates games or game elements to enhance knowledge, skills or attitudes whilst making use of unique affordances of games (Cantoia et al., 2023; Plass et al., 2020). It is sometimes used synonymously with other terms such as games for learning, serious games and educational games (Johnson et al., 2017). Game-based learning is not a learning theory by itself, but is rather a complex learning environment or an instructional approach that can be explained and researched by different learning theories (Plass et al., 2015). Plass et al. (2015, 2020) suggest four theoretical foundations for studying game-based learning, namely: motivational foundations, cognitive foundations, affective foundations and socio-cultural foundations. In this framework our research falls under the latter which Plass et al. (2015) describe as "Theories describing social and cultural aspects of learning" (p.14). We are interested in understanding the socio-cultural processes that occur during game play of an educational escape game and how these interact with learning.

5 In this research, we aim to explore the game experience by examining the strategies adopted by players, the extent to which they engage in discussions about the educational content of the game (science), and the impact of different puzzles on both the solving strategies and the nature of the science-related discussions. The research should help the many practitioners who are designing and using educational escape games build on a stronger theoretical foundation, and researchers who would like to explore the learning outcomes of this approach. Also, it is worth noting that most GBL research has been conducted on digital games (Plass et al., 2015). Our research which focuses on a physical game can help guide future research on physical educational games.

## 3. Methods

### 3.1. Context

6 "Con-science escape" is an educational science escape room game consisting of six scientific puzzles (Figure 1), designed to demonstrate the principles of educational escape rooms (including intellectually challenging puzzles linked with content knowledge, an environment that fosters teamwork and communication, and a sense of accomplishment upon completion). It is played by a whole classroom who are divided into four groups (each identified by a colour). The puzzles focus on chemistry (5 puzzles)

and biology (1 puzzle). Four puzzles require hands-on lab activity with equipment and chemicals, and two are based on thinking with no hands-on lab work required (Peleg et al., 2019). None of the puzzles requires previous scientific knowledge.

