

EXPLORING PARTICIPANTS' PERCEPTIONS OF A PHYSICAL EDUCATIONAL ESCAPE ROOM FOR CLIMATE CRISIS AWARENESS

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Abstract

Educational escape rooms represent an increasingly visible approach to active and collaborative learning, offering opportunities to connect subject content with problem solving, communication, and learner engagement. Within the Erasmus+ project *EcoMystery: Climate Crisis Awareness and Civic Engagement in School Education*, we designed a physical educational escape room aimed at supporting climate crisis awareness in the context of school education. This paper presents the testing of our developed escape room with participants who experienced the activity and reflected on its educational value. The study explored three main areas: participants' perceptions of the escape room as a learning experience, the knowledge they reported gaining from its content, and their views on its potential usability in teaching practice. The research was designed as a qualitative study combining multiple sources of data to capture both participants' immediate responses and broader reflections on the activity. The data were collected through observation of the participants during the escape room activity, as well as through questionnaires and interviews conducted afterwards. The gathered data were analysed using thematic analysis, which made it possible to identify recurring themes related to engagement, perceived learning, and pedagogical applicability. The study aims to explore how participants perceive the escape room as an educational tool for active learning about climate crisis-related topics. Attention is paid to its interactive, collaborative, and immersive character, as well as to its perceived potential for fostering discussion, awareness, and motivation in school settings. At the same time, the findings could provide insights into how participants understood the educational contribution of the escape room and what conditions they considered important for its effective classroom use. The study contributes to current research on educational escape rooms by offering empirical evidence from the testing of a physical climate-themed escape room. These findings also support the importance of the integration of active learning methods into teacher education, which is one of the key areas addressed in our KEGA project *Innovative Learning Technologies in the Preparation of Future Mathematics Teachers*.

Keywords: Educational escape room, climate crisis, game-based learning, active learning, problem solving.

1 INTRODUCTION

Educational escape rooms have become an increasingly used form of game-based and active learning. Originally inspired by recreational escape rooms, they are usually understood as team-based activities in which participants search for clues, solve puzzles, and complete tasks to achieve a specific goal within a limited time [1]. When adapted for educational purposes, escape rooms are not designed only as entertaining games, but as learning environments in which puzzles, clues, narrative elements, and collaboration relate to specific educational objectives [2]. In this sense, educational escape rooms can be seen as structured problem-solving scenarios that support learners' engagement, communication, teamwork, and active participation. This makes them relevant to the focus of our KEGA project 037UK-4/2024, *Innovative Learning Technologies in the Preparation of Future Mathematics Teachers*, which examines the use of innovative active learning technologies in teacher preparation.

Previous research has shown that educational escape rooms may provide an enjoyable and motivating learning experience. Their potential is often associated with collaboration, problem solving, critical thinking, creativity, and communication, which are frequently discussed as important skills for effective learning [3], [4]. From a pedagogical perspective, escape rooms can relate to social constructivist views of learning, because learners construct understanding through interaction with peers, materials, and challenges situated in a meaningful activity. The game structure also supports experiential learning, as participants are not only recipients of information, but active solvers of tasks who must interpret clues, make decisions, test ideas, and negotiate possible solutions within a team.

In our previous studies, we explored several forms of educational escape rooms in teacher education and in the lifelong learning of mathematics teachers. These studies showed that both pre-service and in-service teachers perceived escape rooms as engaging educational tools with potential for developing problem-solving and collaboration skills. Digital escape rooms, for example those created in Google Forms or Room Escape Maker, were often perceived as practical for classroom use because they are easier to organize, can be used with larger groups, and are not dependent on a specific physical space [5]. At the same time, physical escape rooms were perceived as more immersive and authentic. Participants valued the opportunity to be physically present in the room, manipulate real objects, communicate directly with other team members, and experience the atmosphere of being “inside” the activity [6].

