

**EDUCATIONAL ESCAPE ROOMS IN HIGHER  
EDUCATION**

**PART 2**

**COUNTRY REPORT**

**UNLOCK**

Creativity through game-based learning at  
higher education

December 2020

[WWW.UN-LOCK.EU](http://WWW.UN-LOCK.EU)

## PROJECT PARTNERS



### **Disclaimer**

This document was prepared by the authors using data that had been collected in the framework of an Erasmus+ project funded by the European Commission. The report reflects the views only of the project consortium and the Commission cannot be held responsible for any use, which may be made of the information contained therein.

### **Acknowledgement**

The UNLOCK project EER Country Report was prepared by the Science to Business Marketing Research Centre of Münster University of Applied Sciences as part of the KA2 Knowledge Alliance UNLOCK project, funded by the European Commission during the period of 2019-2022. For more information about the report, please contact Hacer Tercanli ([tercanli@fh-muenster.de](mailto:tercanli@fh-muenster.de)) and Daniel Dirksen ([ddirksen@uni-muenster.de](mailto:ddirksen@uni-muenster.de)). Comments and input were received from the project representatives at Amsterdam University of Applied Sciences in the development and finalisation of the document (Dr. Richard Martina, Prof. Ingrid Wakkee). EER experts and practitioners from 6 project partner countries provided insights into the UNLOCK Country Report via interviews held by all project partners. UNLOCK project consortium is grateful for the valuable input and insights provided by the interviewees, whose information is provided below:

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## **Introduction to the document**

The Country Report compilation was prepared as part of the Erasmus+ UNLOCK project, which has the objective of identifying the use of educational escape rooms (EERs) in higher education environments, and examining the role of educators in those activities. The document presents a local perspective on the game-based learning and EER practices in the six project country regions, including insights into enabling/ hindering national and organizational contexts. Each country report incorporates data from primary and secondary sources, that involves expert and practitioner interviews and desk research. The case studies mentioned in the reports can be accessed in their full-form in the Case Study Report (PART 3) of the series.

### **How to read the UNLOCK project WP4 research phase reports?**

UNLOCK project research phase has been concluded with set of 4 reports, that are complementary in content:

PART 1: LITERATURE REVIEW

PART 2: COUNTRY REPORT (Compilation)

PART 3: CASE STUDY REPORT

PART 4: SYNTHESIS REPORT

The literature review provides an overview of the status-quo of the EERs in higher education sector (PART 1), followed by UNLOCK project partner country reports (Denmark, Germany, Netherlands, Lithuania, Portugal, Spain) for targeted insights on the adoption of EERs in the local (higher) education contexts (PART 2). Case study report offers a detailed presentation and analysis of 37 case studies identified from project country regions and beyond (PART 3). Finally, the synthesis report provides a discussion of the major findings, along with emerging themes and recommendations for further EER research and practice (PART 4).

The reports are in the form of living documents, that will be updated during the lifetime of the project.

# Definitions

<b>Term</b>	<b>Description</b>
Game based learning	Type of game play with defined learning outcomes (Shaffer, Halverson, Squire, & Gee, 2005). Usually it is assumed that the game is a digital game, but this is not always the case.
Gamification	Use of game elements, such as incentive systems, to motivate players to engage in a task they otherwise would not find attractive (Plass, Homer, & Kinzer, 2015).
Educational escape room (EER)	Live-action team-based game where players discover clues, solve puzzles, and solve tasks in one or more rooms in order to accomplish a specific goal (usually escaping from the room) in a limited amount of time (Nicholson, 2015)
Student	In the context of this research, the term student includes those registered to all levels and types of formal studies, including secondary, vocational, undergraduate and postgraduate levels.
Game Designer	Game designers (e.g., Schell 2008, Koster 2004) are professionals who do considerable thinking and writing about what makes play fun, including social play. In some of the case studies in the report, the educators/ support staff/ professionals with game design specializations are referred as Game designers.
Game Master	A game master (GM; also known as game manager, game moderator or referee) is a person who acts as an organizer, officiant for regarding rules, arbitrator, and moderator for a multiplayer role-playing game. In the report, in some of the case studies the educators and/or the support staff are referred as Game Masters.
Higher Education Institutions (HEIs)	Higher education, any of various types of education given in postsecondary institutions of learning and usually affording, at the end of a course of study, a named degree, diploma, or certificate of higher studies. Higher-educational institutions include not only universities and colleges but also various professional schools that provide preparation in such fields as law, theology, medicine, business, music, and art. Higher education also includes teacher-training schools, junior colleges, and institutes of technology.
Folk High School (Denmark School System)	A folk high school is a non-formal residential school offering learning opportunities in almost any subject. Most students are between 18 and 24 years old and the length of a typical stay is 4 months. It is a boarding school, so you sleep, eat, study and spend your spare time at the school. There are no academic requirements for admittance, and there are no exams - but you will get a diploma as a proof of your attendance.

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# 1. Denmark

## Introduction

The purpose of the following literature review is to provide the reader with an overview of the current landscape of the use of game design (including the use of gamification, use of commercial games, and didactic design) as problem-based learning within Higher Learning Institutions (HEI) in a Danish context. The primary goal of this literature review is to lay out the foundation for an understanding of how educational escape rooms (EER) would fit within an educational frame.

## Status of EER and GBL in Denmark

In recent years, many schools and universities have been (re)built to support new pedagogies. Visions to promote, for example, the development of 21st century competencies are often materialized in new types of learning environments with more open, flexible and activity-based interior. But for the interior design of these new learning environments to become supporting tools in teaching, a need for new teaching and learning strategies is arising (Bojer, 2019).

Along the same lines, there has been a significant increase of games in learning in Denmark the past few years (2019: 9). James Paul Gee (2007) highlights 16 principles for how games can incorporate learning. Among the principles, it is especially relevant to highlight the experience of being able to interact with games that allow you to be a co-creator of the game world; acting through a projected identity where one can test and reflect on other versions of oneself; being able to meet and deal with specific problems that can be complex and profound at the same time; and to fail without serious consequences and then to try again (Hanghøj 2019). Further, Hanghøj (2019) points out the importance of having basic experience as a teacher to utilize the learning potential within games. Hanghøj (2019) describes the numerous landscape of game designs and proposes four different approaches to teaching with games (2019), 1) the use of learning games, 2) the use of commercial games, 3) the use of game elements in non-game contexts (gamification), and 4) working with design of games.

The basic concept behind escape rooms (ER) stems from a digital-based gaming genre (Nicholson, 2015), which is broadly similar to adventure games, where logic, puzzles and story are prioritized higher than fast reactions and action. In the genre, there are successful games such as “The Room” (Fireproof Games, 2012) and “Myst” (Cyan, 2016). In computer games, as a player, you are usually locked inside a locked room, and the goal now is to investigate everything in the room to find your way out. In the computer games you use the mouse to explore the space, find objects and connect them to unlock new paths and escape routes (see Hautopp, Ejsing-Duun & Vigild, 2019).

Escape rooms gain ground in the entertainment industry, but also in relation to education. However, there is a lack of empirical research in the application of escape rooms in teaching settings (Hautopp, Ejsing-Duun & Vigild, 2019).

## **Status-quo of the use of ER games in the (higher) education area**

The following country report is based on five case studies, seven interviews consisting of three expert interviews and five practitioner interviews which constitute the case studies (one interviewee is both represented as an expert and in two case studies), as well as relevant literature on game design in learning environments. The following section will present a short introduction of the case studies as well as the EER experts and practitioners.

### **Interviews**

The country report has set out to achieve a nuanced understanding of the use of educational escape rooms which is why the country report distinguishes between two types of interviewees. Firstly, the country report has engaged with three experts which is characterized by a deep theoretical knowledge around educational escape rooms and its position within problem-based learning and game-based learning in higher learning institutions. Secondly, the country report found a number of educational escape room practitioners who are characterized by an extensive experience with facilitating escape room activities in learning situations.

#### **Expert interviews**

As an expert, *Heidi Hautopp* is one of the co-authors of Hautopp, Ejsing-Duun and Vigild (2019), and is a PhD Fellow, Department of Culture and Learning at Aalborg University, Denmark. Heidi is involved in the The Center for Applied Game Research.

*Eric Torsøe* who is teaching at Re Videregående Skole (Eng., Re High School), Tønsberg, Norway. Torsøe integrates EERs in a large part of his teaching across the disciplinary fields. The implementation of EERs is done by the initiative of Eric, and was initiated by a group of teachers who was funded by the municipality to try out new teaching forms. Eric has a small firm *Camelot*, together with Jørn Weines, next to his teaching where he teaches other teachers about the implementation of escape rooms in educational contexts.

The third expert is *Ville Tahvanainen* who is a University teacher at University of Eastern Finland (UEF). In the autumn 2020, the Joensuu Campus of UEF will witness the construction of an escape room that seeks to gamify education and to develop students' collaborative problem-solving skills. The escape room is created in collaboration between the academic subjects of teacher education, computer science and physics. Ville Tahvanainen, coordinates the pedagogical development within the project.

#### **Practitioner interviews**

*Thomas Vigild* who is one of the leading specialists on educational escape rooms in Denmark. Teacher at Vallekilde Folk High School, journalist, founder of escape game firm HV3M, consultant and freelance lecturer specialising in the culture of play, gaming and boardgames. He was involved in starting up Game Development as a subject at Vallekilde Folk High School in 2011.

*Elisabeth Christine Tang* is a former primary school teacher and is currently employed by Horsens Municipality with the responsibility for Vidensby Sønderborg which is an extensive

pedagogical palette of specialised educational offers ranging from primary school to universities (from ABC to Phd). Elisabeth Christina Tang is in charge of EscapeGames which is developed together with Alssundgymnasiet Sønderborg (AGS) and Rubilees Escape House in Sønderborg.

*Tim Nelson* is project manager at Uddannelsesvejledning Horsens, and is, together with Hanne Frøslev, co-founder of Uddannelse og Job Rejsen which is an EER helping students from primary school guide them in making the right educational choices.

*Kasper Zederkof* is an Editor and Project Manager at Danish Broadcasting Corporation (DR), and is responsible for branding DRs cultural products, among many other, the TV-series *Bedraget* (Eng. Follow the Money). As part of the branding activities, Zederkof initiated a collaboration with live escape room developer TimeQuest who was set to develop a commercial escape room using Follow the Money as a storyline.

## **Case studies**

The country report is furthermore based on five case studies which have been conducted by using a premade template developed by Hacer Tercanli from Münster University of Applied Sciences. All case studies are built on interviews from the abovementioned practitioners along with Thomas Vigild, who both act as an expert and practitioner in this report.

### **Didaktisk Gåderum**

Didaktisk Gåderum [Eng. Didactic Puzzle Room] is an educational escape room developed by Thomas Vigild, together with PhD Heidi Hautopp and PhD Alice Juel Jacobsen, where folk school students from the Game design course at Vallekilde Højskole designed an escape room targeted at a course in science studies for bachelor students in Communication and Digital media at Aalborg University, Copenhagen (AAU). The case frames how the learners can act as both game designers and players in the educational escape room.

### **Ernst Trier's Office**

Ernst Trier's Office is an educational escape room developed by Thomas Vigild with the purpose to design an interesting escape room at Vallekilde Folk High School in connection with the school's 150th anniversary on November 1, 2015. The intention was to test whether such escape room could be designed to include both explicit and implicit learning - in this case, about both Vallekilde Folk High School, its founder Ernst Trier, and in general the history of the Danish folk high school movement, values and special pedagogical form. Ernst Trier's office trains the particular and important skill that the author Thomas Vigild calls "fail-courage" - i.e. to train the courage to make mistakes and learn from them.

### **EscapeGames**

EscapeGames is a fix-and-finish escape game concept developed by House of Science and Elisabeth Christine Tang in collaboration with High School Alssund and private live escape room firm Rubi Lee Escape House. The intention of Escape Games is to give upper secondary and higher secondary school students the opportunity to design, execute, and try each other's escape rooms for themselves as a way to learn about coding and encryption, in a fun and hands-

on way that fits the gamer and experience culture among children aged 13-16 year olds. The overall game design is based on the idea that the students are building the Escape Game themselves with the help of guide lines from House of Science representatives, supporting materials (provided by Rubi Lee), and content curricula developed by teachers. The students then design the escape games using the materials (artefacts, themes) and knowledge given. It is in other words, an escape game through EER, and not used as introductory or evaluatory learning design.

### **Follow the Money**

Follow the Money is a commercial escape room based on the Danish TV-series *Bedrag* (Eng. Follow the Money) which is an award winning financial crime thriller that was broadcast in January, 2016. The TV-series was made by the Danish public service platform Danish Broadcasting Corporation (DR) and the private live escape room developer TimeQuest (TQ). The escape room is based on the same universe as the TV-series but only partially follows the same narrative.

### **Education and Job Journey**

Education and Job Journey is developed by Tim Nelson and Hanne Frøslev who currently works as study advisors at Horsens Municipality. They have developed a portable Escape Room for lower secondary education students that helps guide them towards the right study program. The purpose of this escape room is to make study counselling more appealing for the students. Instead of the usual PowerPoint-presentations where the students sit passively and observe, the authors came up with the idea of the Escape Room format as an engaging and fun exercise for study counselling. The escape room is space-independent and is developed to fit an entire classroom.

