



Escape rooms as tools for climate change education: an exploration of initiatives

Tania Ouariachi & Elving J. L. Wim

To cite this article: Tania Ouariachi & Elving J. L. Wim (2020): Escape rooms as tools for climate change education: an exploration of initiatives, Environmental Education Research

To link to this article: <https://doi.org/10.1080/13504622.2020.1753659>



Published online: 20 Apr 2020.



Submit your article to this journal [↗](#)



View related articles [↗](#)



View Crossmark data [↗](#)



Escape rooms as tools for climate change education: an exploration of initiatives

Tania Ouariachi  and Elving J. L. Wim

Professorship Communication, Behaviour & the Sustainable Society, Centre of Expertise Energy, Hanze University of Applied Sciences, Groningen, The Netherlands

ABSTRACT

In the last years we have observed a growing interest in the use of gamification approaches for climate change education. While most practices are related to digital gaming, there is a new trend which is still academically unexplored: escape rooms. The main objective of this paper is to serve as an initial exploratory study in this field by identifying and analysing climate change-related escape rooms. For that purpose we carried out a web search and a qualitative content analysis. A total of 17 initiatives are described and compared, unravelling their main audience, country of origin, topics, scenarios and objectives covered. The paper also highlights what escape rooms can offer to climate change education: experiential and immersive learning, problem solving and critical thinking skills, and a sense of collaboration and urgency.

ARTICLE HISTORY

Received 10 December 2019
Accepted 12 March 2020

KEYWORDS

Climate change education; gamification; games; innovation; escape room

Introduction

Education is a key factor of the global response to climate change (UNESCO 2019): it increases knowledge among young people, but it also enables informed decision-making, awareness, encourages changes in attitudes and behaviour to adopt sustainable lifestyles. However, how climate change issues have been addressed in classrooms does not match with the current communication paradigm of young people, the so-called interactive generation (Aguaded-Gómez 2011). Since the second half of the 20th century, the pedagogical model has drawn serious criticism because of its unidirectionality, based on communicative models that form a division between the transmitter and receiver of the information (Aparici and Silva 2012).

The literature suggests that future communication and education efforts should include the consideration of individuals within their socio-cultural contexts, and interactive learning (Cordero, Todd, and Abellera 2008; McKenzie-Mohr 2008). In addition, there is a need to add a critical approach to environmental education, opening up spaces for reflection and debates on possible alternatives for lifestyle changes (Cooper 2011; Michael and Savill-Smith 2004; Reid 2019). Climate change education that includes awareness, knowledge, skills, values and opportunities for participation can therefore bring about in-depth learning.

Perhaps as a reaction to an environment of increasing 'performativity' and 'instrumentalism' in education (Ball 2012), we have seen a growing interest in the use of gamification approaches in the last years. Some scholars maintain that having 'safe playful spaces' supports the idea of

learning from failure, managing risk-taking, fostering creativity and increasing the feeling of enjoyment from learning among students. While most practices have been related to digital gaming approaches (e.g. online serious games, virtual and augmented reality, digital game based learning), there is a new trend: escape rooms. They can be defined as: 'live-action team-based games where players discover clues, solve puzzles, and accomplish tasks in one or more rooms in order to accomplish a specific goal (usually escaping from the room) in a limited time' (Nicholson 2015). The application of (recreational) escape rooms to educational contexts has become more popular as a way to engage students in their learning environment, and encourage both hard skills and soft skills such as collaboration, communication and leadership (Kinio et al. 2019).

'We think of this escape room as not identical to reality but as a sort of microcosm. You need to do these things in order to reach this certain goal, and you need to do these things quickly because there's a time limit. That was what we liked about the escape room created for the classroom; it was going to communicate this sense of urgency and also that [change is] within people's reach' (Harvard student)

Having said that, the field of escape rooms for educational purposes is still quite unexplored and lacks a 'robust' foundation: there is little research related to the pedagogic rationale, game mechanisms, applicability, frameworks of implementation, and effectiveness (Whitton 2018). This lack of research is even more evident in relation to climate change issues. In addition, most research in the field of game based learning and gamification in education has been related to digital applications, further compounding what Clarke et al. (2017) calls 'pedagogical narrowness and digital divide'. The main objective of this paper is to serve as an initial exploratory study in this field. Concretely, the objective is to identify and analyse initiatives of climate change – related escape rooms that have been put in place: country of origin, type, objective, target, scenarios and topics covered. Before that, we are going to address the need to engage learners in climate change education, clarify the concept of escape rooms, their added value for education and their related learning theories, and we are going to present case studies found in the literature review that highlight different types and effects of escape rooms implemented in classrooms.

Climate change education: factors for effectiveness

Since climate change has become one of the most important global challenges, interest in how education about climate change is implemented has increased in recent years. In fact, studies have raised serious concerns on climate change education, often considered 'incomplete' and 'narrow-minded', lacking connection with the current communication paradigm of young people (Aguaded-Gómez 2011; Lehtonen and Cantell 2015).

Certainly, the complexity and uncertainty of the topic itself bring challenges to educators, who often recognize to have deficient and fragmented knowledge, as well as many misconceptions (Lombardi and Sinatra 2013; Ratinen 2016). In addition, the topic of climate change can resonate deeply with values, 'such that adults respond by protecting their group identity and way of life' (Monroe et al. 2019). In this context, there is a dilemma between those educators who defend that climate change education should be limited to conveying factual information about climate science, and those who defend building critical thinking and problem solving skills to help youth understand the issue and its sources of conflict, while encouraging them to take action. The latest group, which is gaining more support and empirical evidence among scholars and practitioners, also maintain that it is necessary to cover the issue from an ethical, humanistic and multidisciplinary perspective (social sciences, health sciences and politics).