This distinction between digital and physical formats is important for the present study. While digital escape rooms offer clear organizational advantages, physical escape rooms may create stronger embodied and social experiences. Their value lies in the direct interaction with physical materials, the shared exploration of space, and the need for real-time coordination within a group. However, these advantages also bring challenges, particularly in terms of preparation, space, time, and classroom management. For this reason, it is important to study not only whether participants enjoy physical educational escape rooms, but also how they perceive their educational value, what strengths and weaknesses they identify, and under what conditions they consider such activities usable in school practice.

The present paper focuses on a physical educational escape room designed within the Erasmus+ project *EcoMystery: Interactive Escape Rooms for Climate Crisis Awareness and Civic Engagement in School Education*. The project aims to support climate education through interactive, collaborative, and problem-based escape-room activities. Its objectives include strengthening teachers' capacity to deliver climate-focused lessons through escape-room-based pedagogy and motivating students to search for solutions related to climate crisis mitigation and adaptation [7]. In this broader context, escape rooms are used not only as a motivational teaching method, but also to connect climate-related knowledge with active participation, civic engagement, and problem solving.

The escape room explored in this study, titled “Underwater World”, focuses on threats currently faced by seas and oceans. It was designed as a physical classroom-based escape room that can be implemented using relatively simple materials such as posters, boxes, locks, hidden clues, and manipulable objects. During the activity, participants encounter tasks related to ocean pollution, climate change impacts on marine ecosystems, ocean acidification, salinity, and the vulnerability of marine animals. The aim of the design was to create an accessible example of a climate-themed educational escape room that could be used not only as a learning activity, but also as an illustrative model for teachers interested in developing similar activities.

The aim of this paper is to explore how participants perceived this physical educational escape room as a learning experience. More specifically, the study focuses on participants' engagement during the activity, their reflections on the educational value of the escape room, and their views on its potential use in teaching practice. By analysing observations and questionnaire responses the paper contributes to the growing discussion on the use of educational escape rooms as tools for active learning, climate crisis awareness, and teacher development.

2 METHODOLOGY

2.1 Context and Study Design

Within the Erasmus+ project *EcoMystery: Climate Crisis Awareness and Civic Engagement in School Education*, we designed a physical educational escape room aimed at supporting climate crisis awareness in the context of school education. In the presented research, we focus on exploring how this escape room was perceived by the participants who took part in solving it. We were interested in how they evaluated the escape room overall, how they perceived its strengths and weaknesses, and what views they had on its pedagogical potential and possible use in education.

We conducted the research as a qualitative study aimed at capturing participants' experiences with solving our educational escape room. The participants solved the escape room in groups of two to five members. In total, 21 participants took part in the testing, divided into five groups. The first group consisted of two colleagues and two students from our faculty, while the second group consisted of two colleagues. The remaining three groups consisted of teachers who participated in a workshop focused

on designing educational escape rooms with a climate crisis theme. This workshop was also part of the above-mentioned project. Each of these three groups consisted of five participants.

Data were collected through observations of participants during the escape room activity, as well as through questionnaires and semi-structured interviews conducted after the activity. The observations focused mainly on the process of collaboration within groups, the ways in which participants solved the tasks, communication among participants, and their immediate reactions to individual parts of the escape room. The questionnaires and interviews focused on participants' reflections on their experience, their perceptions of the educational value of the activity, the identified strengths and weaknesses of the escape room, and its possible use in school practice. All collected data were analysed qualitatively.

2.2 Description of the Underwater World Escape Room

As this escape room was also used during the workshop focused on designing educational escape rooms for teaching, mentioned in Section 2.1, we aimed to create a model example of a simple escape room that could be implemented in an ordinary classroom. For this reason, the room mainly used posters, which teachers can temporarily place in any classroom, and boxes that can be easily brought into the room. We designed the escape room to be solvable within 45 minutes, corresponding to one lesson. For the full game experience, it should be solved in smaller groups of 2–5 players.