## **Development and Implementation**

Hautopp, Ejsing-Duun and Vigild (2019) have sought out the potential of EERs on HEIs through an explorative case study where folk high school students from the Game design course at Vallekilde Højskole have designed an escape room targeted a course in science studies for bachelor students in Communication and Digital media at Aalborg University, Copenhagen. The analysis is based on educational design theory and game theory with a focus on how to frame the teaching so that the learners can act as both game designers and players in the educational escape room.

When an escape room is set in a teaching setting within a university context, it can be relevant to regard it as a form of problem-based learning (PBL) which also is the used learning framework within Aarhus University (see AAU PBL-model). Problem-based learning is centered around students, where the teacher acts as a facilitator (Donnely & Fitzmaurice, 2005; Savery, 2006). Within PBL, it is emphasized that teaching must be organized on the basis that students acquire vocational skills that enable them to work in a critical, problem-solving, autonomous and group-oriented manner (Donnely & Fitzmaurice, 2005).

Based on the research laid out in this report, the use of EERs vary in a number of ways. Despite overall similarities in terms of unlocking puzzles to gain new knowledge that enable the players to move forward in the game, the purpose behind EERs can vary. While some EERs purpose is to introduce new subject to students (see case *Education and Job Journey*), other EERs purpose is to explore a subject through games (see cases *EscapeGames*, *Ernst Trier's Office*), and finally some EERs purpose is to evaluate a subject (see case *Didaktisk Gåderum*). And while the referred cases studies by no means present an extensive overview, it nonetheless points towards a certain use of EERs (introduction; exploration; and evaluation).

However, EERs not only vary in the intended purpose, but can also vary in terms of the design of the EER. What role has the designer before, under and after the game? As Donnelly & Fitzmaurice points out, the teacher within PBL acts as a facilitator (2005), which gives the role of the designers to the students. This was, among a number of EERs, the case for Hautopp, Ejsing-Duun and Vigild (2019) when they set out to establish the EER at AAU. Hautopp, Ejsing-Duun and Vigild (2019) draw upon Sørensen & Levinsens (2018) and the concept of didactic design. Sørensen and Levinsen (2018) emphasize an understanding of the facilitator's role in relation to designing a framework in which students are invited to take on a role as didactic designers. Through this, they help to plan, organize and reflect on the teaching from practical experience and theoretical perspectives.

However, with Hautopp, Ejsing-Duun and Vigild (2019), it was not the university students who designed the EER, but on the other hand game design students from Vallekilde Højskole. As a result, another stakeholder group was integrated in the EER design. A *højskole*, or a folk high school, is, following The Association of Folk High Schools in Denmark, “a non-formal residential school offering learning opportunities in almost any subject. Most students are between 18 and 24 years old and the length of a typical stay is 4 months. It is a boarding school, so you sleep, eat, study and spend your spare time at the school. There are no academic requirements for admittance, and there are no exams” (Højskolerne, 2020). In continuation of this, the Danish Ministry of Children and Education defines the concept of “non-formal adult education” as a form of teaching and education that only to a limited degree are part of the formal, public educational system: “The concept of “non-formal adult education” is associated with N.F.S. Grundtvig, a Danish philosopher, poet, educational thinker and clergyman, (born in 1783 - died in 1872), and his thoughts concerning free educational opportunities. The concept arose in the 19th century and is one of the cornerstones of the Danish educational system.” (Ministry of Children and Education, 2020).

As a matter of fact, a number of EERs used within educational learning frames are occurring at folk high schools around Denmark (e.g. Askov Højskole, Vordingborg Fri Fagskole, Odder Højskole and Vallekilde Højskole; see also HPU 2016: 12), and common for all of them is the use of students as-designers, or following Sørensen and Levinsen (2018) refer to, they play the role as didactic designers.

In accordance with Vigild, co-author of (Hautopp, Ejsing-Duun and Vigild, 2019), and teacher at Vallekilde Højskole specialising in the culture of play, gaming and boardgames, the occurrence of EERs on folk high schools is not coincidental: “*In some ways, the escape room and the (folk high) school resemble each other – the latter simply takes place over a longer*

*period of time and its aims are rather less explicitly formulated. But both spaces share the same principles, for in my view education and edification are all about (mis)leading people towards their own freedom. They are about gradually rendering the teacher superfluous, about encouraging a bubbling-up of curiosity about ourselves and the world about us.*” (Vigild in Tanggaard 2019: 39). There seems to be a fruitful playground between game-based learning and folk high schools which might be harder to replicate in higher learning institutions due to stricter curriculums and more traditional teaching methods. In addition to this, one of the recurrent challenges related to EERs in HEIs found in the case studies, which will be elaborated in *Facilitating and inhibiting factors*, is how to balance the development of accessible and motivating escape games with syllabus-related content.

## Supporting and inhibiting factors

The following section will focus on the facilitating/hindering factors that affect adoption of ER methodologies in higher education. Additionally, this section will include citations from expert interviews that are not present in the case studies.

### **Knowledge, attitudes, skills sets and competences of the educators**

Thomas Vigild is a firm believer of the didactic potential ERs have within educational contexts in general, and with HEIs in particular. When Vigild applies EER in his teaching at Vallekilde Folk High School he sees it as *“interactive experiences in a system”* (Vigild, 2019: p. 43, in Tanggaard 2019). He notes that the games are as much about edification than educational learning, which only emphasises the core ethos of the Folk High Schools in general:

*“All games are a dialogical process, in which game and player systematically manipulate and are manipulated. At Vallekilde, the development of games is part of ‘the school day’, and development takes place in the students’ ‘teaching time’. But the extraordinary magic of edification that comes into play is that self-forgetting takes over.”* (Ibid.).

Vigild believes that edification is part of any educational learning context, which, of course, also stresses out his background as a Folk High School teacher. Vigild is backed up by Torsøe, who teaches in English, History, Religion, and Media & Communication. For Eric, EERs ability to train ‘soft skills’ are equally important to syllabus-related learning outcomes:

*“We always start with the question ‘what will the escape room be about?’ What is the theme? Is it WW2 - do we then need an U-boat? (...) Look, I’m an English teacher, but if I need a math assignment inside my U-boat, then I put a math assignment inside my U-boat. It is always about putting the narrative before the content. And all this is before we ask what kind of tasks we want to develop. Since we need to know whether the assignments fit within an U-boat”* (Torsøe, E. 2020, April 1. Personal interview: 20.20)

This points towards a certain *eclecticism* in Torsøe’s teaching. The fact that Torsøe is willing to use math-assignments in his English teaching, not only seems to suggest that he gives up his

teaching at the cost of a good EER narrative, it also suggests that he is a firm believer of '21st century skills' and skills like 'adaptability' and 'collaboration' should be cultivated. In accordance with this statement, Nicholson believes that the escape games themselves should always fit the space, and the game developer should always ask herself: "*Why is this here?*" about every puzzle. Improve the narrative or change the puzzle to make it fit (Nicholson, 2015). However, as Eric Torsøe points out, there needs to be a balance between the narrative (form) and the subject (content):

*"A lot of teachers, when they start an escape room, already have assignments they want to use in the ER. Let's take the example of an english teacher. They put an english assignment inside a puzzle box in the escape room and say, "this is an escape room" - but that is not an escape room. It doesn't, entirely, become an escape room. And that is where we spent much more time to develop the narrative; the space itself. We focus on the experience."* (Torsøe, E. 2020, April 1. Personal interview: 19.45).

However, according to Torsøe, it is challenging from a teacher's perspective to find the right balance, especially because the development of puzzles changes the very form of the content. For example, in the development of puzzles the content is distorted to fit a puzzle. That could express itself, for example, when the students in a history class need to know when a particular battle occurred in history to solve the puzzle, but, in doing so, they first need to know what they need to know in order to solve the puzzle. In that sense, the puzzle obscures the traditional teaching format. According to Ville Tahvanainen, University teacher at University of Eastern Finland (UEF), this is the biggest challenge in the development of teaching material fit for EERs: "*The biggest challenge of this pedagogical aspect or method is how we ensure that the problems are, of course, related to the theme or subject, so we need to look for the curriculum, especially in Finland, we are quite strict with the curriculum, we have to follow it.*" (Tahvanainen, V. 2020, March 27. Personal interview: 8.01). Once again, balancing content and form seems to be one of the biggest challenges for the implementation of EERs in HEIs.

On top of this, Tahvanainen further reflects upon the gaming aspect, as the escape games need to be appealing for the students to be motivated. As a teacher, in order to make the puzzles appealing enough, you need to test and secure that the tasks are clear, accessible and solvable. However, as Tahvanainen states, too accessible and undemanding puzzles will translate into lacking motivation from the students. As a result, another dichotomy presents itself as Tahvanainen not only addresses the challenge between content/form in terms of syllabus but also between appealing/demanding in terms of puzzles: "*We need to make sure that the problems, which the students face, are clear enough, and at the same time they need to be sufficiently demanding. That there won't be any frustration that, "ok, these are too easy" but at the same time they can't be "too challenging", so there needs to be a balance between the level of difficulty*" (Tahvanainen, V. 2020, March 27. Personal interview: 8.35)

This form of dichotomy can be explained by the fact that conventional syllabus-content gets obscured when put on a puzzle-format, Tahvanainen reflects: "*One challenge within the development of puzzles is the fact that content becomes too difficult when it is put on a puzzle format, and therefore we often have to make the puzzles a little easier than the normal level of content. It's a challenge in terms of the requirements from the board.*" (Torsøe, E. 2020, April

1. Personal interview: 35.24). And this insight is further challenged by another factor of variation, understood as the fact that the games cannot be made on a continuous recurring format puzzle without the possibility of creating a sense of boredom between the students: The form of problems should be varied. There should be variations. For example, that they should not all be calculations.” (Tahvanainen, V. 2020, March 27. Personal interview: 09.30). This insight is relevant if any HEI teacher wishes to integrate EER activities on a continuous basis in her course program.

Despite insufficient numbers of cases to provide reliable data, the research suggests that there were no prominent disciplinary fields among the EERs. And except for the case of *Didaktisk Gåderum*, there are currently no universities involved with EERs, in spite of an increased interest in GBL in HEIs learning environments in Denmark (Bojer, 2019).

The insufficient number of cases further challenges any judgement on the prominence of physical / digital escape game elements, but based on the cases, it can be suggested that the use of a digital screen as a guidance tool was most prominent (in three out of six cases with two more examples referred to by the experts), but other than the screen there were no digital elements in the total number of cases.

There was, however, a prominence of EERs represented in lower education levels, which among numerous factors is caused by an overall lack of integration of GBL in HEIs in Denmark, and, as suggested in above, the challenge of implementing EER-activities with the 1:1 curriculum structure and teaching form on HEIs in Denmark which seems to be more flexible in lower education levels than on HEIs.

### **Institutional support mechanisms (funding, strategy, equipment and facilities)**

Despite a willingness to give up content for the sake of the narrative, when asked, Torsøe still emphasises content over form on a more general level. However, the reason is not educational, but on the other hand administrative: “I guess we’ve emphasised content the most. Mostly because it is easier to “sell” the escape room-idea to the management. To get their blessing. But we also focus a lot on soft skills, 21st century skills, communication, critical thinking, collaboration.” (Torsøe, E. 2020, April 1. Personal interview: 14.50). Torsøe has witnessed a lot of resistance from the management despite a grant they got to explore new pedagogical formats from the municipality, and which resulted in the development of educational escape rooms. As a matter of fact, the lack of trust in the pedagogical experiment has required Torsøe to establish his own private firm next to his teaching in order to be allowed to teach other teachers about the use of escape rooms in educational contexts.

Vigild (2016) states that “Crucial is the magic of the narrative”. With EERs, the players put their brains in another mental state where they have to "play" and "explore" and just not learn. Therein lies the extremely important “seduction”. Players should not view space as a learning situation because in doing so, players' minds are otherwise prepared for the experience that space provides. Thomas’ thesis is that those kinds of challenges and experiences can manifest themselves as learning through completely different learning channels because the space conveys its story, narrative, puzzles and mood through real furniture, candles, objects and presence. The presence is crucial to the space, and as Nicholson (2015) says in one of his

dogmas behind a good puzzle: “Make the players matter. Players are not bystanders who happen to be somewhere with puzzles”. This is a crucial point in the design of the puzzles, and it is important that all players in the room feel appreciated, heard and recognized. The meaningfulness must be built into the narrative, enigma, dramaturgy and scenography of the room itself (Vigild 2016, p. 5). This is exemplified in *Ernst Trier’s Office* (2016) where Vigild emphasised the importance of space in a degree that required him to hire professional movers to help him move materials relevant for the development of the space. And despite an impressive dedication to space and narrative, in terms of transferability, it provides university teachers with a number of central challenges related to cost, time and accessibility of space.