Therefore, designing and implementing programs about climate change should balance different factors. One of the first efforts in developing a climate change education model was conducted by Palmer (1998). His so-called 'tree model' highlights three forms of education (leaves): education in or from environment, education about environment and education for environment.

A more recent model has been developed by Cantell et al. (2019): the 'bicycle model' is an holistic educational approach that emphasizes the importance of the following aspects: knowledge, thinking skills, values, identity, worldview, action, motivation, participation, future orientation, hope and other emotions, and operational barriers.

In an effort to review existing literature to describe effective teaching strategies about climate change in formal and non-formal settings, Monroe et al. (2019) has conducted a systematic review (959 unique citation records addressing climate change education were identified in EBSCOhost, and 49 sources met the criteria of focusing on assessment of climate change education interventions). The study highlights two effective strategies: (1) focusing on personally relevant and meaningful information and (2) using interactive and engaging teaching methods. Regarding the second strategy, interventions were described as using an experiential, inquiry-based, or constructivist approach, including gamification approaches such as role-plays and simulations that mimic reality.

What are escape rooms and what is their educational value

At their core, escape rooms are a relatively new entertainment and interactive format in which small groups of players work together within a given time limit to complete a series of challenges (puzzles) and win (escape a real life room); they are usually based around a specific theme and narrative, and they use this schema (Whitton 2018; Wiemker, Elumir, and Clare 2015):

1. A Challenge to overcome
2. A Solution (may be concealed)
3. A Reward for overcoming the challenge

Common puzzles are: decrypting messages, finding information in a text, reading a text in a mirror, revealing invisible messages by UV-light, searching for items in odd places, searching for objects in images, using something in an unusual way, combining parts together, triggering a magnetic lock, assembly of a physical object, counting, abstract logic, symbol substitution with a key, riddles or mazes (Nicholson 2015; Vörös and Sárközi 2017).

The first recreational escape room can be found in 2007, in Japan. Nowadays, there are around 5,000 around the world, spanning 75 countries. Over the last year, there has been a growing interest among educators, adapting the concept to fit the needs of their students in classrooms, in both physical and online learning environments. So, how can educational escape rooms benefit students? How can they create engagement in learning? Many educators understand that they need to engage their students by arousing intrigue and interaction, especially for complex topics such as climate change. After carrying out an initial literature review, the following positive attributes of educational escape rooms have been identified:

- **Experiential and immersive:** escape rooms are experiential at their core, requiring diverse skills to play. According to Wiemker, Elumir, and Clare (2015), while the first generation of escape rooms were centred around difficult logic puzzles, nowadays they have become fully immersive environments with 'high quality props and effects'.
- **Problem solving:** while digital games rely on hand-eye coordination because of the screens, and board games on strategy and luck, escape rooms are designed to use the mind and solve problems, which makes them a great match to the learning environment of the classroom (Nicholson 2018). Since they can be themed with almost any topic, they can also contribute to meet curriculum goals (Clarke et al. 2017).
- **Critical thinking:** escape rooms motivate players to think 'creatively, differently and unconventionally', engaging them in critical thinking since solving puzzles requires students to

make use of different approaches to knowledge (Whitton 2018; Wiemker, Elumir, and Clare 2015).

- Collaboration: escape rooms are team activities, and puzzles (connected to the theme of the room) are designed to such an extent that every student can contribute in a meaningful way, according to Wiemker, Elumir, and Clare (2015), who adds that a good escape room will incorporate various puzzles that appeal to different ways of thinking (e.g. of math, visual or word puzzles). In the context of an escape room, players learn fast how to 'acclimatize' themselves to the new environment and how to combine different skills with other players, establishing trust and communicating specific tasks in order to analyse and solve clues (Zhang et al. 2018). This shared environment sets the bases for active learning and social constructivism (Nicholson 2018).
- Sense of urgency: a time limit has the potential of creating a sense of urgency and risk that drives students to engage with the content and complete the challenges. In a way that a traditional activity structure may not. Other methods to create that feeling are actors, props and outside influences (Clarke et al. 2017; Nicholson 2018).

Students can also design their own escape room. In this case, other benefits can be added such as creativity. According to Nicholson (2018), learning by designing is a pedagogical construct based on project-based inquiry approach, 'exploiting the features of a design process that is non-linear, iterative and generative' (Nicholson 2018).

When compared to other popular gamification strategies in education such as the use of serious games, perhaps one of the main added values of escape rooms is the cooperation mechanism. Most climate change related serious games encourage individual skills development, so a greater use of cooperation mechanisms would be highly recommended to call for collective action and enhance efficacy, which is in line with the current paradigm in sustainable gamification research. Unlike screen-based games, 'live-action games' bring the players into face-to-face contact with each other and immerse directly into the game world, according to Nicholson (2018), who also argues that unlike other forms of games where the player controls an avatar, escape rooms place the player directly into the game, and because of that, the effects of experiential learning can be more effective as 'there are fewer barriers between the player and the experience'.