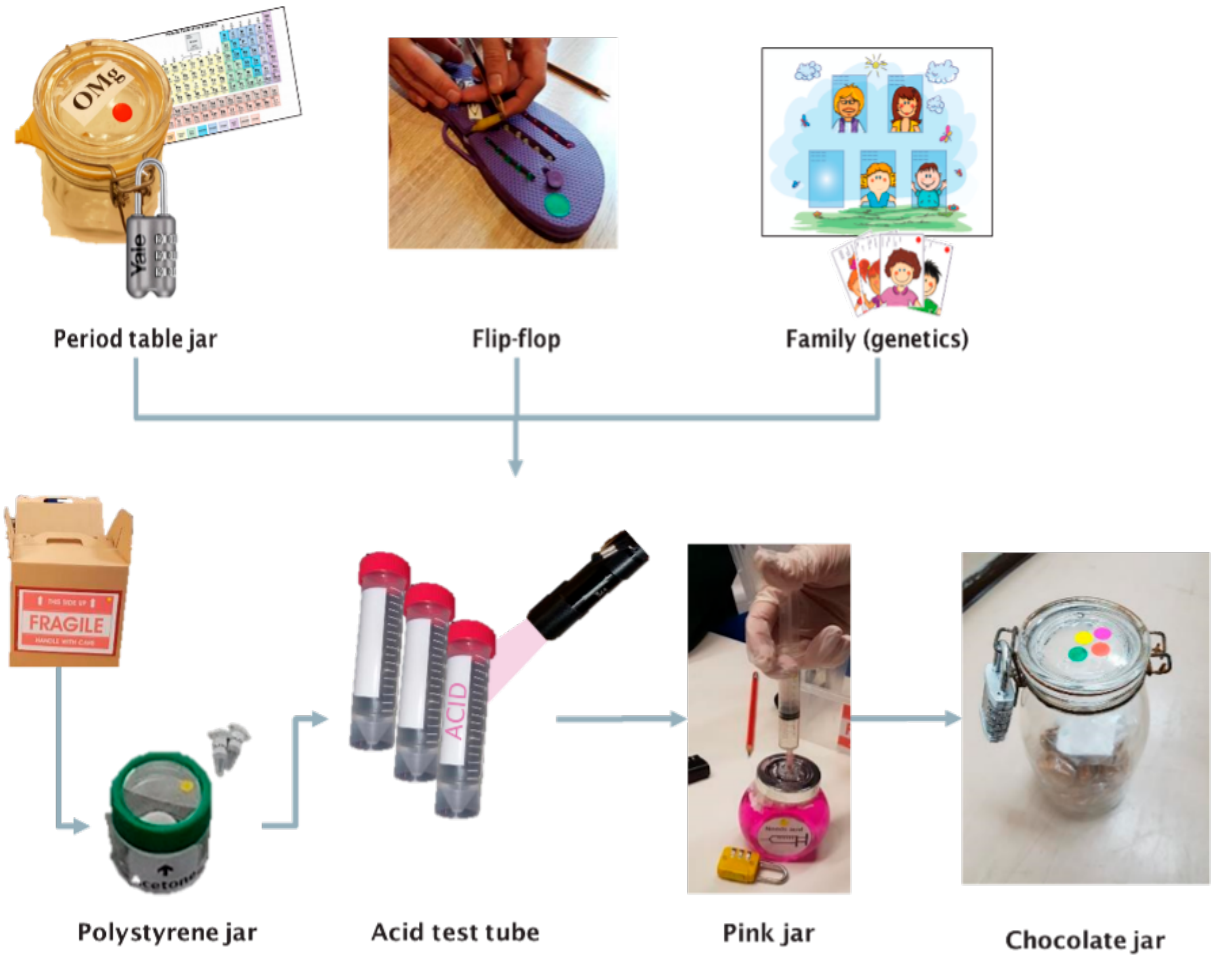


**Figure 1.** Con-Science Escape puzzles

7 When participants enter the room, they see very little apart from regular classroom tables. All materials are hidden and need to be discovered. The background story told to participants at the beginning of the activities is that the lecturers/teachers brought a jar of chocolates, but some devious mastermind decided to lock the jar and make it accessible only if the four groups successfully solve all puzzles. The jar was sealed with four locks, marked by each group's colour, indicating that each group needed to open one lock.

### 3.2. Participants and settings

8 Twenty-four MSc students participated in the escape room game as part of a course activity in a university in the UK. We ran the escape room in two consecutive academic years (14 students in the first year, 10 students in the second year). Participants were randomly divided into four groups comprising 3-4 members in a group.

### 3.3. Data collection

9 The groups were video recorded by fixed cameras positioned near their working table (each group was recorded using separate cameras). Willing participants signed consent forms following the university's ethical guidelines. Groups solved the escape room within 20 to 23 minutes. There were 7 video recordings of approximately 23 minutes in length in our dataset.

### 3.4. Data analysis

10 Data were analysed directly from the video in the following steps: First, we watched each video to write memos to describe the chain of events, making comments on the way each group worked together. In the second step, we generated themes that describe the strategies groups used, while extracting quotes and actions to support each theme. In the third step, we defined "science talk" as talk that focuses on the educational content of science in the escape game. We operationalized the definition and in the final step we re-watched the videos, measuring the science talk in each group (Glaser & Strauss, 2017). Examples of what we identified as 'strategies' and 'science talk' are given in the findings.

## 4. Findings

### 4.1. Strategies in solving an educational escape room game

11 Our analysis showed that participants in the groups utilized a variety of strategies to solve the puzzles. Although there are several ways to approach each task, it seemed that all but one group "chose" a strategy and stuck with it throughout the game. The strategies we identified were seeking, individual leader, doing and collaborating, doing, and collaborating. One group did not seem to have a clear strategy, leaving them baffled in face of the puzzles (see Table 1).

12 Seeking. As described above, the groups needed to reveal the different materials hidden in the room to solve the puzzles, naturally, each group started the task by seeking those elements. However, most groups have discovered some elements and started solving the puzzles, while others just continued seeking (for example, the blue group). This strategy of *seeking* usually caused a delay in the actual solving tasks, resulting with them finishing last only by relying on answers from other groups.

13 Individual leader. A group with one obvious leader. In our case, the leader of the purple group sat down (while others were standing), ordering the other group members around, instructing them what to do. The leader also explained different procedures that needed to be done and provided their rationale for solving. Other groups did not have a defined leader, and each member contributed to solving the puzzles.

14 Doing. A strategy relying on trying to simply solve the puzzles with no previous discussion between group members. For example, with very minimal verbal communication, the members of the yellow group collected the materials, trying out different ways to solve with no elaborate explanations. In the genetic puzzle one member matched each of the four figures without even taking the instructions out of the envelope, resulting in four different number combinations, which he just tried out. This pragmatic approach seemed to work, since the yellow group were the first to unlock the jar.