We focused on the theme of the underwater world. In our escape room, players are introduced to the threats currently faced by seas and oceans. The escape room consists of six tasks in total. When entering the room, players are introduced to the storyline by being told that the ocean is facing various threats, and that their task is to uncover and explore these threats in order to prevent its destruction.



Figure 1. Room layout

At the start of the game, players can work on two different tasks. One of them is a task in which players identify the name of the project they have just joined. This is a visual puzzle in which a letter code has to be read from the correct position in the room. Players may find it easier to solve by using the diving goggles and taking a seat near the door next to the diver illustration. This action is also suggested by a poster with the text *Our oceans are drowning*, which playfully incorporates a reference to the current

situation of the oceans. The obtained letter code is used to open one of the three locks placed on a large box.

The second task that can be solved at the beginning uses an information poster with short texts about the consequences of the climate crisis for the oceans. The texts present real facts about the amount of heat absorbed by the ocean, the amount of plastic waste in the oceans, and the rate of sea-level rise. In the texts, numerical data are written in words. The players' task is to identify these numbers and use them to obtain a numerical code needed to open the lock on the box placed below the poster.

After opening this box, the players find a poster with short story-based riddles, a puzzle showing various marine animals, and a UV flashlight. Each riddle on the poster indirectly describes a specific marine animal through its way of life and the problems it faces in the ocean as a result of the climate crisis. The participants' task is to correctly identify the individual animals and then find them in the puzzle. Numbers are hidden on the pictures of the animals using a UV pen and are visible only under UV light. After correctly matching the numbers to the individual riddles, the players obtain a numerical code needed to open the next two locks placed on the large box.



Figure 2. The first two groups solving the tasks. On the left, the second group is working on the task with riddles and the puzzle; on the right, the first group is working on the waste-related task.

After opening the large box, the players find a fishing rod. In the room, there is a container with water containing various objects that represent typical types of ocean waste, specifically a plastic bottle, a plastic bag, a fishing net, and a can. Using the fishing rod they have found, the players gradually “fish” these objects out of the water. They then arrange the collected waste according to its level of harmfulness, from the most risky to the least risky. A poster placed above the water container can help them determine the correct order. Each piece of waste has a number on it, and by arranging the waste correctly, the players obtain a sequence of numbers that forms the numerical code needed to open the next lock. This lock opens the door to the next room.

In this room, the players first solve a task focused on the issue of ocean acidification. They have three containers with liquids, indicator strips for measuring pH, a comparison colour scale, and an information poster explaining the relationship between the increasing amount of carbon dioxide in the atmosphere and the decrease in ocean pH. Based on the pH measurements and the information on the poster, the players have to assign each liquid to the environment it represents. After correctly matching the samples

to the individual types of environments, the players obtain a numerical code that is used to open the lock on the box.

In this box, the players find cards with four marine animals. Each card contains short clues about the environment in which the animal lives and about the salinity it can tolerate or prefers. The task focuses on working with a map of ocean salinity and on understanding that marine animals are not equally adapted to all conditions of the aquatic environment. On the wall in the room, there is a world map on which different ocean areas are colour-coded according to salinity values. The map also includes a legend explaining what level of water salinity each colour represents. Based on the clues on the cards, the players have to correctly assign the animals to suitable areas on the map. After solving the task, they obtain a numerical code that opens the final lock. Inside the box, they find a thematic diploma confirming the completion of the mission and symbolically recognising their role in saving the underwater world.

3 RESULTS

3.1 Results from observations

All five groups worked on the escape room with a high level of engagement. In each group, all participants were actively involved in the solving process and communicated with one another throughout the activity. Well-functioning collaboration could therefore be observed, particularly in the form of shared reasoning when solving individual tasks. When someone in the room noticed a particular object or clue, they shared their discovery with the whole group. The participants then jointly formulated possible explanations and tested them by manipulating the materials. Each group member contributed their own ideas to the solving process, while the others considered and further developed them. In situations where the nature of the task required it, participants spontaneously divided subtasks among themselves.