Theoretical perspectives on learning

The relevant learning theories related to escape rooms, Zhang et al. (2018) are behaviourism, social learning, and constructivism. With regards to behaviourism, 'positive' behaviour is reinforced by providing progression through the escape room process. Behaviourists maintain that learning is provided by a 'change in actions through an explorative process' and it exposes individuals to external stimuli until a desired response is received (Harzem 2004).

In relation to social learning, the authors suggest that learners imitate or perpetuate behaviours of successful puzzle solving and assimilate their previous knowledge and skills (i.e. pattern recognition, mathematical fluency, trivia knowledge) to help them process environmental clues; in addition, social learning theory believes that people learn from observing other people, and in escape rooms learning is also related to social relationships. According to Bandura (1977), most human behaviour is learned observationally through modelling: by observing others, people conceive ideas about how new behaviours are performed, and eventually, this coded information serves as a guide for action. As with other related theories, it stresses on the positive effect of observation, group workings and social interaction within this process.

Factors of constructivism are linked to the fact that learners construct their own knowledge based on real-time experiences of advancing through several challenges in the escape room.

Constructivism assumes that learning is a process of constructing knowledge rather than acquiring it and it takes into consideration that the learner constructs knowledge through experience. In other words, learners 'interpret new information through their contextual experiences and build on their existing knowledge from the conclusions reached during the assimilation of new knowledge and reflection on it' (Devries and Zan 2003).

According to Powell and Kalina (2009). There are two major types of constructivism in the classroom: cognitive or individual constructivism depending on Piaget's theory (1936), and social constructivism depending on Vygotsky's theory (1978). Social constructivism, formed after Piaget's theories on how the individual constructs knowledge, maintains that social interactions are an integral part of learning. In fact, according to Lehtonen, Salonen, and Cantell (2018), social constructivism has been considered the 'most trusted-ism' generally applied to Finnish schools, believing that constructivist thinking skills have been one of the key explanations for Finland's good Pisa results.

In relation to climate change education, Taber and Taylor (2009) research reveals that students learned best from hands-on activities related to constructivist approaches. In their study on effective climate change teaching methods they found a direct relationship between increased understanding of climate change and concern about the issue. However, constructivist teaching is not a magic bullet. Although there is a general consensus on the utility of these methods, some locally-based activities that teachers prepare (e.g. turning off lights) do not necessarily make connections to the global scale and bigger related issues (e.g. consumption), doubting therefore on its 'transformative' impact.

In order to increase the learning gains from constructivist interventions implemented in classrooms, the following criteria by Aebli (1983) could be considered: (1) start with students' prior knowledge, (2) untangle complex processes into successional steps, (3) reduce the content to focus only on key ideas necessary to learn the new mental model being presented, and (4) avoid technical terms.

Escape rooms implemented in classrooms: types and effects

In the literature we can find two main types of case studies for educational escape rooms implemented in classrooms. The first category corresponds to escape rooms that are designated by educators for students. Most of these studies are related to medical education. For instance, at University of Ottawa, faculty members designed a vascular surgery-themed escape room to improve medical students' motivation, satisfaction, and engagement in CanMEDS roles. They combined vascular surgery objectives, knowledge-based problems and technical skills and formed groups of 3 to 4 medical students. Results from a follow up study reveal that 83% of participants increased motivation and consolidated the knowledge that they had (Kinio et al. 2019). In another study, faculty members created an escape room focused on diabetes disease management. Students showed statistically significant increases in knowledge after completion of the game (Eukel, Frenzel, and Cernusca 2017). At University of Kentucky College of Pharmacy, Cotner et al. (2018) investigated the design and implementation of an escape room learning activity in a third-year pharmacy infectious diseases elective course.

Among science disciplines, physics has also received attention, not only in higher education but also in secondary education. Vörös and Sárközi (2017) describe a case study in which students participate in an educational escape game for physics of fluids (discipline that studies fluids, understood as a phase of matter, including liquids, gases and plasmas), as this topic is left out from the Romanian high-school curriculum. In this case, the format does not follow the traditional 'breakout' format (escape the room) but a 'break in' one: instead of a locked door, there is a multiple-locked box, that the teams have to open by finding the right codes of the locks, to reach the final goal of the game. From the evaluation, authors conclude that students preferred

this innovative didactic method over conventional pedagogies, and that even students with poor grades in physics had good results in the final quiz (Vörös and Sárközi 2017). Programming is another recurrent topic. Research carried out at Universidad Politecnica de Madrid reveals that an appropriate use of educational escape rooms can have significant positive impacts on student engagement and learning in programming courses compared to traditional computer laboratory sessions (López-Pernas et al. 2019).

Another interesting topic found in the literature is disaster preparedness. To educate college students at a university, an earthquake-themed escape room was designed and implemented as part of a campus wide preparedness event. Post-test results showed that a) earthquake reaction knowledge and knowledge of mitigation strategies were high, and that b) a majority of participants reported intentions of starting or updating an emergency kit. Not only are escape rooms designed to create, reinforce or test hard skills but also to address soft skills such as team building. At Thomas Jefferson University, emergency medicine residents participated in an escape room as part of a team-building exercise where they had to practise teamwork, communication, task delegation, and critical thinking to tackle complex puzzles, ranging from hidden objects, physical object assembly, and symbol matching. Activities required members to recognize and utilize the collective experiences, skills, knowledge base, and physical abilities of the group (Zhang et al. 2018). Escape rooms can also be useful to teach interdisciplinary subjects such as research methods (Clarke et al. 2017).