The degree of dedication and investment points to the question of the level of escape room integration within the curriculum specific to the course, and to the teaching method in general. For, Ville Tahvanainen, who is the project coordinator of UEFs Sm4rt LOC project, these pedagogical design dogmas seem approachable since they are building an entire space dedicated to EERs but might provide the average HEI teacher, who wishes to integrate escape game related activities to her teaching, with a number of challenges.

## Preparation of Educators

The following section will focus on knowledge, attitudes, skills sets and competences of the educators that will help them in the preparation of EERs, and tap into ways educators can establish fruitful learning environments.

When integrating EERs in HEI teaching for the first time, educators have little time to prepare students for the gaming experience, and hence establish a space for exploration and wonder while also making sure the puzzles are tailored to the syllabus in ways capable of generating the intended learning outcomes. Following the *Didaktisk Gåderum*-case, one of the learning criteria was to enact students-as-designers (Sørensen & Levinsens, 2018). Reflecting upon her experiences from the case, Heidi Hautopp believes one of the points of success was to involve the students in the design of the escape room, but also suggests that they should have prioritised more time to prepare the students in the kind of disciplinary field than what they did as it was discovered in the subsequent evaluation process that some students were unsure about their learning outcomes (Hautopp, Ejsing-Duun and Vigild, 2019). This aspect is crucial in the particular case as two different student groups were involved: Game designers (Vallekilde Folk High School) and game participants (AAU) each with different learning outcomes. Such a complex learning environment is part of the game according to Hautopp, and she suggests differentiated instruction (DI) as a teaching framework to understand and approach the learning situation. As students differ in terms of performance, cultural background, language competence, gender-based learning preferences, learning styles, motivation, interest, self-regulatory competencies and other features, differentiated instruction, according to Carol Ann Tomlinson, is the process of "ensuring that what a student learns, how he or she learns it, and how the student demonstrates what he or she has learned is a match for that student's readiness level, interests, and preferred mode of learning" (Tomlinson, 2004: 188-189). DI can therefore be conceptualised as a toolbox of instructional practices, which enables teachers to

appropriately cater to students' specific learning requirements and ensure successful learning for all students within a diverse and inclusive classroom" (Pozas et al., 2019).

Moreover, Hautopp emphasises a clear learning goal when initiating EERs which otherwise risk to confuse the students: "*If you haven't articulated a clear learning goal, there is a risk to provide a foundation of ambiguity which confuses the students more than necessary.*" (Hautopp, H. 2020, March 20. Personal interview, 20/03). Hautopp suggests to perceive the possible ambiguity in the context of Gregory Bateson's concept of *framing* (1976). Bateson was the first scholar to deeply investigate context issues in connection with play activities. Bateson claims that each play activity requires meta-communication, i.e. a statement which provides a context for its own interpretation. In the context of the EER, the framing is articulated through an invitation about participation prior to the day, introduction during the day, facilitation during participation, the communication between the participants and the digital as well as physical installations found in the room. Finally, the institution sets a framework around the event, as the testing of the puzzle room takes place at the university. Thus, there are many different micro- and macro-frameworks that play into the interpretation of individual things and events, their contexts and meaning (Hautopp, Ejsing-Duun and Vigild, 2019: 7-8).

Hautopp points out three different aspects capable of generating ambiguity: The *context* can be a source of ambiguity when the game designer plays on the sociocultural discourse into which an object or event is interpreted. The *personal relationship* to things and events can be a source of ambiguity when the individual becomes in doubt about his interpretation and assessment of these. And finally, *information* about an artifact can give rise to ambiguity. Ambiguity arises in connection with the way the artifact's information is presented (ibid. p, 8). Researcher Jane McGonigal (2003) emphasizes that players maximize their gaming experience by pretending to believe that what is happening in ambiguous gaming situations is "real," rather than actually believing it. They thus help to maintain a framework of their own participation, they help to meet objects and events with the premise set by the game's framework - and thus they act as an interface for the game on their surroundings (Ejsing-Duun, 2011).

The ambiguity arises when the game designer gives inconsistent information, inaccurate information or gives the players reason to doubt the sources of the information. Building on this, Vigild highlights the harmful effects of ludonarrative dissonance. Ludonarrative dissonance is often described as a conflict between a game's narrative and the gameplay's narrative which can break with the 'realness' of the game. Vigild builds on the concept to describe the phenomenon that occurs when an escape game, for example, uses a thematic narrative set in ancient Greece and employs artifacts, for example a Viking helmet, which are culturally incoherent. The occurrence of cultural incoherence is one example, but was also expressed in anachronistic terms in one of the cases, when Ernst Trier's Office made use of a TV screen (a conventional guide tool in escape rooms) set in a narrative which took place in 1865. However, when educators are using students-as-designers in the escape room-development, which was the example in the case of *Ernst Trier's Office*, an interesting learning situation takes place which Vigild describes as 'the mirror of the game'. When Vigild was constructing the escape room with the students from Vallekilde Folk High School, they were seeing the games as "interactive experiences in a system": "*All games are a dialogical process, in which game and player systematically manipulate and are manipulated. At Vallekilde, the*

*development of games is part of 'the school day', and the development took place in the students' 'teaching time'. But the extraordinary magic of edification that comes into play is that self-forgetting takes over.*" (Vigild in Tanggaard 2019: 43). Sometimes during the development process itself but especially during the experience of the game, players become so immersed that they forget that they are in the process of learning because they find themselves in the best possible learning situation.

The framing aspect is a central design principle to prepare before initiating EERs in teaching situations. It is necessary for the educators to get properly familiar with the EERs. This mirrors Torsøes recommendation, as he stresses the importance to ally with teacher colleagues: *"I often say that the most important thing, if you want to embed escape rooms in your teaching, is to do it together with a lot of teachers, three-four teachers, don't do it alone or with one other. It's obvious that our success is due to the fact that we did in a group and collaborated with each other. Otherwise, you will never get to test the way."* (Torsøe, E. 2020, April 1. Personal interview: 27.20). Being in a group can generate a beneficiary environment to experiment with EERs in HEIs as teachers can perform and test games before the implementation in teaching, but teachers can also make use of each other's competencies. According to Hautopp, and based on insights from several reviewed cases (Didaktisk Gåderum, Ernst Trier's Office and EscapeGames) having experience with both game design theory as well as the specific disciplinary field in focus is key to the success of EERs: *"It is a really good idea to have both competencies: game development and the specific field the escape room communities"* (Hautopp, H. 2020, March 20. Personal interview, 20/03). A variety of knowledge and competences among educators within relevant disciplines to EERs will with higher probability provide a supportive and informative basis for developing effective escape game activities with a variety puzzle formations.

Finally, Hautopp, drawing on her experiences from *Didaktisk Gåderum*, stresses the central attitude of openness, both in terms of the design phase but also in terms of the particular learning situation: *"It is also crucial to be open in the development phase, and you have to let loose a little bit of the control, and trust that the students will learn, differently, since it is so difficult to identify and demarcate exactly when and what the student learns in the escape room"* (Hautopp, H. 2020, Marh 20. Personal interview, 20/03). Having the ability to stay open-minded in the process of the development of the escape games while also having an open attitude towards the learning processes is a crucial attitude when working with EERs in HEIs. How or if this openness can be integrated as a natural feature in the course program is still something that requires more discussion.

## Outcomes and Impact of EERs

The following section presents the reported outcomes and impact of the escape room cases with emphasis on learnings, competences and skills. For more information, please go to the case study section in the appendix. The section will firstly present a short overview of the overall reported insights, and secondly elaborate more in-depth based on examples from the cases.

Based on the overall outcomes and impact of the reviewed EERs, the following insights are central to bear in mind:

- Clear and articulate learning intentions which otherwise holds the possibility to get concealed by the narrative and puzzlement of the game. Providing a learning framework, and being able to articulate where in the process (of developing, exploring or evaluating) the students are can enable the students to understand where, why and what they are doing in the EER.
- Working with diverse groups (e.g. age, educational levels) can obscure the intentions of the game. Make sure to design EERs that support diversity.
- Working with too big groups holds the tendency to allow students to 'hide' or 'zone out' instead of interacting fully in the EER. This can for example be done by making explicit differences or developing clue design that supports diversity.
- Design EERs that students can take ownership over and match their world. Teachers need to be careful not to interact too much with the students or otherwise breaking the narrative by 'being the teacher'.
- Different EER formats fit different learning styles. The use of students-as-designers might fit a course-evaluation process better than a course-exploration.
- Different stakeholder motivations require transparency in terms of ownership (materials), responsibility (reimbursement), and intended learning goals.
- Implementing EERs require teachers to take into account the time investment before, under, and after the game situation.

With regards to the outcomes of EERs and impact on students, it can be noted that students were keen to try out new teaching methods but in order to translate the fun experience into a learning experience it was required from the teacher's perspective to be explicit and articulate about the intended learning goals. This became evident in the case of *Didaktisk Gåderum* where students from Aalborg University expressed uncertainty about the relevance of the EER in the subsequent evaluation round. In the same case, from an educational point of view, it was also clear that the learners' physical presence in the room is central for the gaming experience which then requires a clear framing of the game in the context of a larger learning situation. And it was therefore important to match expectations and articulate the learning goals for the students before they examined the escape room.

Another important aspect was that game factors such as time pressure, group dynamic and the game framework influenced the level of contemplation and reflection, and instead made the participants focus on the form of the game rather than academic content. Which in addition highlights the importance of the teacher's role as an active actor in the subsequent evaluation process. In the case of *Didaktisk Gåderum*, it furthermore became clear that there was an academic mismatch between the folk high school students (who designed the educational escape room) and the 6th semester students (who tried the educational escape room). This mismatch can be explained by the fact that (most) folk high school students would not yet have become acquainted with science studies. The authors suggest that their game format should be tested as a joint effort between the game designers from Vallekilde and 6th semester students

AAU targeting 1-2 semester students from AAU. In that sense, it is more probable that each of the actors' skills will shine more through.

In the case of *Ernst Trier's Office* with Vallekilde Højskole, due to a large diversity in terms of age and skills within the escape room groups, one of the design principles was to develop puzzles that supported the variety of people. To counter any possible dysfunctional group dynamic, Vigild developed a clue design that would require the group to perform a social activity which would boost the group dynamic positively. In the same case, another design dogma was that as soon as players enter the room, the puzzles and thus the game must feel like 'theirs', and all solutions should not attend to the game master's intelligence and knowledge, but, on the other hand, the player's intelligence. This kind of seduction is essential to keep in mind, and also leads to a natural, albeit problematic, loss of control over the learning situation. Now, the game master can control parts of the process via tips on a flat screen (or other clue elements), but it can quickly become a disruptive force and directly counter the more magical seduction for learning in the puzzle room.

Contrary to the above mentioned case, the learning in *Ernst Trier's Office* works on most implicit plans, and the Vigild purposely designed the room, so the seduction, the narrative and especially the mood in the room were the first priority. The puzzles should fit this, but not fall outside the time frame, and it locked him a bit into puzzles about e.g. Nordic mythology and about the national anthem. The ultimate goal of the game is to cultivate a concentrated, intense and genuine sense of a participatory community, where all individuals in the room contribute to solving not only the puzzles, but also the solution to the entire room. In this way, through the ERR-design, Vigild tried to build a sense of presence and unity, where the interrelationships of the puzzles are important, but not all decisive for building that kind of space. Based on subsequent evaluations from the EER-participants this worked really well, however it is worth noting that there were no explicit learning objectives in this EER, and the individual learning experience therefore has time and space to unfold.

According to Elisabeth Christine Tang, one of the challenges related to the fix-and-finish pedagogical format in *EscapeGames* was the level of complexity concerning the 'in situ learning' aspect where students had to develop the escape game themselves using their pre-existing knowledge together with materials and guidance from teachers. Here, the ambiguity of the learning is added an extra layer since the students need to be the designers of their own learning. It is suggested that this form of EER-format is used differently, for example in an evaluation process and not necessarily in an explorative process.

Another relevant aspect of *EscapeGames* was the collaboration between House of Science and Rubi Lee's Escape House since the collaboration made House of Science dependent on Rubi Lee's engagement, expertise and game materials. The stakeholder dependency makes the collaboration vulnerable, and provides another aspect of educational escape room worth taking into consideration. Establishing transparency in terms of ownership (materials), facilitation (teaching EER) and responsibility (learning objectives) before initiating EERs is key to a fruitful collaboration.

This unclear transparency aspect became a factor in the commercial case *Follow the Money* where the success criteria between Danish Broadcasting Corporation (DR) and the ER-

developer TimeQuest (TQ) were inconsistent. The main challenge of this case was the tension between a commercial motivation (TQ) and an experiential one (DR). For TQ, the way to increase revenue of the escape room was to build the room on a generic set-up and then add the Follow the Money-universe as a ‘skin’. Hence, minimising the reset process and tear of the physical space were ways for TQ to increase earnings. For DR, this became an unused potential in rebuilding the universe of the TV-series. The initial idea included both analogue and more high-tech clues organized in an open manner around the prop of an iconic bulletin board known from the TV set. As such, DR experienced that the final escape room lacked realness in the re-establishing of the universe and characters.

