

NATURAL HAZARDS AND ENVIRONMENTAL SUSTAINABILITY: USING ESCAPE ROOM AS A LEARNING TOOL

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Abstract

Keeping the attention of students is one of the most difficult challenges teachers have to face. The large experience with *distance learning (DAD)* during the Covid-19 pandemic underlined how game is a potent educational instrument able to engage students and maintain their focus, at the same time helping to implement knowledge and improve *critical thinking*. In particular, the use of educational digital games further enhances skills and competences adopting reality tasks in a challenging path according to storytelling. One of the main goals for our activities for schools is to spread good practices to be adopted in case of natural hazards. Two competitive Escape Rooms have been developed and tested to prepare future citizens to save themselves and others during natural disasters and to educate them to environmentally sustainable behavior. The first was an Escape to run away from natural risks (seismic, tsunami and hydrogeological risks), created in occasion of the 9th Planet Earth Week 2021, involving more than 900 students of Middle Schools (ISCDE 2) and Primary Schools from all over Italy in two different races. The second Escape room is the final product of a meaningful participatory *Project Based Learning (PBL)* experience on environmental topics between researchers, teachers and students of the second class of a Middle School. The students have learned through *real-life* tasks and they personally have promoted to their peers the sustainable behavior to mitigate the effects of climate change. In particular, deforestation, wildfires, sea rising and acidification have been discussed to solve enigmas. This Escape was played online during World Earth Day 2023, involving almost 800 students of Italian Middle Schools, and in presence as a peer education experience for about 100 students of Middle Schools during the Fosforo Science Festival (Senigallia) 2023. These games are also a multipurpose and useful tool for teachers for new ideas of teaching activities. In addition, they are examples of effective active learning in which the students' skills and cognitive development are enhanced. Experiencing escape rooms during special events highlighted that they are both learning and dissemination tools and can therefore be used for different purposes, both at school as a tool for innovative teaching and in research to promote projects or disseminate new scientific findings. They are to be considered bridging activities between School, Research and Society.

Keywords: Knowledge, gamification in education, best practice dissemination, natural hazard, environmental sustainability.

1. Introduction

The need to design engaging and educational activities in the occasion of special scientific events during the pandemic has led to experiment the online use of innovative digital teaching methods for science outreach educational activities for schools in *distance learning*.

Gaming is a powerful communication tool, an effective *active learning*, which allows the assessment of players' abilities, learning progress, and limits (Piangiamore *et al.*, 2021). It is also a tool that can help to explain natural phenomena and to communicate science. Good practices can be instilled to automatically promote safe behaviors to be implemented during natural events.

In our gaming practice, we have always used *serious games* which intrinsically have the idea of stimulating learning. Our serious games are *transformative learning* educational tools, useful to increase public awareness of risks related to natural events (Piangiamore *et al.*, 2024a).

The main purpose is to educate on natural risk reduction and environmental sustainability in Middle Schools (ISCDE 2) in an engaging way with new learning experiences, guided by researchers from the Istituto Nazionale di Geofisica and Vulcanologia (INGV). The activities are aimed at preparing students to cope with and reduce disasters (*DDR - Disaster Risk Reduction*) as well as acquiring different behaviours to be adopted in case of earthquakes, tsunamis, floods and landslides (*Life Save Skills*).

Two Escape Rooms were designed and tested, featuring a fictional character in which students recognise themselves: the rescuer called Salvina. She is a young girl who faces several hazardous situations, from earthquake to flood and to environmental issues. Escape Rooms involve students in clues, logical puzzles and tasks that a team must solve to win (Manojlovic, 2022).

The didactic methodologies are based on the *PBL approach* and on *inquiry-based learning* aimed at promoting behavioral change (*service learning*) through *cooperative learning* (Griffin & Care, 2015).

2. Design and method

During the Covid19 Pandemic, traditional learning settings need to be replaced by more dynamic and engaging educational experiences. Gamification helped us to keep the attention high in Distance Learning, providing the educational community with tools to further enhance learning processes and, consequently, student success. At that time, to keep the School/Research relationship alive, our playing science activities were carried out creating the format “*Salvina’s Choices*” to develop *critical thinking*. *Salvina’s Adventures* are focused on natural risk reduction, in particular “*Salvina and the Earthquake: What Will She Do?*” and “*Salvina and the Flood: What Will She Do?*”. These two adventures have been played during special scientific events (i.e., Science festivals and memorials of occurred events) with online challenges conducted by INGV researchers and involving schools throughout Italy (Piangiamore & Maramai, 2022). In the online races 350 classes competed, connected by interactive whiteboard, tablets and mobile phones for a total of 3800 students of Primary School and 4300 students of Middle School. Thereafter, two more games were developed for environmental education purposes, respectively “*Salvina and the Environment: What Will She Do?*” and “*Salvina and the 4Rs: What Will She Do?*”. The first one promoted sustainable behaviour through the acquisition of good environmental practices, while the second one spread the four easy-to-follow stepping stones (Reduce, Reuse, Recycle and Repurpose) to be adopted in everyday life. In particular, “*Salvina and the Environment: What Will She Do?*” was played online during the European Researchers’ Night 2021 by a total of more than 1800 students (about 770 students from Primary School and about 1050 students from Middle School all over Italy). During the European Researchers’ Night 2022, the “*Salvina and the 4R*” was played in person in Rome by 150 children and their parents.