The second category corresponds to escape rooms that are designated by students for students, following a 'learning by designing' pedagogical approach. Whitton (2018) uses the term of 'EduScapes' when educational escape rooms emphasize iterative design and learning through failure. Under this approach, small teams (3–5) usually play a commercial escape room and take part in a short course on escape room design, then they work together to develop a 'professional-quality' escape room, following a process of design, creation and testing over a number of days or weeks. Finally, the room is implemented with a real audience at a live event.

Davis and Lee (2019) describe in their paper how first year engineering students design and build escape rooms containing puzzles using Arduino hardware, laser cut and CNC (computer numerical control) milled parts, and 3D printed models. Through producing the projects, students learn complex programming language and skills.

Therefore, all studies report an increase in knowledge, engagement, and to some extent, change in attitudes and intentions to change behaviour. It can also be observed that case studies address both hard and soft skills, and that there is a predominant focus on science and technical courses.

Climate change-related escape rooms

As a first approach to this topic, it is important to know what initiatives exist in relation to escape rooms and climate change topics, and whether they have been implemented in a classroom or not. To identify the initiatives, we conducted a web search through the main search engines, using the following search request: ('escape room') AND ('climate change' OR 'global warming' OR 'sustainability') in English until saturation was reached. To analyse the initiatives, two researchers were involved in doing a qualitative content analysis of these initiatives based on information provided by their organizers on their websites. The main aspects analysed are: type of escape room, country of origin, target group, topics covered, scenario and objective. In qualitative content analysis, the emphasis is on achieving consistency of interpretation by using at least two researchers (Neuendorf 2002). In our case, we shared a protocol with the criteria and marked the responses, which later were combined into a single one after discussions. In total, 17 initiatives were found. The following table provides a summary of findings (Table 1):

First of all, we observe four different types of initiatives. Two of them are educational escape rooms implemented in classrooms: escape rooms designed by educators or sustainability offices from universities for students, and escape rooms designed by students for students. The third type of climate related escape rooms are a one-day event escape room targeting the general public. These are often related with creating awareness on city plans. For instance, in New York (Governor's Island), the project called Sunken City wants visitors to work as a team to unravel clues and puzzles based on sustainable initiatives currently being implemented across the city. The escape room is set in a dystopian future New York City affected by climate change where teams solve puzzles about possible climate change solutions to prevent future calamity. The philosophy of organizers is to have a fun and impactful way of engaging people through a hands-on approach to highlight the importance of working together as a community to combat climate change. The escape room takes about 15 to 20 min, offering puzzles and clues that relate to the One NYC 2050/Green NYC initiatives and cover a range of sustainability options like solar energy, water filtration, composting and recycling.

The fourth type is a product to be sold online by a private company or an individual (e.g.a teacher), targeting the general public (e.g.corporate activity, leisure activity) or other educators so that they do not have to design an escape room by themselves and instead they can directly implement those puzzles and narratives in their classrooms. As an example, the *Escape Climate Change* (Germany) is sold on its website as an 'interactive game for schools that engages with the subject of climate protection in a fun and exciting way'. In this case, the format is a mobile game aimed at secondary school children aged 16 and above in which teenagers must work together to crack a final secret code to get their hands on what's inside a case. To achieve that, they will need to solve a series of puzzles and tasks, relying on instinct, teamwork, logic and web research, and using an app developed exclusively for the game. The game can be played without additional preparation or materials. Another initiative, the *Climate Change Escape Room Game*, sells teachers a game to educate children about deforestation and climate change, and the effects of global warming, especially for the beginning of a topic to introduce information or at the end to recap. This game focuses on students finding out facts and information and using these to solve puzzles such as answering to clues and decoding different ciphers by trying to 'help an alien' in about 45 min.

Launched in 2015, Breakout EDU is a recurring name in the educational escape rooms space. The company sells small boxes, priced \$89 to \$119, filled with escape tools (think padlocks, UV lights or hint cards), and an empty thumb drive for downloadable lesson plans, created to complement the curriculum, allowing teachers to access the large Breakout community of more than 8,700 members worldwide, and download custom escape games.

The second finding is that most escape rooms aim at increasing or retaining knowledge, as well as creating awareness on climate change mitigation (sustainable actions at the individual or municipality levels) and adaptation (impacts, resilience and adaptation measures). For instance, in *Sustainability Escape Room* organized by the Resource Efficiency Program at Harvard University (United States), the mission was to create awareness in order to increase sustainability lifestyles shifts:

'Because the mission of the Resource Efficiency Program is to encourage sustainable lifestyle shifts, all the tasks are centred around changes that students could make, specifically in a dorm-room-type set-up on campus. In the room, there were mini-refrigerators, wooden furniture, books, surge protectors, and, of course, a snarky roommate — played by Beverly Ge '20 — who every once in a while said something helpful' (member of sustainability office).

In order to build the escape room, members from the Resource Efficiency Program conducted consultancy meetings with cities and universities that had run sustainability-themed escape rooms in the past and connected with a local recreational one for advice on ensuring their narrative and ensuring the sense of urgency they were looking for. Below, some reflections on challenges encountered:



Table 1. Overview of climate change-related escape rooms.