Similar challenges were experienced in the case of *Education and Job Journey* from Horsens Municipality, where the study counsellors initial purpose with the development of the educational escape game was to give the students a more active and immersive experience towards educational choices than the traditional (passive) PowerPoint-presentation. And while the escape game seemed to successfully achieve that, the founder Tim Nelson points out the biggest challenges with the escape game are time investment in terms of preparation and cheap materials which would break after only a short amount of usage. It can therefore be concluded that EERs provide students with alternative and more immersive learning experiences but educators need to take into account the time investment in terms of game setup, game reset process, and game dismantling.

Moreover, because of the success of the *EscapeGames*, Horsens Municipality chose to run a number of free theme days/conferences, but has now entered a strategic partnership with an unspecified private learning institution.

## Aspirations

A number of different aspirations were present among the reviewed cases. Some aspirations were intended towards more research as were the case for Heidi Hautopp, Thomas Vigild and Stine Ejsing-Duun who first of all are considering to translate and publish their article *Didaktisk Gåderum* to international journals. The same authors expressed interest in experimented with embedding different forms of ambiguities in the puzzles which would support different topics and tap into different skills and talents. Moreover, the authors expressed interest in discovering other narrative setups, for example, different film genres.

## Final comments and suggestions

### **Reflections on the landscape of educational ER games in Denmark**

Drawing on the large majority of all educational cases (except the commercial case) it becomes clear that learning take place. But what kind of learning, where the learning emerges, and when the learning takes place is less clear. GBL is most likely a pedagogical method which will become increasingly popular among HEIs in Denmark based on the number of initiatives and interest in the field. EERs are still in their infancy, and there still is a substantial lack in terms of the right use, the needed institutional support and integration with curriculum, and the most

suitable skills, knowledge and attitude from educators. However, based on the cases it seems educators can come a long way with the right mindset and level of trust from their respective institutions.

As the cases has shown, collaboration is key to make EERs function in learning environments. While some experts pointed collaborative puzzle making as central to an efficient and resilient EER, others emphasized the need integrate different stakeholders, both inside and outside educational institutions, in order to succeed implementing EERs. Being able to draw experience from actual escape room practitioners (commercially as well as academically) seemed essential to provide the teachers with the right world-building capacities and the students with the right framing and intention when participating in EER activities.

Moreover, as blended learning and other digital tools are increasingly integrated in learning environments on all educational levels in Denmark, there is a space upon to explore ways to incorporate EERs on a digital basis (see for example Nielsen et al. 2019). This is not least becoming more relevant with COVID-19 currently spreading in most parts of the world.

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## 2. Germany

### Introduction

This report summarizes the status-quo of escape rooms in the educational context in Germany, namely EERs. Accordingly, a review is presented on the EER literature, aggregated with nine expert interviews<sup>1</sup> and six<sup>2</sup> case studies implemented. In addition to the interview-based case studies, the report also refers to the German EERs in literature, including *Escape Room im Informatik*<sup>3</sup> and *Chemie einmal anders*<sup>4</sup> both cited in the references. The scope of the report is EERs in the formal and non-formal (continuing) education context, with five cases from German HEIs and one from a secondary educational institution. All cases target student learning, with two also being implemented to gather data for academic research, and one used for workplace training. Short summary of case studies referred in the report are as follows:

- The mathematics escape room *Escape the Matrix* at TU Braunschweig provides students the opportunity to recap and apply knowledge acquired in the previous semesters. The initiators aim to use the escape room to add a fun element to the rather intense mathematics curriculum.
- The entrepreneurial escape room at Ruhr-Uni Bochum aims to teach students how to deal with uncertainty in a startup environment. The *Think Space* laboratory allows students to deal with scenarios that make the experience of uncertainty in the start-up context tangible.
- *#CanYouEscape* is a breakout box developed by University of Education Freiburg to teach students on secondary level that science can be fun and create fascination for subjects related to technology and natural sciences.
- Stefan Schwarz implements escape rooms in his regular teaching at *Oberlinschule Potsdam*, a school for children with physical handicaps and learning disabilities. He implements his escape rooms for various purposes in the curriculum, such as developing social skills or teaching thematic content.
- The escape game *The Lost Scientist* at Mannheim University can be played by everyone. The project was initiated for research purposes. During the Escape game, the behavior and movements of the participants are tracked to research new ways of group cooperation and leadership.
- *Escape Room - The Employee in the Production of the Future* at RWTH Aachen is launched as a means to integrate students and workers in workplace transformation and innovation processes by exposing them to recent innovations and challenges of production workplaces.

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<sup>1</sup> The expert interviewees referred in the report are as follows: Amelie Metzmacher, Katharina Flößler, Annabelle Beyer, Dirk Lorenz, Laura Marie Edinger-Schons, Stefan Schwarz, Markus Wiemker, and Rebekka Riebl & Thomas Schmitt.

<sup>2</sup> One of the case studies, *Escape Room - The Employee in the Production of the Future* at RWTH Aachen is not included in the Case Study Collection, due to limited information obtained from the institution.

<sup>3</sup> Hacke, A., Przbylla, M., & Schwill, A. (2019). Beobachtungen zum informatischen Problemlösen im Escape-Adventure-Spiel „Room-X“. In *Informatik für alle*.

<sup>4</sup> Groß, K., & Schumacher, A. (2020). Chemistry Escape–Finde den Weg: Chemie einmal anders erleben. *Chemie in Unserer Zeit*, 54(2), 126–130.

## Status of EERs in Germany

Playing escape rooms is an increasingly popular recreational activity in Germany. The trend originating in Japan is favored by new emerging technologies, such as virtual reality, promising a more immersive game experience. Using storytelling and game design, escape rooms can be an effective way of transmitting knowledge and thus represent a great opportunity for education. However, in the German context, escape room method is not fully integrated yet. EERs are more often implemented as a fun teaching element in primary and secondary education, and the use cases of EERs in the HEIs are rather rare.

According to the expert interviews, even though many educators are interested in EERs, they often fail to exploit them as part of their curriculum. A major reason is reported to be the time constraint educators are facing. Being involved in daily teaching and curriculum development rarely allow research for and development of new teaching methods. In addition, many educators in Germany still have a very traditional approach to education. The belief that gaming and learning are not compatible hinders the adaption of the concept in educational contexts. Using games in form of simulations, however, is not very new. Flight simulations for pilots or business simulation games have been part of curricula for years as playful means of exercise for students<sup>5</sup>. The case of *RWTH Aachen* represents an example of an EER in continuing education context that introduces workers, along with students, with digital technologies in production and future workplace innovations.

As targeted by the project, physical EERs have been investigated, which are place-based set-ups in nature, with most integrating digital elements to diversify the offer of challenges. In addition to their focus on education, two German EERs are found to cater for research purposes, e.g. analyzing group dynamics and team collaboration. The behavior of the participants are tracked in the EERs *the Lost Scientist* and *Think Space*, via use of video recordings and movement tracking technology. The results of this research serve as input for teaching, such as seminars for students. Furthermore, by inviting test participants from inside as well as outside the university, escape rooms loosen the boundaries between HEIs and the public.

EERs in the German HEI context are implemented in the fields of natural sciences such as biology and chemistry (*i.e. Chemie einmal anders, #CanYouEscape*) or fields that are dealing with logic and problem-solving, like mathematics and informatics. In natural sciences for instance, they provide students opportunities to learn in a practical way by conducting experiments. EERs are also implemented in the field of social sciences, more particularly in the areas of business, e.g. corporate social responsibility (*i.e. in the Lost Scientist*), and entrepreneurship, in teaching students of interdisciplinary teams (of e.g. business administration, business psychology, applied computer science, mechanical engineering, IT security, electrical engineering & information technology, civil engineering, computational engineering, and mathematics) how to deal with uncertainty in entrepreneurial contexts (*i.e. Think Space*).

German EERs exhibit presence of internal and external stakeholder groups who participate in, and contribute to the development and design of the games. The cases *Think Space* and *RTWH*

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<sup>5</sup> Niedermeier, S., & Müller, C. (2016). Game-Based-Learning in Aus-und Weiterbildung–von der Idee zur Umsetzung. In *Digitale Medien: Zusammenarbeit in der Bildung* (pp. 190-200).

*Aachen* demonstrates that it is possible to cooperate with business partners who provide technical equipment for the escape games. In the case of *Think Space*, the WorldFactory Startup Center of the Ruhr University Bochum provides rooms, federal education funding programme *Infrastructure for Teaching and InStudies* covers the finances, and the business organisation *Think Square* team offers their expertise in the construction of escape rooms and their use in team training.

Financial support is mentioned as one of the crucial factors in the development and adoption of EERs in the German context. Receiving institutional or third-party funding for escape room projects promote the implementation of this method and allows the facilitators to design games that are more sophisticated. Among the analyzed cases, two German EERs are funded by the German Federal Ministry of Education and Research and the European project MaSDiV (Supporting mathematics and science teachers in addressing diversity and promoting fundamental values), with support ranging between 10.000 € – 50.000€. However, most of the analyzed educational escape rooms did not receive any specific funding for their escape room projects. In such cases educators draw back on facilities and equipment of their faculties, which reduces the overall costs of the escape room implementation, which was the case in *Escape the Matrix*, *Oberlinschule Potsdam*, and *The Lost Scientist*. These examples demonstrate that it is possible to develop simpler, yet successful escape rooms with only modest financial investments.

Regarding the digital tasks of the escape rooms, these challenges can be fully digital, like e.g. researching for information on the internet or integrated in a physical task, such as finding NFC tags which are distributed across a building and retrieving tasks from those tags with a smartphone<sup>6</sup>. Of the examined examples of German escape rooms, however, none was conducted completely digitally. Reasons might be the advantage of a greater immersion that can be provided with a spatial and haptic dimension, but also the barrier of technical skills that are required to design such a game.

## Development and Implementation

### Development

The EERs are developed in line with the goals and objectives of the course, and learning outcomes identified. The blueprints are then prepared accordingly, and puzzles selected, along with prototyping and testing phases prepared and implemented with involved stakeholders. The EERs are designed for different purposes. The observed EERs in Germany aim to promote explicit learning of course content (*i.e. Chemie einmal anders, Oberlinschule Potsdam*), introduce students into a new topic (*i.e. Think Space*), motivate them for certain topics (*i.e. Escape Room im Informatik, Chemie einmal anders*) or to promote their social skills (*i.e. #CanYouEscape*). Even though examples of students developing escape rooms themselves exist (*i.e. Oberlinschule Potsdam*), most use cases focus on students playing the game.

Planning and testing of EERs are mentioned to be crucial. In the case of *The Lost Scientist*, experiments were scheduled where volunteers could participate in the escape room experience

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<sup>6</sup> Niedermeier, S., & Müller, C. (2016). Game-Based-Learning in Aus-und Weiterbildung–von der Idee zur Umsetzung. In *Digitale Medien: Zusammenarbeit in der Bildung* (pp. 190–200).

in exchange for filling a survey. Conducting 20 test runs beforehand helped to find the right level of difficulty and to optimize the flow of the game. After the testing period, escape room facilities were made available for young scientists as a laboratory for experiments. In the case of *#Can you Escape?* the game organising team found working on an excel file very useful. They have identified the paths and marked down which riddles would go into which box, as well as the required codes for each puzzle. The directions marked on the Excel document allow the tutors (the FUE students) coordinate the games accordingly, and independent from the organisers being present.

## **Resources**

The resources invested in the EERs include human, financial, and physical resources. In almost all cases, there is presence of a team of EER staff, or student assistants supporting the development and implementation of the games. Financial support refer to internal and external streams of funding, while physical facilities the room/ space allocation made by the HEIs.

In one of the cases, the interviewees reported to have received support from their institutions when adapting innovative teaching methods (i.e. *Think Space*). External stakeholders can be involved as funding parties contributing with financial means. However, regarding the analyzed use cases, this scenario is rather rare. In the case of the *#Can you Escape?* organizers received financing from a federal funding programme. Private escape room companies are consulted for their expertise, and institutional facilities are exploited in designing immersive games. In one of the cases organizers benefit from collaborations with industry partners by receiving technology and equipment for the escape room setting (i.e. *Escape Room RTWH Aachen*).

## **Challenges in design process**

Interviewees reported a number of challenges, some of which will be re-visited in the supporting factors & inhibitors sections. Regarding the type of challenges faced, it is related to the EER pedagogy to be used. Facilitators find themselves challenged to make a trade-off decision between steering the attention of the students more on discipline related tasks and maintaining the immersiveness of a game by eliminating game elements that are not necessarily related to the course content but contribute to the game experience (e.g. the narrative) facilitators might move the focus towards educational contents but on the other side loose parts of the immersion and game character of the escape room (*Braunschweig*).

When designing the escape room, facilitators report to be challenged by connecting the tasks of the game with each other to create a coherent pattern between the individual puzzles. Often, the connections between the tasks feel constructed and not intuitive. Furthermore, it is difficult to assess the difficulty of the designed game beforehand (i.e. *Escape the Matrix*). In the case when student involvement in the EER development is considered, teaching students escape room development can be a challenging task. For students it can be an unknown genre and not every student went to an escape room. Therefore, it is strongly suggested that students are first introduced to an actual escape room, and are allowed to analyze the experienced elements in order to successfully develop their own escape rooms.