Although all groups enjoyed solving the escape room and were actively involved in the activity, differences could be observed in the strategies they used and in how far they progressed within the 45-minute time limit. Only the first two groups, which consisted of teachers and students from our faculty, managed to complete the entire escape room. Their solving process was smooth, and they did not remain stuck on any of the individual tasks for a longer period of time.

However, differences in solving strategies also appeared between these first two groups. This was particularly evident in the task with riddles and a puzzle. The first group approached the task by dividing into two pairs. One pair focused on solving the riddles, while the other worked on assembling the puzzle. After they had assembled all the marine animals, they concluded that it was not necessary to continue completing the rest of the puzzle. In this way, they avoided spending time on the parts showing the sea, which would have been the most time-consuming. After a joint discussion, they were able to match the animals found in the puzzle to the individual riddles, but for a while they did not know how to obtain a numerical code from this matching. At this point, we provided them with a small hint, which guided them towards using another object found in the box. They then realised that they needed to use the UV flashlight and completed the task.

The second group, which consisted of only two members, chose a different approach. At the very beginning, they shone the UV flashlight on the puzzle and noticed that some parts contained hidden symbols or numbers. One member then read the riddles while the other assembled the puzzle, and they discussed the possible solutions together. Gradually, they deduced that only the puzzle pieces showing marine animals were important for obtaining the code. They therefore focused directly on assembling these parts, continuously checking the completed sections with the UV flashlight. Once they had identified the number on a particular animal, they moved on to assembling the next one. This approach allowed them to solve the task relatively quickly and efficiently.

The final group also consisted of practising teachers; however, one of its members had extensive prior experience with solving escape rooms. This group chose an unexpected approach that significantly changed the intended course of the activity. After entering the room, the participants immediately noticed the container with water and waste, lay down next to it, and gradually read the numbers placed on the individual waste items. Using the poster above the container, they then arranged the waste according

to the level of pollution, created the numerical code, and moved directly to the second part of the room. In this way, they completely skipped the first three tasks. As a result, they completed the room much faster than we had originally expected. After receiving the diplomas, they expressed satisfaction with completing the activity, but also noted that they would have appreciated a longer game with more tasks. Only afterwards did we explain to them that their solution had bypassed a substantial part of the intended sequence. Although they would still have had enough time to solve the skipped tasks afterwards, we did not return them to these tasks, so as not to disrupt the natural flow and closure of their game experience.

The next two groups consisted of practising teachers who had less prior experience with solving escape rooms. In some tasks, they were unsure about how to proceed, needed more time to find a solution, and occasionally expressed doubts about whether they would be able to complete the task. Nevertheless, they remained willing to continue and showed determination to search for further clues. Both groups eventually managed to solve the first part of the room and open the door to the next part. However, as the workshop programme did not allow enough time to continue with the entire activity, we ended the solving process in both cases after the door had been opened and awarded the groups thematic diplomas. Although the activity was more challenging for these teams, their reactions showed that they enjoyed it, perceived it as a positive experience, and were satisfied with how far they had progressed within the available time.

Overall, satisfaction prevailed across all groups, and the participants felt that the tasks in the game were meaningful and appropriately represented issues related to the underwater world.

3.2 Results from questionnaires

The questionnaire results complemented the observation data by providing insight into participants' own reflections on the educational value of the physical escape room. The questionnaire focused on participants' overall experience, engagement during the activity, clarity of the tasks, perceived suitability for learning, and suggestions for improvement. The questionnaire items were: 1) How do you rate your overall experience? 2) How engaging did you find the physical escape room activity? 3) How suitable was the escape room for learning? 4) Were the tasks clear and understandable for students? 5) What was the strongest aspect of the escape room? 6) What would you improve in the escape room activity? Although the number of respondents was limited, the answers provide useful qualitative insight into how participants perceived the activity as an educational tool.