15 Collaborating. The majority of the groups did work collaboratively, explaining what they were doing to each other and consulting each other whilst they were solving the puzzles. One group (red) worked together on all puzzles, moving from one to the other in a consecutive way (they did not solve puzzles in parallel). The pink group initially formed subgroups within the group, solving the puzzles in parallel and then joining to one group to continue in a linear way. Collaboration was not always successful, as shown by the green team, who worked together but overthought the puzzles and complicated things, making them slower in solving the puzzles.

16 Lack of strategy. One team (orange) did not have a clear strategy, showing absence of strategy which caused them to stand around the materials, baffled, not really knowing how to proceed. They received assistance from other groups to help them move forward.

### 4.2. Talk about the educational content of science in the game

17 Besides the solving strategy used by the groups, we also measured the amount of time science was mentioned explicitly during the game. The strength of our data collection

method (recorded observations) was that it relied on what actually happened and not what participants remembered happening (in an interview for example). The shortcoming was the inability to determine what participants were thinking about, but only capturing their verbal communication and actions. Having the activity recorded enabled us to count the exact time of science talk. We defined science talk as an utterance that was either directed to the group, to a specific member or to oneself, that included a science concept that was not simply reading what was on the labels of the puzzles, for example, "You need the right chemical to dissolve", or an explanation of it, for example, "So blue eyes and blue eyes, dominant, so the child will have blue eyes". Explanation about the logistics of solving the puzzles did not count as science talk.

18 As Table 1 shows, the amount of science talk was scarce in this activity for all groups. From our sample, the 'Collaborators' (Red, Green & Pink groups) showed the most science talk, both in the number of instance and in the duration of the talk. As mentioned, the groups that did engage with science talk were not necessarily the group that finished the game first. In addition, we looked whether any specific puzzle elicited more science talk than others. Findings showed that no specific puzzle elicited more science talk than others.

**Table 1.** Group strategy and details of science talk for each group.

| Group | Blue | Red | Green | Yellow | Pink | Purple | Orange |
|---|---|---|---|---|---|---|---|
| Main observed strategy | Seekers | Collaborators | Collaborators | Doers | Collaborators | Leader | Lack of strategy |
| # Instances of science talk | 4 | 9 | 11 | 4 | 7 | 5 | 1 |
| Total duration | 26sec | 1min 55sec | 1min 57 sec | 27sec | 1min 15sec | 33sec | 5sec |

## 5. Discussion

19 In this study we took a deeper look at an educational escape room experience to better understand the participants' learning experience. We identified several strategies which the groups of players adopted to solve the escape room games backing the supposition of Nicholson (2015) that each group chooses their own strategy. In terms of finishing the game first, the most successful strategy was 'doing' (Yellow group). Since normally escape rooms are time-limited, this is often presented as the main indicator of success. However, if success is measured by collaboration or the amount of talk about the educational content of science, it was the collaborators (Red, Pink and Green) who were most successful.

20 The tension of defining success in educational games stems from the very nature of educational games themselves: should they be more entertaining or educational? The literature demonstrates a variety of views on the balance between the ludic elements and the knowledge or skills to be learnt (Ravyse et al., 2017): ranging from "pedagogy should be subordinate to story and entertainment" (p. 32) to "educating the player should be the primary goal of serious games" (p. 32). The definition of success depends directly on the pedagogical stance chosen. This raises an interesting question for future research on game-based learning: how does each type of success influence other learning outcomes, such as cognitive learning, critical thinking and soft skills? Our data, for example, suggests that time constraint can unintentionally hinder collaboration and discussion which could be and lead to valuable learning outcomes. Further research might also focus on the design of specific elements (such as the background story, how puzzles are hidden in the room or the extent to which puzzles foster collaboration) and investigate how and whether the design room influences group strategy.

21 All groups exhibited very limited talk about the educational content of science. It is important to note that this does not mean that participants did not think about the educational content. They could have undergone internal processes of thinking, understanding and meaning making. Future research could look at the embodied interactions and sense making (Shaby & Vedder-Weiss, 2021) to try to understand internal processes, with combination of interviews as supplementary data collection method.

22 As educational escape room games are a new field of research, there are not many studies examining the learning processes of this educational activity. In our view, this type of game-based learning integrates the motivational aspects of games with educational content, making it a promising educational activity that promotes various skills and scientific sense-making. The significance of this research lies in its potential to enhance our understanding of how different groups approach problem-solving and collaboration within an educational escape room game.

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