Other unique challenges included not being able to keep all the students interested and motivated in participating the game - especially when students have difficulty understanding the purpose of the activity, or if they cannot quickly solve the puzzles, some get easily discouraged (i.e. *#Can you escape?*); the regulations around the approval of the EER by the

university that required some time (i.e. *Think Space*), which was followed by other challenges in structuring of the room by the collaboration partners due to certain regulations.

## Design

The interviewees have mentioned a number of design elements they consider in developing EERs. These include (i) learning outcomes targeted, (ii) pedagogical elements, and (iii) gamification elements.

The learning outcomes appeared to be diverse, ranging from reinforcing learned knowledge prior to an exam, development of soft skills, increasing self-awareness on capabilities, and create enthusiasm about desired subjects. The EERs are not suggested as useful for delivering large chunks of knowledge, but rather introduction of new topics to the learners. From pedagogical perspective, active student learning is targeted, by allowing experimentation and co-construction of meaning assigned to the EER environment. Enriching their learning experience, students are involved in the design process. From the examined sample of German EERs, students on a secondary education level were designing escape rooms that were played by younger students (i.e. *#CanYouEscape*). In one case the activity was incorporated in a subject called natural science and technology, and in another one in handcraft lessons focusing on the designing on the puzzles. In almost all cases, student reflection is ensured via debriefing sessions, during which participants reflect on their experience, directed in line with the identified learning outcomes.

As per gamification, the dimensions discussed include rules, narratives, team size, hints, awards, and time limits. Most of the examined escape rooms are designed based on a narrative, except for one case, which is solely structured around solving the riddles. The applied narratives, however, are mostly thematically linked to the subject the escape room is developed in, and the storyline and the puzzles of a game are built around that narrative. Regarding the participants, the most common team size ranges between five and seven people, in only two of the examined cases, participating groups had a size between two and four students. The shortest escape games of the analyzed case studies have a duration of 30 minutes, while longer ones take up to 60 minutes of playing. Including the introduction and debrief, a whole session can take up to 120 minutes, when the students are additionally required to fill a survey (i.e. *The Lost Scientist*). In another case, a teacher fits the full escape room session in a 45-minute school hour (i.e. *Oberlinschule Potsdam*).

Escape room sessions thereby, usually have a common structure. Starting with an introduction where the moderators introduce the narrative and the task of the game, the core part of the experience – the actual game – follows. In the final element, the debrief, moderators give feedback on the performance of the participants, provide room for the students to reflect on and discuss their problem-solving approaches and on their experience with the escape game.

Most of the examined escape rooms are designed based on a narrative, except for one case, which is solely structured around solving the riddles. The applied narratives, however, are mostly thematically linked to the subject the escape room is developed in, and the storyline and the puzzles of a game are built around that narrative. Thereby, the narrative has the function of a motivating element. The facilitator of the escape room at *Oberlinschule Potsdam* reports that an overarching narrative, that connects puzzles to a backstory provides additional reason for the students to solve the tasks. Furthermore, the narrative can be presented to the players in multiple ways, for instance through a plain text or introducing it in a video or audio format.

Regarding the logical structure of the puzzles within the game, multiple approaches are applied. In every game, the puzzles are linked to the overarching narrative of the game to provide a holistic and immersive experience. Some games are organized in a sequential structure, meaning that all puzzles follow a chronological order (*i.e.* #CanYouEscape, Think Space). This allows to tell a chronological story and creates a stronger interconnection between the puzzles. Other games do not follow any logical order and thus, can be solved in arbitrary order (*i.e.* Oberlinschule Potsdam, Chemie einmal anders). The advantage of this approach is that players can start with tasks they prefer or switch to another puzzle once they are stuck. Participants can also split their team in multiple subgroups to work on different challenges simultaneously. On the other hand, students would miss the parts of the game their teammates worked on. An alternative approach, which is a combination of the first two options, allows players to choose between different paths. Those paths are again organized in a sequential order and have to be solved in order to solve the final puzzle of unlocking a door or a box. In the case of the Freiburg #CanYouEscape, students must solve three independent tasks in different teams to unlock the, ultimate code together in the end. Thereby, the paths are still interconnected since groups need input from other teams to solve their own puzzles. This still allows for interdependence between the players.

As for hints, it is typical that the moderators are located in a separate room while monitoring the activities of the participants with microphones and webcams (*i.e.* Escape the Matrix, The Lost Scientist, Think Space). Thereby, facilitators find it helpful to hide elements that are disclosing the fact that players are observed, so the participants do not feel constantly watched. In one case, the facilitators provide walkie-talkies to players to create the illusion participants are alone in the room. Considering the examined cases, especially in the context of lower educational levels, it is more common that the moderator/teacher is present in the room to provide guidance.

Furthermore, different tactics are applied for the provision of hints. Hints can be provided on demand, when participants feel stuck. In other settings, teachers provide additional guidance when they observe that students are not headed towards solving a puzzle. In the case when moderators are located in a separate room, hints are given remotely, for instance via a microphone or a chat programme. In another escape room, the facilitators use cue cards or write hints on a whiteboard, which the students can draw back on in case they are stuck. To make facilitate the performances of the students are comparable, facilitators of the *The Lost Scientist* escape room only provide hints at standardized times.

## **Implementation**

The EERs developed as part of the analyzed case studies are used in both formal and non-formal (continuing) education contexts, as well as non-educational e.g. providing recreational activity to public in the case of the *Lost Scientist*.

As for implementation, German EERs are integrated within course modules. The purpose is the development of knowledge and skills, build an attitude of curiosity, and make learning fun. Escape rooms are created with reference to prior knowledge that is taught in preceding lessons. In the escape room setting students then are challenged to apply this knowledge and develop new skills. In a gamified setting, students test their previously acquired knowledge and skills. Other educators implement escape games as an activating element to introduce students into a new educational topic. The interviewees of the case #CanYouEscape stated that their escape

game can be applied for the purpose of team building or revising learned topics, but not for the introduction of a new topic.

Especially in subjects of technology and natural sciences, educators design escape rooms to create fascination for their subjects. Targeting in particular, students in high school or secondary education, some examined initiatives aim to introduce students into subjects like chemistry or informatics and attract them into science in a gamified way (*i.e. Chemie einmal anders*).

Other examined EERs prioritize the promotion of soft skills like teamwork and leadership, and thus do not aim at teaching any educational course content. Especially at the beginning of a semester or a school year, these escape games are a favored method to break the ice among students and strengthen their relationships and collaborative skills. The educator in the *Oberlinschule Potsdam* uses the escape game experience additionally as a diagnostic tool to identify behavior and personalities of his students to apply right teaching and communication approaches.

Accordingly, the EERs are integrated into course modules, except *#Can you escape*, at the start, during, or end of the module, depending on the goal of the learning activity. In the case of *Think Space*, the EER activity is integrated into the curriculum of the course module “Coping with Uncertainties in Entrepreneurial Contexts”, and it is used at the start of the teaching period for the students to get to know each other. In the case of *Escape the Matrix*, the EER is set at the end of the course teaching, to consolidate knowledge previously acquired.

### **Daily operation**

The daily operations required involvement of additional internal staff for successful implementation of the games. In the three cases *Escape the Matrix*, *Think Space*, and *#Can you Escape?* the educators as coordinators are supported in the operations by student assistants, tutors, PhDs and Postdoc students. In *Escape the Matrix*, supervision during the game is reported to be the most time-consuming activity in the game days, with postdoctoral students involved invest 6-8 hours each day for this task.

In the case of *#Can you Escape?* certain decisions made regarding selection of the escape room environment based on request, either staying in the room where they use the walls and the classroom setting, with the puzzles that can be gathered and moved in different rooms, or carrying the Breakout Box form to the locations, if the game is going to be played in the schools, or events e.g. STEM science and education fairs.

### **Assessment and Evaluation**

The EERs in the German context only employ formative assessment. According to interviewees, evaluating the performance of students within the game is a challenge since the performance in the game is a group effort, which makes assigning individual grades difficult. Furthermore, there are different player and learning types within groups, which makes a quality assessment more challenging.

In all cases analysed, the students are given a platform after each session where they reflect on their experience, and perceptions of skills and attitudes of themselves, as well as their classmates. Regarding scientific analysis, in the two cases of *Think Space* and *The Lost Scientist* student behaviour is systematically analysed and evaluated across an identified theoretical framework. This scientific framework is continuously adopted with each set of incoming data

retrieved from the Escape Room videos. The goal of this analysis process is to identify the competencies linked to entrepreneurial and team leadership behaviour.

### **Roles of stakeholders**

The EERs in the German (higher) education context involve a number of internal and external stakeholders, participating in different stages of game development and implementation. Educators hold the most crucial role, due to the multiple hats they are wearing. Considering the examined case studies, all escape rooms were initiated by educators themselves in a bottom-up process to introduce alternative methods of teaching. Depending on the setting, educators take on the role of project managers and escape room developers, but also take over more operational tasks, such as the moderation of the game (*i.e. Oberlin, Braunschweig, Mannheim*). Often, they collaborate with fellow teaching staff or other chairs at universities to realize the escape room projects (*i.e. Braunschweig, Oberlin, Mannheim*). Moreover, educators involve faculty staff, such as student assistants in the planning and operation processes of the escape game. Especially, when developing more sophisticated escape rooms, collaboration across departments can be beneficial. As an example, working together with departments of informatics can help to tackle the technical challenges of the escape room development (*i.e. The Lost Scientist*). Students are involved in both development and implementation/ operations of EERs. Regarding the behavior within the game, four types of participants were identified: Those allocating tasks, those receiving tasks, those who want to collaborate with others and those who want to work independently. Collaboration with third parties include public and private institutions. It has been observed that HEIs collaborate with secondary education institutions (*i.e. in #Can you Escape*), industry partners (*i.e. in RWTH Aachen*) and business start-ups (*i.e. in Think Space*).

## **Supporting and Inhibiting Factors**

Availability of resources, including time, guidelines and materials, infrastructure, and finances as well as preparedness level of students and educators appeared to be the most influential factors in the successful design and implementation of the EERs.

Designing an engaging and comprehensive EER is seen as a time-consuming task. Despite the awareness on the availability of online EER guidelines, resources and tools, German educators only rarely reach out to this content in designing their courses. Educators often require a selection and a combination of these resources to fit escape room games to their respective curriculum. Thus, the content is mostly not ready to use. Adapting, redesigning, and prototyping could cost educators weeks of work before a game could be implemented. Different languages and deviating country curricula might be other factors inhibiting the adaption of those resources.

Despite the interest of educators in escape rooms, it is further observed that EER methodology is often being used solely for the sake of applying an alternative teaching method rather than actually making teaching more effective. The lack of knowledge can cause the content of the escape room not to be delivered in a meaningful way. Thus, the full potential of the method cannot be exploited. Therefore, in preparation of resources it is very important to highlight the subjects that can be taught through the EER and the learning outcomes that can be achieved. Moreover, to make these platforms useful, it has to be used by many people, which creates network effects.

Lack of facilities and ICT infrastructure are some of the inhibiting factors in the development of escape room games. Regarding the competences of educators, creating educational escape rooms requires facilitators to have digital skills. In order to set up digital challenges, using digital tools, or to solve technical issues a certain level of technical expertise is needed. In addition, in order to design immersive puzzles, facilitators must possess creativity. It is important to be analytical, open to criticism and be willing to take risks in order to try new concepts. Consequently, not possessing these skills and experience might hinder educators to adopt the escape room method into their teaching.

For escape rooms to be successful, it is also crucial that this method is adopted by the students as well. Educational escape rooms are a rather novel educational concept that many students are unfamiliar with. It is also the case that there are students who have never played an escape room game. Hence, the concept of Escape Rooms as an educational activity must be clearly explained to the students since there can be misconceptions about it.

## Preparation of Educators

The educators can be supported in three directions to develop knowledge, experience, and the right attitude towards successful adoption and implementation of EERs. The results of the interviews are found to be clustering in three dimensions regarding educator support: (i) Encouragement on changing own understanding and approach to EERs, (ii) providing resources about game design and EER pedagogies, and (iii) creation of a hub of resources, including access to customizable materials, and access to persons, who would be interested in providing guidance in EER design. It should be noted that the experts and practitioners interviewed as part of the project have had either access to available resources, or have shown resilience despite the lacking opportunities. Thus, the suggestions should be in the direction of not only supporting already practicing EER developers, but also reaching out to those who have not yet experimented with the concept, yet hold potential.

Next to creative and technical skills that are required to develop escape games, it is beneficial for educators creating escape rooms to gain knowledge and experience in game design. To start, it is suggested that the educators experience ERs themselves, and get familiar with working structures of the game. Educators can be made aware of existing societies, networks, conferences, and available workshops series and encouraged to explore and seek out support for questions. The implemented games must fit in the taught curriculum. Therefore, teachers need manuals and guidelines on how to integrate those methods into their classes. Already existing platforms can be a valuable source for educators to exchange ready-to-use materials and puzzles. In that regard, toolkits would provide elaborated templates for EER design.