The scaled responses show that participants perceived the escape room very positively. In the items focused on overall experience, engagement, and clarity of the tasks, almost all respondents selected the highest possible rating. This suggests that the activity was not only enjoyable, but also sufficiently understandable and engaging for participants. The high ratings indicate that the escape room format was able to maintain participants' attention while also providing a clear structure for solving the tasks. In this sense, the questionnaire results support the observation findings, where participants were actively involved, communicated with each other, and followed the sequence of tasks with visible interest.

A similarly positive tendency appeared in the item focused on the suitability of the escape room for learning. Most participants rated this aspect with the highest score, while only a small number selected slightly lower ratings. This indicates that respondents did not perceive the escape room merely as a game or entertaining activity, but also as a meaningful educational method. The results suggest that the combination of puzzle solving, physical interaction with clues, and collaborative work was seen as suitable for supporting learning, especially when the activity is adapted to the learners' age and prior knowledge.

As shown in Figure 1, the responses to the item concerning the suitability of the escape room for learning were strongly positive (1 = not suitable, 5 = very suitable). Most respondents selected the highest rating, which confirms that the activity was perceived as appropriate for educational purposes.

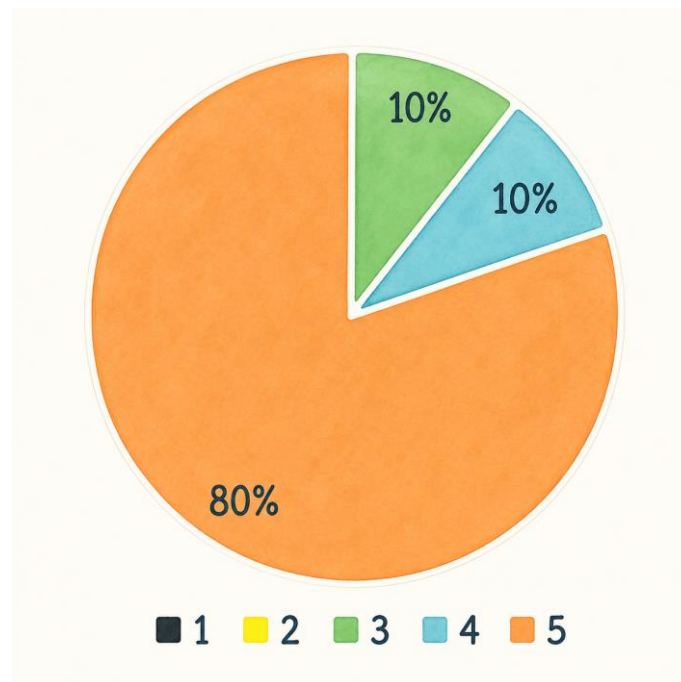


Figure 3. Participants' evaluation of the suitability of the escape room for learning

The open-ended responses further explain why participants evaluated the escape room positively. One of the most frequently mentioned strengths was the collaborative character of the activity. Participants appreciated the opportunity to work together, communicate, and solve problems as a group. This was expressed, for example, in comments such as *"collaborative work to solve problems"*, *"collaboration and surprise"*, and *"work in a group"*. These responses correspond with the observation data, where cooperation and shared problem solving were also visible during the activity.

Another important aspect was the playful and engaging nature of the escape room. Several participants described the activity as enjoyable, surprising, or innovative. One respondent characterised it as *"engaging, really fun"*, while another highlighted *"the surprise and innovative task"*. The element of anticipation also appeared in the answers, as one participant stated that the strongest aspect was *"the anticipation of what comes next"*. These comments suggest that the escape room format supported curiosity and motivation, which are important features of active learning environments.

Participants also appreciated specific game elements, especially those connected with searching for clues, codes, and locks. Responses such as *"finding the numbers"*, *"to find ordering of number code, that unlock door"*, and *"opening locks"* show that the physical and puzzle-based structure of the activity contributed to engagement. The use of hidden clues and unlocking mechanisms appears to have strengthened the immersive character of the escape room and supported participants' involvement in the learning process.