2.1. Educational escape rooms

Due to the enthusiastic responses from teachers and students after playing, we designed a first digital hypertextual Escape Room, “*Let’s free Salvina!*”, to get away from natural hazards. From this experience “*4S Salvina and Samantha save species*” Escape Room was born in the participatory design of students, teachers and researchers as a new tool to protect the environment (Escribano, 2018).

Escape Rooms are collaborative logic games, accompanied by storytelling, that a group of people need to complete in a limited period of time. Intuition, logic and team building come into play. Competitors work together to find the way out of a thematic room thanks to a final key gained after a path of enigmas and solutions (Eukel & Morrell, 2021).

Used in teaching, Escape Rooms can motivate students, promoting the development of *collaborative problem-solving* competencies and communication skills (Awwal *et al.*, 2017). Soft skills achievement is becoming increasingly important in properly preparing students for *real-life* (Pan *et al.*, 2017).

Genially, a no-code platform for interactive visual communication was used to create the structure of the multi-hazard Escape Rooms rich in interactive contents, created by using several free learning apps, including *Quizziz*, *Flippity* and *Word Wall*.

As far as “*Let’s free Salvina!*” is concerned, the storytelling led players to help Salvina who faces earthquake, tsunami, landslide, and flood, by making safe choices to solve enigmas as quickly as possible. For each risk scenario Salvina is the protagonist of educational quizzes designed with a level of complexity that fits the target it was intended for. To win, the students have to choose the right actions to survive (Care *et al.*, 2015).

The “*Let’s free Salvina!*” challenge was enthusiastically played in online competition between classes during the Planet Earth Week 2021, simultaneously involving almost a thousand students from Latium, Liguria, Lombardia, Marche and Sicily. In particular, more than 300 students of 14 classes from Primary School and more than 600 students from 29 classes of Middle Schools were involved.

Figure 1. Some games and settings on natural risk reduction used in “Let’s free Salvina!” Escape Room, played online on the occasion of Planet Earth Week 2021.



This experience impressed the 2A class of the «S. De Magistris» Middle School of Caldarola (MC) that wished to try out the creation of a new Escape Room on climate change and sustainable behaviour, the “4S Salvina and Samantha save species”. Starting from the pre-existing Salvina’s games on environmental issues, for the realization of the new Escape Room 15 weekly online meetings were carried out between students, teacher and INGV researchers. During these meetings, the students became familiar with both “Salvina and the Environment: What Will She Do?” and “Salvina and the 4Rs: What Will She Do?” games, playing them to learn eco-friendly behaviors. Students demonstrated their creativity, autonomously personalising the Escape Room paths on deforestation, planting, glacier melting and the consequent sea level rising, ocean acidification, and other topics to face climate change. In order to move on in the virtual game from one setting to another it’s necessary to reflect on the right choices to save ourselves and planet Earth. The final product was played online during World Earth Day 2023 by 14 Middle Schools from Latium, Sicily and Liguria, for a total of 35 classrooms and 800 students, simultaneously challenging each other. In addition, at Fosforo Science Festival 2023, the student involved in the realisation of the “4S Salvina and Samantha save species” led in presence the learning activity in a successful experiment of *peer education* for a total of 100 students.

At the end of each scientific special venue, we collected data through individual satisfaction questionnaires, differentiated for teachers and students.

Figure 2. Some examples of feedback received to the questionnaires distributed after the “Let’s free Salvina!” race online on the occasion of Planet Earth Week 2021.

How would you judge the activity carried out with the escape room “Let’s free Salvina”?

Interesting!
Very engaging and instructive
Very interesting
Totally positive experience!
Very positive
Excellent
It was a stimulating and engaging initiative. Children were protagonists: asked questions and looked for answers, just like a real researcher does.
A fruitful and exciting activity that placed the pupils at the center of the learning process, making them the protagonists of their own educational journey. An opportunity to experience the conscious and responsible use of new technologies.