## Outcomes and Impact of EERs

As reported by the interviewees, the escape room method is very motivating for the students and produces higher engagement than other conventional teaching methods. In particular, the physical and haptic experience contributes to an increased motivation. Escape rooms are reported to be a fun experience which even increases motivation for low achieving students.

According to expert interviews, EERs might be effective in challenging students' attitudes and developing perceptions towards behavioral change.

As reported by the interviewee of the *Oberlinschule Potsdam* escape room, debriefing sessions can further be used to facilitate transfer of knowledge to areas outside of the escape room or the specific subject. However, no research does exist yet proving that escape rooms produce long-term learning outcomes.

A very essential element that was reported to be a learning of escape rooms is teamwork. It was observed that teams who communicated more intensively and collaborated well within their groups were overall more successful than others. Analogously, teams who knew each other before the game showed greater problem-solving capabilities than teams consisting of strangers. EER settings are argued to further promote the creativity of students in finding unconventional ways to solve tasks. Regardless of their level of achievement, students are further provided the opportunity to exhibit skills that are not linked to an educational subject. Overall, the examined German escape rooms successfully transport soft skills such as teamwork, increase in student motivation and challenge students' attitudes.

Observing the participants within the escape room allows facilitators to gain insights on their behavior and their cooperation within a group. These insights additionally allow educators to conclude on their students' ability to solve problems or are used for research purposes (i.e. *Mannheim*). When working on solving the puzzles, students were observed to prioritize tasks that are not too hard to solve and fit their personal interests. Other tasks are neglected or other team members were asked for help.

## Aspirations

Regarding the transferability of the examined escape rooms, multiple interviewees stated that their escape rooms could be applied to other subjects and different levels of education. One escape room project is planned to be opened to external participants outside of the university. In the *Escape Room RWTH Aachen*, the scope of the simulation laboratory is to be increased by other interesting courses and by various measures from the department. Besides, the parallel development of an offer concept for training outside the university aims to ensure a funding basis for continuous teaching and research operations. A similar approach creates a good starting point for the long-term development of the EER *Think Space* towards an interdisciplinary and curricular anchored approach to research-based learning.

Others plan to expand the capacity of their escape rooms and offer it to a wider range of students (i.e. *Escape the Matrix*). The facilities of the escape room project used for research purposes are planned to serve young researchers as a lab (i.e. *The Lost Scientist*).

## Final comments and suggestions

EERs seem to be offering meaningful learning environments and there is interest among the HEI community to exploit it further. Our research revealed that EER development and implementation takes place in an ecosystem, and along with set of stakeholders, that influences

the quality of games developed. Thus, it is important to first understand the dynamics, and maximize one's own knowledge in designing EERs. While there are wealth of materials and lesson plans available online, there has to be more offered to educators to efficiently and creatively pull together those resources and exploit them for own use.

# 3. Lithuania

## Introduction

The purpose of the report is to present a national-level literature review, case study and expert interview reviews on game-based learning (further GBL) and escape rooms (further ER) in the Lithuanian higher education context. The report presents literature review on the existing practices in higher education published by Lithuanian authors, five case studies on implementation of escape rooms and an interview with the expert in GBL and ERs. The expert interview and case studies took place in March-June, 2020. The expert interviewed was a teacher from Kaunas University of Technology (KTU) who have an extended experience in theory and practice of GBL.

The five case studies are the following:

Case Study 1 and 2 document “Open Access” and “Christmas” ERs organized by KTU Library staff. Case Study 3 - “Finding stolen Einstein’s brain” organized by a private commercial ER. “Infinity Room” owner, Case Study 4 - “Room of Justice” ER organized by Lithuanian Courts Administration for educational purposes and Case Study 5 - “Escape the Lab” ER organized by KTU Scientific Student Association.

Data obtained from interviews, case studies and academic publications were analyzed with MAQDA2020 software. Data analysis was carried out in terms of the status of educational ER (further EER) and GBL in Lithuania context, EER methodology and implementation, skills and competence development, drivers and barriers for the development of GBL and ER games, and impact of ER games.

The main research questions that were guiding the Lithuanian context research presented in this report are the following:

- How is the game-based learning (GBL) concept, Escape room games in particular, are interpreted in the context of Lithuanian Higher Education and disciplinary area?
- In what ways the ER games (or GBL in general) methodology is/can be integrated into the curriculum and pedagogy of HE?
- What are the skills and competences that might be developed by using GBL and ER methodology?
- What are the main drivers and obstacles regarding the implementation of GBL and ER methodology in practice?
- What is the impact of GBL and ERs on the study process?

## Status of EER and GBL in the Lithuanian Context

Regarding EER games in Lithuanian context there are no consistent practices used in this area. The research identified a few cases of EER in the educational context. The majority of other EERs are developed as commercial products.

It is a challenging task to define the GBL and ER concepts in the context of Lithuania (Bitinas, 2006, 2013; Kalinauskas, 2018) and internationally (Faiella & Riciardi, 2015) as literature review reveals that Lithuanian authors tend to adapt definitions of GBL and ER of different researchers from other countries.

Particular examples of EER in the project indicate that Lithuanian educators are more involved in applying GBL in general rather than in EER in particular. Literature review has demonstrated that GBL as such is both researched and implemented at HEIs and educational institutions within levels of elementary, secondary and adult education. The most in-depth research on GBL presents the analysis of the impact of GBL on students' motivation and involvement in the learning process. Particular cases of GBL application at different educational levels can serve as examples when (i) GBL is considered an innovative method for seniors' teaching and learning, (ii) teaching a specific discipline of economics and (iii) the development of a musical game for young learners.

When it comes to EERs, it turns out that only in one HEI we could identify researchers and educators implementing this method of learning. They developed a virtual ER, which still has more features of a science dissemination exercise rather than being implemented within the curriculum of a particular subject.

Regarding pedagogical aspects of GBL and EER, experts state that there are two possibilities of their use in the process of learning. One is *“when the elements of gamification are applied in learning process which is not related to virtual reality (further VR) or 3D implementation but gamification is used for assessment as a tool to move on to the next levels of learning. E.g., Moodle environment provides a possibility to integrate certain plug-ins; teacher can organize assessment at certain levels without grading. Another version of GBL is when it is applied for learning and assessment processes. This could be exemplified by VR and 3D technologies implementation. This aspect would be most suitable for the methodology of development of escape room courses. Escape room could be used for the presentation of learning material and assessment by moving from ER to another where the teacher could assess the knowledge and skills of learners”*.

The question about the *form of EERs* – digital or physical is more suitable for presenting a course material could be viewed differently. Now, many Lithuanian researchers are working on digital ERs and digital learning environments in general (Gudoniene and Rutkauskiene, 2019, Blazauskas and Gudoniene, 2020), but they state that it is possible to prepare teaching material and assessment for a physical escape room. It depends on the pedagogical aim: to apply a certain technology or a pedagogical methodology. A creative teacher will design an ER in any case, in a physical or virtual environment. However, if speaking about technologies, the emphasis would be on virtual reality and 3D.

If to compare the methodology of ER and other GBL activities, within the context of Lithuania and *different disciplines*, and its place, experts suggest that this is a very big niche, especially for VR ERs. This is firstly because the VR technology itself has not been strongly controlled, in a positive sense, it is a strong technology, but probably it has not been mastered for the

purposes of education. In terms of education, there are not many learning objects or learning contents related to VR, which would present all learning process in the virtual environment. There are many technologies, but mainly it is a matter of creativity. It should be very popular especially for technological subjects where visualization is very important, where safety is very important, e.g. to test how to connect electric wires, in VR first, and then to try it in real conditions. In this aspect, GBL is important.

The case studies of ERs developed for this project illustrate in which disciplines they are used or could be potentially applied to. The example of a chemistry laboratory VR ER shows that such a type of ER could be used in many areas of studies when there is a need to create a safe environment for laboratory experiments (engineering, natural sciences) or specific training when it is not possible to use real subjects (medicine, veterinary). Other examples demonstrate the application of ERs in social sciences (communication, law), when specific case studies from those areas could be transformed into ER formats.

Researchers also emphasize the *student engagement and motivation by using GBL and EER*. For example, Kalinauskas in his PhD dissertation “Expression of students’ engagement into gamified studies” (2018) discusses the process of application of gamification at higher education (further HE) with focus on student engagement and “*Educational interactions between educator and learner when gamified system is being introduced in the study course*” (p. 253). The author also emphasizes the role of information and communication technologies (ICT) as a tool for gamified learning. He distinguishes two approaches, which define gamification. Firstly, he mentions that gamification is “*defined by a set of elements that are specific to games used in the design of the system*” (p. 257). Secondly, “*the game-specific spectrum of experiences appearing in the gamified system is emphasized*” (p. 257). “*Gamification in education is perceived as a method and thinking approach to system design, focused on creating engaging experiences through interactions with part of elements of game mechanics. The purpose of gamification is to engage users of the system into learning activities. Gamified systems also work as a medium for the deeper educational interactions between educator and student*” (Kalinauskas, 2018:261).

*Drasute et al (2018), who focus on video games in education and present the gamification as the most powerful learning tool, also discuss student engagement. The authors base their definition on Oxford scientists, claiming, “in the near future, digital learning tools will substitute books, whereas the combination of an increased focus on student engagement as well as the possibilities provided by digital learning will make gamification a powerful tool for educators”.* They present an EU project-based initiative “Videogames for teachers”, the website of the project: <http://v4t.pixel-online.org/>.

Petrauskiene (2018) talks about gamification as a *motivational aspect* in learning. The author discusses the elements of gamification that vary depending if it is a digital or non-digital one. She presents the following aspect of gamification: “*Creativity, innovativeness, courage to create and try, non-traditional thinking, entrepreneurship, striving for progress, willingness to explore, etc. are new personal characteristics and requirements for future employees in a competitive business world. Games create active participation in action, develop a sense of mastery and deepen into the subject. Collaboration and positive competition are also very*

*important elements of the game that create new learners' competencies. As the learner becomes more active in the process of learning, a new challenge for the teacher is to get to know and strengthen the learner's motivation. Therefore, gamification aims to activate and more effectively involve the learner in the learning process”.*

Analyzing how widely GBL is used in Lithuanian HEIs, it has been observed that GBL is not very widely used, but, e.g. at Kaunas University of Technology educators are using a GBL plug-in in Moodle, in the process of assessment, when assessment is made for different levels. Another example is VR and augmented reality (AR). In this case, in Lithuania there is very little experience, not much has been done yet, but during the period of COVID-19 pandemic, it was observed that for studies of engineering and technologies, VR could be a useful solution when physical laboratories are not available and EERs could add elements of fun and keep students more motivated and involved.

### **Lithuanian involvement in European projects on GBL**

Lithuanian educators participate in a number of EU projects related to GBL, which focus on methodology of seniors teaching and learning; teacher training – how to use video games and video systems for education; and creating a gamified learning platform on learning social inclusion skills. The results of these projects offer extensive resources for educators and could be considered as support for teacher training on the application of GBL. The following paragraphs describe particular features and examples from those projects.

As an example, LOGASET project developed the methodology for location-based games as a contemporary, original and innovative method of seniors' teaching and learning. The project was based on the concept of *“edutainment – the fusion of valuable educational content with elements of entertainment, being one of the more effective methods of transferring knowledge, acquiring skills, and shaping social attitudes. The effectiveness of this method is to a large extent based on the informal character of education. The educational content is usually hidden in a formula attractive to the recipient, who is often unaware of the fact, that he is participating in education – acquiring new knowledge or developing new skills”* Jurczyk-Romanowska et al. (2019:39). Project website: <http://logaset.eu/>.

Another EU project related to GBL where Lithuanian educators participated is “Video Systems in Education (ViSE)”. The project partners prepared a Guidebook on Video Systems in Education, and one chapter is on gamification. The project website: <http://video-in.education/>. Project “PROMIS - Promoting inclusion skills in a post-truth world” partners are developing a gamified online platform and curriculum. Project website: <https://promis.education/>.

Summing up the status of EER and GBL in Lithuania, we could distinguish the following features:

- Comparing GBL and EER as educational practices, GBL is more widely spread than EERs, research and international projects on GBL allow maintaining that this educational practice is applied at all educational levels.
- ERs within education were identified at one HEI and not in specific educational disciplines but as science dissemination games in the areas of social sciences and STEM.

- The developed ERs were both physical and virtual, physical ERs involving small teams of players/students/members of university community and the VR ER involving one player only.
- As often the case with limited resources/financial support from the university, a personal initiative and creativity of ER developers enables them to develop EERs with minimal material resources available.

## EER Methodology and Implementation

The following section will present observations from of case studies and expert interviews, and some publications with reference to the different stages of ERs implementation.

### Design

The analyzed escape room cases have *different aims*. They show games seeking to introduce the participants to a specific topic, e.g., open access for students and researches, the work of courts to the general audience; to entertain by using educational elements as it was the with a commercial ER; and to attract new members to a scientific student society, e.g., a virtual escape room in a scientific environment.