Name	Type	Country	Target	Topic	Scenario	Objective
Sustainability Escape Room	Classroom activity (designed for students)	United States	University students (Harvard University)	Sustainability: recycling, waste management, energy waste	Stop sea level rise	Knowledge of sustainable lifestyle; call to action
Climate Change Escape room	Classroom activity (designed for students)	United States	University students (University California)	Ocean, Arctic and landfill	Undefined	Knowledge (test) of climate change; call to action
Refugee Escape Room	Classroom activity (designed for students)	Spain	University students (Autonomous University Barcelona)	Climate change and migration	Earth as uninhabitable place, extreme temperatures, desertification, lack of water. Limited sports for people	Awareness of barriers and realities of immigrants, refugees and asylum seekers
Sustainability Escape Room	Classroom activity (designed for students)	United States	University students (University of Virginia)	Sustainability	Undefined	Awareness and knowledge of sustainability
Climate Change Escape Room	Classroom activity (designed by students)	United States	University students (Texas)	Climate change and resilience to natural disasters	Researchers on an oceanic platform escaping a storm	Awareness and knowledge of resilience
Escape Room Competition	Classroom activity (designed by students)	United Kingdom	University students (Leicester)	Sustainability: 17 Sustainable Development Goals	Undefined	Knowledge of sustainability
Watershooed Impact Escape Room	Event	The Netherlands	General public: visitors, Social Impact Factory (Utrecht, Rotterdam)	Policy planning and implementation challenges	Stop sea level rise and global warming	Awareness of climate change impacts and our responsibility
Migration control room	Event	The Netherlands	General public: IHP-HWRP Committee, focus on students (Wageningen)	Climate change and migration	Response in hazard situations: lack of water, diseases	Awareness of climate change impacts (water on migration flows)
Sunken City	Event	United States	General public: visitors at Human Impacts Institute (Governor's Island)	Sustainability: solar energy, water infiltration, composting, recycling	Stop future calamity	Awareness of sustainable initiatives being implemented across the city
The Railcar	Event	United States	General public (Chicago)	Sustainability: recycling	The world had burned and people had to rebuild with what was around.	Convey environmental message in an artistic manner (recycle materials)
Escape 4 Change	Event	Italy	General public (Turin)	Climate change and migration	Find water and avoid global warming	Awareness of climate change impacts (resilient practices, adaptation)
The Climate Change Escape Room	Event	Finland	General public	Climate change, general	Undefined	Awareness of causes and consequences
Imagine2050 Escape Room	Event	Canada	General public (Mississauga)	Climate change impacts, actions to reduce impact (mitg-adapt)	Undefined	Awareness of climate change impacts, individual and city actions

(continued)

Table 1. Continued.

Name	Type	Country	Target	Topic	Scenario	Objective
Climate Change Escape Room Game	Product (by private teacher)	Global	Primary school students	Climate change impacts	Help an alien to understand climate change	Introduce topic in class or recap
Escape Climate Change	Product (by a private company)	Germany	High school students	Climate protection	Stop future calamity	Knowledge and engagement with the subject
Blue Mirror	Product (by private company)	The Netherlands	General public	Climate change impacts	Battle sea level rise before 2050	Awareness of climate change impact
Escape Fake	Product, project (award winning)	Austria	High school students	Fake news (augmented reality escape room)	Stop future calamity	Awareness and knowledge of fake news

'Having made the puzzles and designed the rules, we had no idea whether the level of difficulty was correct, how long it would take, and whether [the puzzles] were intuitive or not. The beta testing helped a lot with the small details of connecting the tasks in the room, but it also helped a lot with the broader framing. Those small refinements ensured participants would have fun but also learn something. It's all put in a way that will make me remember it. It will click for me next time, as opposed to just receiving just a flyer or a handout' (member of sustainability office).

Another interesting topic is fake news, although this initiative is not necessarily centred around climate change. In *Escape Fake* (Austria), developers co-design with school kids aged 14-18 an augmented reality escape room game. Activities include reading, checking facts, researching, and solving riddles. Interestingly enough, at least three initiatives identified in this study focus on creating awareness on the impact of climate change on migration flows, to make participants understand that the planet is becoming an uninhabitable place due to extreme temperatures, desertification and lack of water, which forces people to migrate to other countries. For instance, in *Migration Control Room* (The Netherlands), the issue of migration is associated with water problems:

'People often don't realise that in practice, migration is frequently a result of water problems and climate change. We are trying to use the escape room as a fun way to explain that if you solve water problems, you might be able to stop migration' (organiser).

Another example is *Refugee Escape Room* (Spain), an activity organized by a university that aims to explore the barriers and realities that immigrants, asylum-seekers and refugees live through during their migratory process. For that purpose, the following scenario is created: *'we find ourselves in 2084 and the Earth has become an uninhabitable place because of climate change, extreme temperatures, desertification and lack of water. Several families (organised in groups of 6 participants) will have to request asylum to planet Mars but unfortunately spots are limited and only half of the affected people will get to access. During the game, your family will have to solve a series of situations and challenges. Only those who do it more efficiently will be privileged to enter Mars'.* This game aims to emulate, to the extent that this is possible, the stress, confusion and tension that many people face day by day during their migratory process caused by climate change.