Figure 3. Some climate change topics developed in the “4S Salvina and Samantha save species” Escape Room, played online on the occasion of the World Earth Day 2023.

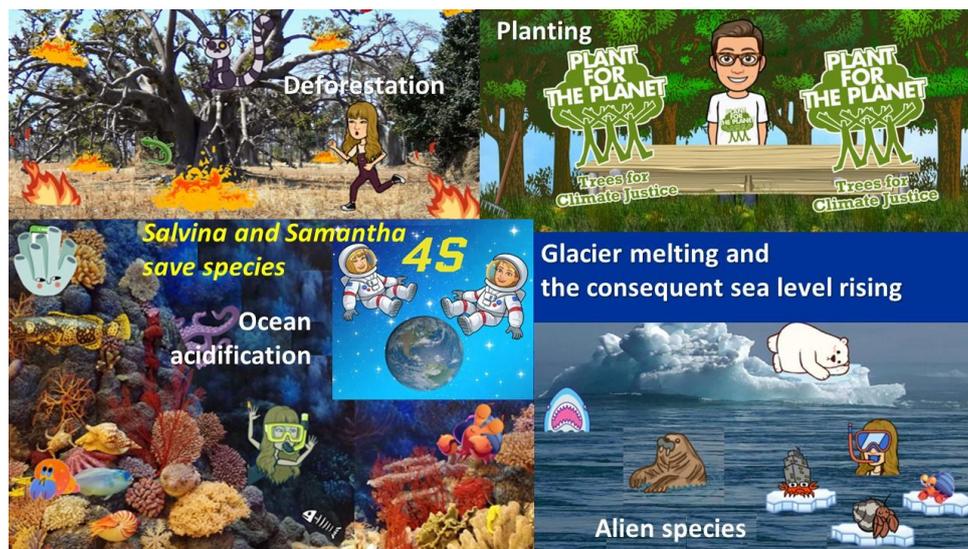


Figure 4. The peer education experience of “4S Salvina and Samantha save species” Escape Room, played in presence at Fosforo Science Festival 2023.



3. Discussion and conclusions

Escape Rooms are emerging as a new type of learning strategy to enhance student interest, involving them in engaging experiences. Thanks to the shift from traditional didactic models to the approach of *active learning*, Escape Rooms are increasingly used in *game-based learning* and *peer to peer* education activities (Wiemker *et al.*, 2015). One of the main goals of educational Escape Rooms is to contribute to the development of soft skills. In particular, both “*Let’s free Salvina*” and “*4S Salvina and Samantha save species*” are focused on the dissemination of good behavioural practices. The first one concerns safe behaviour to save ourselves in case of natural risks. The latter has the pedagogical purpose of instilling eco-sustainable behaviour, solving enigmas on crucial issues concerning climate change. The educational path on risk involves cognitive and, above all, emotional and behavioural dimensions, with the main objective of changing personal and collective behaviour for everyone’s good (Piangiamore *et al.*, 2024b). The long-lasting educational process (*lifelong learning*) involves all dimensions of human experience in relation to the social, cultural, natural and built context (Piangiamore, 2018). Educational strategies of *cooperative learning*, ‘*group*’ *problem solving*, *goal-based-scenarios* and *inquiry-based learning* are applied to play online and in presence (*peer education*). Both Escape Rooms use storytelling to attempt engaging adventures, facing different situations from time to time, according to players’ choices and solutions. In “*Let’s free Salvina!*”, the involved teams have to use their knowledge in Civil Protection matters to survive in the event of an earthquake, tsunami, landslide, and flood, learning from experiences to adapt to new conditions (Piangiamore & Maramai, 2024). Whereas in the “*4S Salvina and Samantha*

save species” students must use all their skills to protect the environment and to preserve biodiversity in different settings. All sets designed are educational playing activities according to students’ competence level to facilitate the development of all key competences and citizenship skills, stimulating discussion among peers and with adults and fostering *critical thinking* to apply knowledge in *real-life* situations. The ambition to achieve common goals of *lifelong learning* triggers a process that fosters knowledge, awareness and best practices in the implementation of social interactions, both for facing natural risks and fighting climate change, in a *challenge-based learning* perspective too (Manojlovic, 2023). The digital Escape Rooms, created to support the teaching difficulties due to the Pandemic, has turned out to be a useful learning tool even after the health emergency because it allows simultaneous interaction between many classes remotely, stimulating learning. In fact, the competition triggers students’ enthusiasm, facilitating the understanding of scientific issues (Borrego et al., 2017).

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