For example, in the case organized at the KTU Library, the aim is to introduce the topic of open access to a wider academic audience in an interesting way and to celebrate the Open Access Day. Another case, illustrates an EER which was set during Christmas celebration at the university the aim was to use an ER room to set free all the presents so that everyone could get their Christmas presents. A commercial ER with a potential for an EER, still has the aim to entertain. Another ER is intended as an EER for a wide general audience, organized by the Lithuanian Courts Administration, the aim is to familiarize the audience with the job of a lawyer and to try to solve a complicated case. The last case, organized by Scientific Student Society to attract new members and the main goal of the game is to escape the laboratory in a certain amount of time. Inside the virtual world, the player has to look for clues and perform chemical experiments to progress further ahead.

The specific details of each CS in relation to their aims and objectives are the following:

*CS1 ER “Open Access”. October 14th is the Open Access (OA) Day, and the KTU Library staff wanted to celebrate it in a more interesting way, to introduce OA to students doing research and academic staff in general. One librarian was interested in ERs and she found online a full scenario with all details how to develop this ER. She organized a few more colleagues and they prepared this ER.*

*CS2 ER “Christmas”. This was the second ER developed by the KTU librarians. As they had materials available from ER 1 (Open Access) and had experience, they came up with an idea to make an entertainment activity for the university community before Christmas.*

*CS3 ER “Finding stolen Einstein’s brain”. The owners of “Infinity Room” ER started their business activities first by participating in ERs rooms and got interested and then decided to develop their own ERs. When they started, there were very few ERs in Lithuania. At first, everything seemed simpler than when they started implementing the idea. However, the wish to engage in an activity that you like was the main driving force. People who like solving puzzles,*

*play table games, choose this kind of activity or similar leisure activities requiring thinking how to overcome challenges. They have been involved in this kind of activities for four years.*

*CS4 ER “Room of Justice”. The results of surveys conducted by Lithuanian Court administration have demonstrated that majority of our society members learn about the implementation of justice from mass media or social networks. Therefore, for a few years, the National Courts Administration has been consistently organizing different initiatives about the openness of courts, which allows people to understand better the processes of court work, to educate people and to increase general legal literacy among population, to develop a more constructive society. There are still situations when in some cases people expect a very radical decision even before the court had a chance to investigate it. Therefore, by choosing this project, “Room of Justice”, the aim was to show people the specifics of legal profession and courts in an interesting and nontraditional form of communication.*

*CS5 ER “Escape the Lab”. The developers of this VR escape room (ER) wanted to create a marketing project for the Scientific Student Society, to attract new members and they got the idea to create the chemistry escape room because that student organization is mostly based on interactive experiments that they are showing for people all around the Lithuania. The main concept of the game was taken from laboratory facilities of University chemistry faculty. With additional features, these facilities have been turned into a gamified Virtual Reality “Escape room” type experience, which is based on real chemical experiments. The target audience of this escape room is from formal education, e.g. bachelor or maybe even master’s degree students and it is mostly used get the basic knowledge of chemistry or it can be used for private activities, when students from schools who like to perform experiments. It makes easier for them to experience through virtual reality that they can even fail and restart the progress and try again so that it will be a lot safer to use that to do these experiments than in real life after all.*

An observation was made that the *preparation* of all EER was usually based on the internal resources of the institutions without the external funding or other resources. The physical facilities for the ERs were adapted from existing group workroom with a glass wall and it was set as a temporary ER, for a certain period, and no additional investment was needed. The human resources are the driving force as it is thanks to their enthusiasm and dedication that such EERs have been implemented. The financial resources needed were minimal, similar to the costs of stationary. As it has been mentioned, the existence of a Virtual Reality Laboratory was a direct result of the activities of its staff.

For example, in the case of the library, staff mentioned that they used the materials already available within environment and very insignificant amount of money were needed to purchase specific items for EER. The virtual EER development became possible because people working at the university virtual laboratory initiated it. As they mentioned in the interview, this was part of their job description. The costliest development of EER is for commercial and educational purposes when owners have to buy services of specialist when it is too time consuming to learn the new skills needed for the development of EER.

*Hints* were organized in different ways. The hints used in the documented ER cases indicate the tendency to operate within limited resources and avoiding additional costs is important. Therefore, to save costs of using a camera to monitor the actions of the participants a good

solution is to allocate the escape room in a group workroom with a glass door of wall. This way the game masters can see when the participants are stuck in the process. The game master would show with a gesture what to do or write an e-mail message. The hints in a virtual escape room are presented in the environment of the players in the form of open books on the table, a notice board on the wall.

*Game Design.* Most of the games were based on the small challenges/puzzles, the solution of which leads to escape from the room or to next level.

The examples of ER games below illustrate the kinds of puzzles that were used. All of the puzzles were organized in a sequential mode when without solving one puzzle, the participants could not move to the next one. In physical ERs, the participants most of the time managed to escape from the room within the time limit set. In a VR ER, it was more complicated. It was not only about solving a puzzle. The players firstly need to have some experience in operating in a virtual reality environment. Like in a computer game, players have to be skilled in using controllers and joysticks, in VR the participants have to familiarize themselves with the VR gadgets and accessories. With the timer set, novices usually fail to end the level successfully because of the lack of skills in using VR. When they have skills of operating in VR, then application of knowledge in the subject matter becomes the focus of activities to solve a puzzle.

### **Creation**

The documented ER cases were not integrated into the curriculum of any specific university course; therefore, discussion of intended learning outcomes (IOLs) is limited. Having in mind the aims of developing the ER cases, which were more of a general nature: to inform about a certain area, to get the attention of prospective members to involve in the activities of an informal organization, to entertain – the ILOs were not formally stated. They could be directed to develop the ability to use or improve information search skills, to develop deduction skills, and to practice soft skills (negotiation, leadership, teamwork, time management).

Information from CS1 and CS2 could be good methodological examples on how educators willing to integrate ERs into their subject could learn to design the puzzles. In CS1, the organizers of the ER had no previous experience how to develop puzzles and the game itself. What they did was that they used the scenario and step-by-step description of an existing game and made only minimal changes to adapt to existing physical facilities. After gaining experience by using a guided step-by-step process, the same ER organizers set a new ER (CS2). In this case, they already could apply the knowledge and experience gained from the development of the first ER.

Thus, by using the analogy and existing models, the developers are likely to be able to set new pedagogical aims relevant to their specific course and then form ILOs.

### **Implementation and the daily operation**

The ERs described in the cases studies are not used directly in the study process in a particular HEI. They have been implemented either at HEIs environment (CS1, 2, 5) or for a general audience (CS3,4). The duration of the game is similar, mostly 60 minutes, or between 30-60 minutes, with the levels of difficulty ranging from medium to difficult.

## Assessment and evaluation

In this section, we discuss the evaluation of the ERs by the users or stakeholders and the assessment for the teams participating in the game.

Speaking about assessment, the ERs were not a part of a course curriculum and the traditional assessment of the teams participating in the game could not be applied. On the other hand, as the aims of the ERs were to combine education and entertainment, to keep the participants motivated, different rewards, like the photos of the winning teams displayed on notice boards were in place for the winners, or organizers offered sweets to all participating teams.

The insights of the expert of digital GBL (INT1 provided valuable suggestions on assessment) reveal that assessment could be organized by combining Moodle with additional plug-ins when completion of certain puzzles or levels could be assessed as a certain level of achievement. About the questions of how the involvement of students in the ER games can be best assessed, the expert in INT1 mentioned that the involvement depends on the course itself and the aim of the course. If this is a gradual game, or a serious game; if it lasts half a year, or full year – all this makes a big difference. If this is an on-the-spot game – only now, here- a student went there, and carried out tasks, it is a creation of a certain activity, certain object and the assessment is adapted accordingly to it.

The developers of the VR ER in CS5 shared interesting experiences. Fellow teachers asked the developers of the VR ER to implement the monitoring of the player's movement during the game. This included tracking all the controllers, to see what the player was mostly doing with his hands, what he was searching, the position of the headset – where he was facing, what items he grabbed, how many trails it took to perform the experiment. They believe that these aspects could be a step toward assessment integration.

Regarding CS5, the developers of the ER also published an article (Janonis et al, 2020), where the elements of formative assessment may be recognized: “After completing the required experiment or other tasks, the player is awarded a part of a three-digit code. After collecting all the required parts of the code, the player can type the code on a virtual console and complete the scenario. Additionally, to make the experience more immersive and simulative, the virtual environment is developed to allow the player to interact with every object in the scene” (p.9).

In addition, speaking about rewards, the developers of VR ER expressed an opinion that a reward system means basic achievements, e.g., if you carry out an experiment, you can get a reward, if you break 50 tasks, or similar, you get a reward. As the ER is fully interactive, players can even find a hidden fantasy, so called “Easter eggs”. E.g., if you see a flask under the table and you try to reach it, it suddenly grows legs and tries to escape, which makes the experience more fun and immersive. You cannot really experience such things in real life. The project itself has gained recognition, the project was showcased in different university events, participated in KTU “Technorama” competition, won an award in a competition organized by an outside company, and they applied to other educational events.

Different stakeholders' (participants, university authorities) evaluation and recognition of the ERs is best expressed when they spread the news about the existing ERs. This way the

stakeholders “advertise” the ERs, or the members of the university authorities come to participate in the game and show their positive attitude this way (CS1 and 2), or it gains recognition due to a widespread coverage in media after journalists tried the ER themselves (CS4).

Thus, summing up assessment practices in EERs, we may differentiate between the assessment of achievements (ILOs) and assessment of involvement (process). The assessment of ILOs could be assessed as completion of certain puzzles or levels could be assessed as a certain level of achievement. The assessment of the process could be implemented by using different methods of assessment, more likely formative assessment, when the educator and students evaluate the process of the game.

### **Roles of educators and other involved individuals/ stakeholders**

The analysis of case studies showed that when the ER is not integrated into a subject curriculum, the developers of the game, who are not teachers, become a kind of educators. The game developers with the help of their ER game educate the game participants on a certain topic, e.g., how to use Open Access system, how the national courts operate and the daily activities of lawyers. In such circumstances, developers of the game have the responsibility to prepare and implement the game.

It is worthwhile noting that the developers in the process learn new skills necessary to develop the ER game. When learning new skills takes too long or they do not have sufficient knowledge in a particular subject, then they turn to experts to hire their services or to get a consultation.

Thus, in the documented cases discussing the roles of educators in ER games cannot be supported by specific experiences.

Below we present a brief overview of the roles of the developers of the ER games in each case.

In CS1 and CS2 the librarians (3 persons) were the organizers, they were responsible for preparation and implementation.

In CS3 the company owners developed the game themselves. They hired a programmer to write a program for several tasks. It was obvious that it is better to make an investment in some areas instead of learning everything from the start.

In CS 4 the Lithuanian Courts administration – it initiated the development of the ER; representatives of Vilnius, Kaunas, Klaipėda, Šiauliai and Panevėžys – were local game masters when the mobile ER visited their cities. They were responsible for the registration of teams to participate in the ER puzzle.

In CS5 students from KTU Scientific Student Association – they are the developers of the ER it was students of this organization who developed the VR part and the subject matter part. KTU Virtual Reality Laboratory staff is also a supporting stakeholder. The role of these persons was to help provide the images from the Faculty of Chemical Technology laboratory, so that the developers could create a realistic VR laboratory. The teachers from the Faculty of Chemical Technology were consultants, answering all specific questions about the laboratory. The team initially were four students – 3 from programming and 1 from multimedia, from the

Faculty of Informatics. Later on, one team member left. A year later, a new member joined them, she is developing the narrative and helping with design and color management. The students from the Faculty of Chemical Technology were more like consultants, the third party.

From the literature review about the role of teachers in the use of educational games: *“Teachers play a crucial role in the use of educational games in the classroom. They have to act as mentors in order to tie the implicit learning to the explicit. Therefore, they need to be able to draw attention to the learning taking place through the game and make students aware of the learning that they have experienced. This can be done through a variety of ways, such as discussions directed at pairing the learning content with the gameplay experience. This requires the teachers to have played the games and to be aware of the offered game experiences. Teachers also have to align the game with the curriculum. This alignment can contribute to the partial use of the game in individual sections of the curriculum. Teachers have to decide at what stage of the learning process the videogame will be integrated”* (Project: “The V4T - Videogames 4 Teachers”).

Kalinauskas (2018) points out to the role of teachers: *“To develop communication and feedback tools in the case of development of educational gamified study systems. The role of an educator is very important for the engagement of learners. It is one of the key factors for efficiency of gamification. So, it is advised to integrate the educational relations strengthening tools inside the gamified system. The feedback must be informative, vivid, timely and fair with respect to the users of the system”*.

Even there was no evidence on the role of educators in the development of ER games in the documented cases; the literature review of Lithuanian researchers on the role of educators in GBL provides useful insights that could be adapted when preparing the guidelines about the role of educators in EERs. The most important aspects of the roles of educators are as follows:

- (i) to be mentors for students during the game and have experience of playing games,
- (ii) to be the planners of the educational process in making sure that the implemented game aligns with the course curriculum,
- (iii) to be the trainers who provide feedback to students on their achievements and behavior.

## Facilitating and Inhibiting Factors

In this section we will present facilitating and hindering factors witnessed during case study and interview research that affect adoption of ER methodologies in higher education (or in their particular circumstances).