In relation to scenarios, as observed in the example above, most games include responses to hazardous situations such as extreme temperatures, lack of water, desertification and diseases, and especially in The Netherlands, the most recurring scenario is sea level or flood water rise, encouraging participants to solve the puzzles and leave the room before it is too late. For instance, the *Blue Mirror project* (The Netherlands) describes the following scenario on their website: *'you'll step into a kind of world control room and get the chance to change every factor influencing climate change. You get to turn the 'knobs and dials of the world'. However: you're also in a time vortex. Every 5s, a whole season passes! Within minutes, the effects of climate change become tangible: it gets hotter, storms erupt inside the room, and before you know it water -yes water- starts to rise at your feet. You have 10min. Can your team make it to 2050 without getting your feet wet?'. In another initiative, *Watersnood Impact Escape Room* (The Netherlands), participants are invited to be at the helm of 'Rijkswaterservice' during the escape room: under considerable time pressure, participants need to work in teams and must make careful assessments between the short and long term: an emergency plan with sandbags, water drainage and space for the river, sustainable energy, and circular construction, taking on complex policy, planning and implementation challenges. Organizers want participants to be aware that more than a quarter of the Netherlands is below sea level, and that the rising water level and frequent weather extremes due to climate change have an enormous impact on the country. Therefore, protecting people and the planet requires a balance between acute flood protection and structural investment in long-term measures.*

As observed, escape rooms have the potential to connect causes and consequences of climate change in the minds of participants. Many of these initiatives, especially those ones implemented

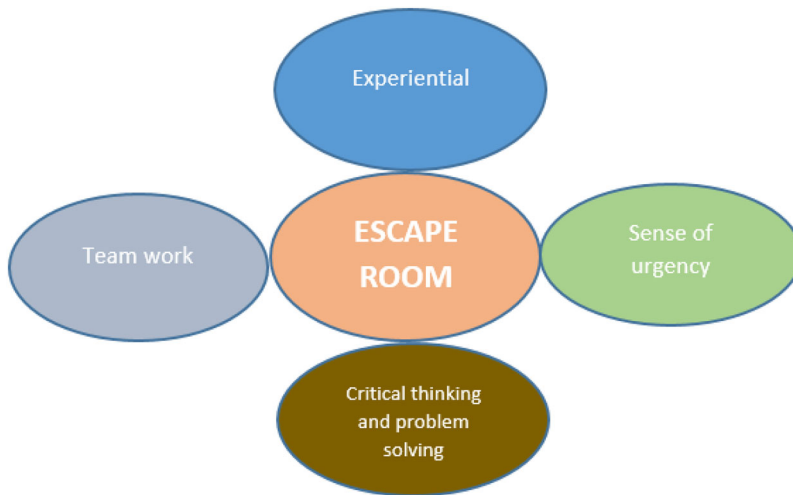


Figure 1. Positive attributes of escape rooms to climate change education.

in classrooms, offer rewards to those students who manage to solve the challenges and ‘escape’ the room, such as a ‘Green Living Certificate’ or an academic award from the university.

Finally, if we look at countries of origin, we can find 7 initiatives in North America (6 United States, 1 Canada), 9 in Europe (3 The Netherlands, 1 Austria, 1 Italy, 1 Spain, 1 Germany, 1 Finland, 1 United Kingdom), and 1 global/online. Therefore, the majority come from United States, followed by The Netherlands. Companies in The Netherlands that have been involved in designing climate change escape rooms are *Sherlocked*, *Corporate Escape* and *Popup Escape*.

Discussion and conclusion

In response to the need of interactive and engaging approaches to climate change communication and education, identified as one of the two most effective strategies in teaching climate change (Monroe et al. 2019), the application of escape rooms to educational contexts are becoming very popular as a way to engage students in their learning environment. They are capable of addressing both hard and soft skills, increasing their knowledge, rising their motivation and encouraging attitude change.

However, we still know little about this new ‘edutainment’ format. The field of escape rooms for educational purposes is still quite unexplored, and even more in relation to climate change issues. This paper offers an initial exploration into this field, presenting initiatives from around the world and analysing their origins, formats, objectives, targets, scenarios and topics.

Our exploratory study has identified a total of 17 initiatives. Findings from the analysis reveal that there are two types of educational escape rooms implemented in classrooms: ones designed by teachers and ones designed by students themselves. In addition, we can find escape rooms prototypes sold as ‘products’, and one-day events for students as well as general public. Most escape rooms aim at increasing or retaining knowledge, as well as creating awareness on climate change mitigation (sustainable actions at the individual or municipality levels) and adaptation (impacts, resilience and adaptation measures). Scenarios include responses to hazardous situations such as extreme temperatures, lack of water, desertification, diseases, and overall, sea level or flood water rise, encouraging participants to solve the puzzles and leave the room before it is too late. Finally, if we look at countries of origin, most examples come from United States or The Netherlands.

This paper also highlights what escape rooms can offer to climate change education: experiential and immersive learning, problem solving and critical thinking skills, and a sense of collaboration and urgency (Figure 1).

Perhaps the last two factors, collaboration (through teamwork) and a sense of urgency (through time limit), are two of the most relevant values that can be taught to students about climate change. On the one hand, escape games are cooperative games where the players work together to win or lose as a team (in real life, students will be expected in the future to work together from their different disciplines and reach agreements in the fight against climate change). Another reason that the escape games can work well in climate change education is the time limit. As in the case of recreational escape rooms, students are given approximately an hour to finalize the challenge. By adding a timer, students can also feel the urgency to take action in real life understanding that it is not too late to slow the pace of climate change as long as we act quickly. In practice, it is recommended to allow time in the classroom for debriefing and reflection after the challenge is finalized.

To count with a shared space where young people can collaborate on a game designed around specific learning outcomes sets the basis for social constructivism, considered an important factor for good Pisa results in countries like Finland, as addressed in the theoretical framework. In practice, suggested criteria for fostering constructivist learning in classrooms include starting with students' prior knowledge, untangling complex processes into successional steps, reducing the content to focus only on key ideas necessary to learn the new mental model being presented, and avoiding technical terms. Therefore, climate change education through escape rooms, when combined with other long-term change activities, could have the potential to build societies that are characterized by supportive, creative, and well-informed sustainable communities.