At the same time, the questionnaire responses also pointed to several areas for improvement. Some participants suggested that the activity could include more varied or more challenging tasks. One respondent noted that there could be *"more information in the activities"* and *"more difficult activities"*. Another commented that the tasks were based on a similar principle, stating that *"the tasks were in the same style – opening locks"*. This suggests that, although the lock-based structure was engaging, greater diversity in task types could make the activity richer from both a game-based and educational perspective.

The questionnaire also shows that the educational value of the escape room depends on the participants' prior knowledge. One respondent wrote that the activity was connected to knowledge about marine animals, which they did not feel they had sufficiently. This indicates that the escape room should be carefully adapted to the target group's age, knowledge level, and previous learning experience. In the context of climate crisis education, this is especially relevant, as the topic should remain scientifically meaningful while still being accessible to learners.

Despite these suggestions for improvement, the overall findings show that participants perceived the escape room as a suitable and engaging educational tool. The responses indicate that the activity supported cooperation, problem solving, curiosity, and experiential learning. Participants valued both

the content and the format of the activity, especially its interactive and collaborative character. The results therefore support the use of educational escape rooms as a method for active learning about climate crisis-related topics, provided that the activity is appropriately scaffolded and adapted to the classroom context.

4 CONCLUSIONS

The aim of this paper was to explore how participants perceived a physical educational escape room focused on climate crisis awareness and threats to the underwater world. The study focused on participants' engagement during the activity, their reflections on its educational value, and their views on its potential use in teaching practice.

The findings show that the physical escape room was perceived as a highly engaging and meaningful learning activity. During the observations, all groups showed a high level of involvement, active communication, and collaboration. Participants shared discoveries, discussed possible interpretations of clues, tested their ideas, and divided subtasks when needed. This indicates that the escape room format supported not only individual problem solving, but also collaborative reasoning and shared decision-making within groups.

At the same time, the observations revealed differences in how the groups approached the activity. These differences were related to the participants' prior experience with escape rooms, the strategies they chose, and the extent to which they were able to identify relevant clues. Some groups followed the intended sequence of tasks, while one group found an unexpected shortcut and bypassed several tasks. This finding is important from a design perspective, as it shows that physical educational escape rooms need to be tested with different types of participants. The availability of clues, the order of tasks, and the possibility of unintended shortcuts should be carefully considered, especially when the activity is intended for classroom use.

The questionnaire results confirmed the positive tendencies observed during the activity. Participants rated the escape room very positively in terms of overall experience, engagement, clarity of tasks, and suitability for learning. Their open-ended responses highlighted collaboration, surprise, curiosity, and the game-like structure as important strengths of the activity. Participants also appreciated the physical and interactive character of the escape room, especially the opportunity to search for clues, manipulate objects, solve puzzles, and unlock locks. These elements appear to have contributed to the immersive character of the activity and supported participants' motivation.

The results also suggest that the escape room was not perceived only as an entertaining game, but as a potentially valuable educational method. The combination of climate-related content, problem solving, physical interaction, and teamwork made it possible to connect environmental topics with active learning.

However, the study also points to several conditions that should be considered when using educational escape rooms in practice. Some participants indicated that they would appreciate more varied or more challenging tasks, while others needed more time or support during the activity. This suggests that scaffolding, clear task structure, and an appropriate balance between challenge and accessibility are essential for successful implementation.

The study has several limitations. The number of participants was relatively small, and the testing took place in a specific workshop and university context. Therefore, the findings cannot be generalised to all educational settings. Nevertheless, they provide useful insights into how a physical climate-themed escape room can function as an active learning environment and how participants respond to its collaborative and immersive elements.

Overall, the findings support the use of educational escape rooms as a promising method for active learning about climate crisis-related topics. Future work should focus on further testing the escape room with different groups of learners, refining the sequence of tasks, strengthening the connection between game mechanics and learning objectives, and exploring how such activities can be effectively integrated into school education.

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