Having said that, escape rooms' effectiveness and 'transformative power' remain to be researched. As our findings reveal, most escape rooms in our sample aim at increasing or retaining knowledge, as well as creating awareness on climate change mitigation (sustainable actions at the individual or municipality levels) and adaptation (impacts, resilience and adaptation measures). In addition, though escape rooms have possibilities, they are also limited in scope and time, so a complex problem such as climate change might be hard to cover as a whole. Like the examples in our sample show, escape rooms usually need to focus on parts of the whole climate change picture.

In our study, it is important to acknowledge as a limitation in identifying climate change-related escape rooms that the Web search was carried out in English. Using keywords in other languages during the Web search could have revealed new cases. In addition, little information is revealed on organizers' websites about the game mechanics used in our sample. Therefore, further research into game mechanisms and applicability is needed. Further recommended research lines include effectiveness, evaluating the potential of climate change-related escape rooms implemented in classrooms to foster not only environmental knowledge and values, but also encouraging appropriate actions. Lastly, even though the basic premise of escape rooms is similar - people trapped inside a space for a specific amount of time that need to solve a number of puzzles to get out- it would be interesting to understand what challenges teachers face when turning this into a classroom activity besides classroom size, facilities and core standards. That way, we can get better insights into designing successful educational escape rooms.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Tania Ouariachi (PhD) is lecturer and researcher at Hanze University of Applied Sciences, Groningen (The Netherlands). She is part of EnTranCe, the Centre of Expertise Energy. She also belongs to the Research Group 'Scientific Information: Access and Evaluation' at University of Granada in Spain. Her research focuses on climate change communication and education, as well as new media and gamification strategies. In this field, she published more than a dozen papers in high impact journals. She has experience working as a journalist and as a communication specialist for scientific and intergovernmental institutions. ORCID: <http://orcid.org/0000-0003-4472-4767>

Elving J. L. Wim (PhD) is professor of Sustainable Communication at the Hanze University of Applied Sciences, Groningen (The Netherlands). He is part of EnTranCe, the Centre of Expertise Energy, the leading Dutch institute on accelerating the energy transition and establishing the Sustainable Society. He has worked for 18 years at the Amsterdam School of Communications Research and was editor in chief of Corporate Communications. He published on sustainability, corporate communication, branding, CSR-communication in various articles, book chapters, books, blogs, editorials, etcetera.

ORCID

Tania Ouariachi  <http://orcid.org/0000-0003-4472-4767>

References

- Aebli, H. 1983. *Zwölf Grundformen Des Lehrens: Eine Allgemeine Didaktik Auf Psychologischer Grundlage [Twelve Basic Methods of Teaching: General Didactics Based on Psychology]*. Stuttgart: Klett.
- Aguaded-Gómez, I. 2011. "Children and Young People: The New Interactive Generations." *Comunicar* 18 (36): 7–8. doi:10.3916/C36-2011-01-01.
- Aparici, R., and M. Silva. 2012. "Pedagogy of Interactivity." *Comunicar* 19 (38): 51–58. doi:10.3916/C38-2012-02-05.
- Ball, S. J. 2012. "Performativity, Commodification and Commitment: An I-Spy Guide to the Neoliberal University." *British Journal of Educational Studies* 60 (1): 17–28. doi:10.1080/00071005.2011.650940.
- Bandura, A. 1977. *Social Learning Theory*. Englewood Cliffs, NJ: Prentice Hall.
- Cantell, H., S. Tolppanen, E. Aarnio-Linnanvuori, and A. Lehtonen. 2019. "Bicycle Model on Climate Change Education: Presenting and Evaluating a Model." *Environmental Education Research* 25 (5): 717–731. doi:10.1080/13504622.2019.1570487.
- Clarke, S., D. Peel, S. Arnab, L. Morini, H. Keegan, and O. Wood. 2017. "EscapED: A Framework for Creating Educational Escape Rooms and Interactive Games to for Higher/Further Education." *International Journal of Serious Games* 4 (3): 73–86. doi:10.17083/ijsg.v4i3.180.
- Cooper, C. B. 2011. "Media Literacy as a Key Strategy towards Improving Public Acceptance of Climate Change Science." *BioScience* 61 (3): 231–237. doi:10.1525/bio.2011.61.3.8.
- Cordero, E., A. Todd, and D. Abellera. 2008. "Climate Change Educational and the Ecological Footprint." *Bulletin of the American Meteorological Society* 89 (6): 865–872. doi:10.1175/2007BAMS2432.1.
- Cotner, S., K. M. Smith, L. Simpson, D. S. Burgess, and J. Cain. 2018. "Incorporating an Escape Room Game Design in Infectious Disease Instruction." *Proceedings IDWeek2018*, San Francisco, CA.
- Davis, D., and J. G. Lee. 2019. "Building Escape Rooms to Increase Student Engagement in First Year Engineering Classes." *Proceedings 126th Annual Conference ASEE. ASEE: Tampa, FL AIP*
- Devries, B., and B. Zan. 2003. "When Children Make Rules." *Educational Leadership* 61 (1): 64–67.
- Eukel, H. E., J. E. Frenzel, and D. Cernusca. 2017. "Educational Gaming for Pharmacy Students - Design and Evaluation of a Diabetes-Themed Escape Room ." *American Journal of Pharmaceutical Education* 81 (7): 6265. doi:10.5688/ajpe8176265.
- Harzem, P. 2004. "Behaviourism for New Psychology: What Was Wrong with Behaviourism and What Is Wrong with It Now." *Behaviour and Philosophy* 32: 5–12.
- Kinio, A. E., L. Dufresne, T. Brandys, and P. Jetty. 2019. "Break Out of the Classroom: The Use of Escape Rooms as an Alternative Teaching Strategy in Surgical Education." *Journal of Surgical Education* 76 (1): 134–139. doi:10.1016/j.jsurg.2018.06.030.
- Lehtonen, A., and H. Cantell. 2015. ". "Ilmastokasvatus osaamisen ja vastuullisen kansalaisuuden perustana. [Suomen ilmastopaneelin raportteja; No. 1/2015]". Helsinki: Suomen ilmastopaneeli
- Lehtonen, A., A. O. Salonen, and H. Cantell. 2018. "Climate Change Education: A New Approach for a World of Wicked Problems." In J. W. Cook (Ed), *Sustainability, Human Well-Being, and the Future of Education*, edited by J. Cook. Cham: Springer International Publishing, pp. 339–374.
- Lombardi, D., and G. M. Sinatra. 2013. "Emotions about Teaching about Human-Induced Climate Change." *International Journal of Science Education* 35 (1): 167–191. doi:10.1080/09500693.2012.738372.

- López-Pernas, S., A. Gordillo, E. Barra, and J. Quemada. 2019. "Examining the Use of an Educational Escape Room for Teaching Programming in a Higher Education Setting." *IEEE Access* 7: 31723–31737. doi:10.1109/ACCESS.2019.2902976.
- McKenzie-Mohr, D. 2008. "Fostering Sustainable Behaviour: Beyond Brochures." *International Journal of Sustainability Communication* 3: 108–118.
- Michael, A., and C. Savill-Smith. 2004. *The Use of Computer and Video Games for Learning: A Review of the Literature*. London: Learning and Skills Development Agency.
- Monroe, M. C., R. R. Plate, A. Oxarart, A. Bowers, and W. A. Chaves. 2019. "Identifying Effective Climate Change Education Strategies: A Systematic Review of the Research." *Environmental Education Research* 25 (6): 791–812. doi:10.1080/13504622.2017.1360842.
- Neuendorf, K. 2002. *The Content Analysis Guidebook*. Thousand Oaks, CA: Sage.
- Nicholson, S. 2015. *Peeking behind the Locked Door: A Survey of Escape Room Facilities*. White Paper available at <http://scottnicholson.com/pubs/erfacwhite.pdf>
- Nicholson, S. 2018. "Creating Engaging Escape Rooms for the Classroom." *Childhood Education* 94 (1): 44–49. doi:10.1080/00094056.2018.1420363.
- Palmer, J. A. 1998. *Environmental Education in the 21st Century: Theory, Practice, Progress and Promise*. London: Routledge.
- Piaget, J. 1936. *Origins of Intelligence in the Child*. London: Routledge & Kegan Paul.
- Powell, K. C., and C. J. Kalina. 2009. "Cognitive and Social Constructivism: Developing Tools for an Effective Classroom." *Education* 130 (2): 241–250.
- Ratinen, I. 2016. *Primary Student Teachers' Climate Change Conceptualization and Implementation on Inquiry-Based and Communicative Science Teaching: A Design Research*. Jyväskylä: University of Jyväskylä, Jyväskylä Studies in Education, Psychology and Social Research.
- Reid, A. 2019. "Climate Change Education and Research: Possibilities and Potentials versus Problems and Perils?" *Environmental Education Research* 25 (6): 767–790. doi:10.1080/13504622.2019.1664075.
- Taber, F., and N. Taylor. 2009. "Climate of Concern - A Search for Effective Strategies for Teaching Children about Global Warming." *International Journal of Environmental and Science Education* 4 (2): 97–116.
- UNESCO. 2019. *ESD and GCED Up Close: Cognitive, Social and Emotional, and Behavioural Learning in Education for Sustainable Development and Global Citizenship from Pre-Primary to Secondary Education*. Paris: UNESCO.
- Vörös, A. I. V., and S. Sárközi. 2017. "Physics Escape Room as an Educational Tool." AIP Conference Proceedings 1916. doi:10.1063/1.5017455.[10.1063/1.5017455]
- Vygotsky, L. S. 1978. *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press.
- Whitton, N. 2018. "Playful Learning: Tools, Techniques and Tactics." *Research in Learning Technology* 26: 2035. doi:10.25304/rlt.v26.2035.
- Wiemker, M., E. Elumir, and A. Clare. 2015. "Escape Room Games: Can You Transform an Unpleasant Situation into a Pleasant One? In Game." *Based Learning – Dialogorientierung & Spielerisches Lernen Analog Und Digital, Ikon Verlags GmbH*, Brunn am Gebirge, Austria, 2015; pp. 55–68..
- Zhang, X. C., H. Lee, C. Rodriguez, J. Rudner, T. M. Chan, and D. Papanagnou. 2018. "Trapped as a Group, Escape as a Team: Applying Gamification to Incorporate Team-building Skills Through an 'Escape Room' Experience." *Cureus* 10 (3): e2256. doi:10.7759/cureus.2256.