Firstly, let us discuss the facilitating factors, as they are seen in the Lithuanian educational background. They can be discussed in terms of educators, students and other involved stakeholders. The facilitating factors in terms of educators are that the implementation of GBL and EERs is based on the initiative of active educators who are willing to try out new methods of teaching and learning, which demonstrates positive attitudes. It means that there is a willingness to learn new skill sets and acquire new knowledge. The facilitating factors in terms of students is their skill sets. Young people are more exposed to new technologies and various

gamified activities, therefore, including EERs into the learning process is likely to be successful as they learn quickly, especially when working in teams. In addition, they could even offer their skills to help teachers to develop further the new learning experience within the framework of this method. It is likely that student motivation and involvement in the learning process will increase as well. The facilitating factors in terms of other involved stakeholder, who are the authorities of the university or institution, that educational innovations in the teaching and learning practices are always supported and there are examples when specific awards and competitions are established to recognize and reward innovative educators and students. Regarding other institutional support mechanisms, like additional funding or equipment and facilities, this is mostly expressed through provision of existing equipment and spaces needed. This way, the institutions avoids additional costs.

Below are examples of facilitating factors from some of the cases analyzed and expert views.

As the facilitating factor in CS5, the following was mentioned: the availability of the VR Laboratory equipment; additional financial support from the University and teachers, and from the competitions they participated. Additional supporting factor was an IT subject in these students' study program where they could choose anything they wanted to develop from software even to a game, and that was a huge step for the developers of this VR ER, it motivated them even more. This became a kind of professional development.

The expert in INT1 gave insights about facilitating and hindering factors regarding the implementation of VR ERs. They should be viewed both from teacher's and student's point of view. From teacher's point of view, it depends on the subject taught, if there is a need for VR. Another thing is technology that still is rather expensive and if the teacher does not have skills, at least for application of AR, naturally, many challenges and problems will occur.

From student's point of view, on the contrary, the expert says that they would not have any problems, the young generation has very good skills for navigation in the VR and it does not cause any stress and any psychological problems about the application of this method. Research indicates (Blazauskas and Gudoniene, 2020) that GBL methods should be recommended for the coming generations of learners, if it is not 3D or VR, at least in Moodle to introduce levels, badges, etc. to involve and motivate them more to learn.

In addition, Kalinauskas (2018) talks about the institutional support mechanisms. These recommendations particularly concern ICT-supported GBL. *"It is recommended to evaluate the time and financial costs for the administration of gamified studies systems and content development. It is likely that before starting to utilize fully the gamified system, it will take a long time to personalize its features and adapt it to the needs of the learners and their work preferences. It is also recommended to assign some time for the testing of gamified systems before applying it at the full scale"*. He draws attention that, *"not all study disciplines are equally easy to gamify. In the cases, where advanced mechanical skills are required, or on the contrary - highly abstract results are needed, the application of gamification will be more complicated. A recommendation is not to overdo the elements of visual feedback, especially in those disciplines that are perceived as serious and rigorous. In this case, gamification should be focused on creation of challenge rich study environment"*. He adds, *"Before proposing the integration possibilities of gamified studies environments into the study process, consider the*

*aspects of busyness of academic staff, since maintenance of these systems requires more time and financial resources compared to traditional didactical methods. At the initial stages of the integration of gamified systems, greater dissatisfaction and frustration from the academic staff is to be expected. It will inevitably affect the workload of employees responsible for ICT support in the higher education institution. Taking into account these aspects, the application of the gamification in the studies should be applied on a voluntary basis from the academic staff and the students”.*

Speaking about the inhibiting factors, from the teachers’ perspective, developing EERs is highly time-consuming and the present situation at universities is that the teachers have very big teaching loads; therefore, overload of teachers with teaching, preparing for classes, carrying out research activities may be an inhibiting factor to adopt EERs in their subject curriculum. Another inhibiting factor in terms of teachers could be the relatively low visibility of this kind of pedagogical activities across the country. It is widely acknowledged that we learn best when we try out something on our own, experience the process ourselves rather than read about it in a book. Thus, the lack of active practitioners who integrate EERs in their subjects and lack of such teacher training courses could be considered as the primary inhibiting factors of introducing EERs on a wider scale.

In terms of students, there were no observations made what could be inhibiting factors. However, as the developers of the ERs mentioned, creativity could be a challenge for ER developers. It is a challenge to develop an interesting ER, in which participants could both enjoy the process and learn. In addition, another challenge is to develop the puzzles at relevant levels of difficulty.

Further, particular examples of inhibiting factors or examples are presented.

The inhibiting factors of using VR ERs were mentioned by Janonis et al (2020). *“The main question is related to a small number of people who finished all three levels - is the educational game too complex for the people? The authors observed that only several people during the experiment knew how to use HTC Vive equipment. <...> it is challenging to keep the motivation of the player and at the same time replaying the game to advance further means repeating the knowledge and concepts learned by a player. <...> Some participants displayed cases where, while playing, they got too immersed into the VR experience and forgot about their real surroundings, ignoring the safety bounds drawn in the virtual environment or even perceiving virtual objects as real, trying to lean on them and fall over”* (p.10).

The same authors point out the facilitating aspects of VR ERs: *“The combination of entertainment and education can be valuable to the learning process, because the entertainment side of educational games may keep the learner more invested in the subjects that are being thought”* (p.11).

During the case study research, the interviewees presented different challenges they faced:

CS1 and 2: *“Creativity is a big challenge when deciding what and how. It is very important to test the full game in advance to make sure that all procedures are going on as planned. It is important that the participants understand the tasks the way the developers intended.”*

CS3: *“First challenge was to enter the market and to advertise about themselves. Second would be to develop everything by themselves and to develop a room that is well balanced: not too difficult and not too easy, so that the challenge would be there. As the audience is highly diverse from people who have been in all ERs in Lithuania, to those who came to an ER for the first time, the challenge is to make it interesting for all.*

*Another challenge is to get your audience interested in the theme of the ER, so that the audience would say “wow, it was something”, to get the “aha” moments. These are the main features of the ER, that people could feel smart after solving the challenges.*

*Teamwork is very important here, that by team effort you solve a challenge.*

*After a fire in one ER room in Poland a few years ago, when a few teenage girls died in the fire, the safety issue has become very important. Because the ER is a form of entertainment when you are physically locked in a space and you can’t simply escape. Therefore, it is crucial to think about safety. To make it both safe and entertaining.”*

CS4: As the ER was in a camper trailer, parked in a town square, the challenge might have been to attract as many participants as possible to take part in the ER game. Coordination and cooperation between different local representatives in different towns and the National Courts administration could have been a challenge, because game masters needed preparation.

CS5: *“The player has to have virtual reality devices or have access to them to play the game. This is a challenge as this way there is a limited availability of the game. Regarding the software development part, as the game is based a lot on the liquids in the laboratory, it was a challenge to implement liquids in the game correctly. For example, filling a flask with water, or pour it out into another flask, it is possible to see how the liquids mix; to show how the liquids react with each other or do not. As with software development happens, there were many bugs, e.g. if the player tries to grab the notebook and it just would fly from the screen. Some of those challenges funny, when they did not implement collisions correctly, the player could knock down the door with his head. In general, mostly the challenges were related to the software development.”*

To sum up, it is evident that implementation of EERs has its facilitating and inhibiting factors. The positive aspect is that facilitating factors have been identified among all stakeholders (teachers and developers of ERs, students and university authorities). They are teachers’ positive attitudes and willingness to learn new skill sets, students’ interest in trying out new learning experiences and high skills in using technologies, support of innovative teaching and learning at the highest levels of university and existence of institutional reward and recognition system. The reported inhibiting factors or challenges for educators were that the development of ERs is time-consuming and there is no sufficient methodological support to implement this kind of game in university subjects.

## Preparation of Educators

The research also revealed that there exist no teacher training courses or materials dedicated to train teachers how to implement EERs in their courses. However, Lithuanian educators have participated in a number of European projects dedicated to teacher training in the area of GBL. There are numerous online repositories and manuals with methodologies and tools to help educators gain knowledge (and skills) how to use games or their elements in the teaching and learning process.

In INT1 the question of how can academics and HEIs staff be best prepared to adopt GBL and ER games in their teaching practices was discussed. The discussion focused on the development of courses as part of teacher preparation:

*“When we start talking about the development of courses, I always say that there should be templates to implement relevant methodology. The course consists of many standard things: aims and goals, topics, subtopics, etc. Accordingly, for the topics and subtopics we have assessment tools and tests. In this case it is exactly the same, only the mode changes. Another mode – GBL. Certainly, such a template should provide a few versions how this ER should look like and could be provided from a pedagogical perspective. Often, the templates are very helpful and we try to standardize these things and bring to a certain uniformity. And even when we develop a new course, we take into consideration the general needs, standards and we try to describe them with the meta-data, no matter what they are like.”*

From literature review, Janonis et al (2020) present their views of how VR could be useful not just for preparation of educators, but also for the study process itself: *“Virtual Reality (VR) technology introduce new ways to teach students about STEM subjects. <...> Training in a virtual environment could be more efficient, where training in a real-world could require expensive equipment, or could be dangerous, where a potential mistake would mean financial losses, injury or even death. <...> virtual reality (VR) applications, which are still in their infancy, they do show promise for improving education”* (p1-2).

Thus, in conclusion we can state that in Lithuania there is a gap in preparation of educators to use EERs in their classrooms, which in turn opens a potential niche for teacher trainers and the need to develop training programmes and resources for educators.

## Outcomes and Impact of EERs

The analysis of case studies has revealed that even though the EERs were not an integral part of a specific course, they had a positive impact on both the developers and the participants of the ERs. Firstly, the cases demonstrated that by organizing ERs, which tend to be more of entertaining nature with educational elements, an awareness about possible EERs has been raised. It is important to walk through the process of an escape room first to be able to develop own EER. Secondly, it has become obvious that in the situations when teaching becomes not possible in a classroom environment, VR EERs could be an alternative. Certainly, implementing a VR EER requires specific expertise and facilities, but once it is developed, it

can be a good training environment in particular in STEM and medicine studies. Gudoniene et al (2019) present a very important observation about the impact of GBL in general, and VR ER in particular: “*The researchers say that when the learner has an ability not only to hear but also to see and be interacted with the learning environment, they can remember about 80% of whole experienced information*” (p.295).

The reported outcomes and impact of the games included learning of new skills. E.g., CS5 indicated that the impact on the learners is that they have to learn to be focused, to think quickly, it is a lot about critical thinking, because when you see a hint that you haven’t seen before, you have to think quickly and find out what it means, etc.<...> Some elements of creativity, you can use the game as a sand box, to do something else in the lab, not just play this game. The impact on the ER developers: the principle aim of this experience is to present educational material in the form of a game, making the learning process more entertaining and immersive.

Speaking about other outcomes, the change in attitudes is one of them. In CS1, the experts noted the following: “It was very interesting to observe professionals’ reactions to some tools or tasks. e.g. representatives from Electronics and Electrical Engineering are well familiar with an UV spotlight and when they saw it on the table they immediately turned off the light; the representatives from the Informatics faculty. When they had to solve an equation, they recognized that it was a three-level task. It was interesting to see how different areas of education influenced and helped solving the tasks”.

In CS2, the organizers of ER made an observation that “the activity was originally designed to be something for fun, to have a great time as team. Of course, the outcome was that this activity helped strengthening the team or establishing new bonds with peers, which in turn later has a positive impact on the work atmosphere and collaboration among colleagues.”

To sum up, the outcome of EERs and GBL is the possibility to develop soft skills, critical thinking and analysis. There is no doubt that when an EER is developed for a specific subject and aligned to the ILOs, students will gain particular knowledge and skills as well.

## Aspirations

Speaking about aspirations, we would like to mention the ideas from Janonis et al (2020):

*“VR technology can be a useful tool in education bringing more entertainment and engagement into the learning and teaching processes. <...> This VR ER is in between the educational and entertainment game, in the new version, it will be possible to turn from realistic things to fantasy, e.g., you take an object and break it into atoms, and instead of pouring liquids into liquids, now you would have to combine atoms and molecules, and those molecules would be turned into items that are needed to escape the room” (p.2).*

In addition, we could say that to some degree the same ideas could be transferred to the development of EERs in the physical mode.

## Final comments and suggestions

Discussing the status status-quo of GBL and ER in the educational context of Lithuania it is evident that GBL is a methodology that is rather widely accepted within the education area and the larger emphasis is on ICT and digital games. In addition, educational escape rooms still are at the early stage of development. The analysis of case studies conducted in Lithuania within the framework of this project demonstrates the potential of EER development and application in higher education. The findings indicate that EERs could be developed for both Social Sciences, Arts and STEM subject studies. The new reality with the presence of global pandemics has created a higher need for digitalized GBL and ERs. This is a challenge, of course, as it requires additional financial investment, teacher preparation and time. As no governmental documents were found in relation to the support of the state for this area in higher education, it means that there is a need to raise the awareness about the potential and need of GBL and ER integration in the curriculum of HEIs in Lithuania.

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- PROMIS - Promoting inclusion skills in a post-truth world: A gamified online platform and curriculum (<https://promis.education/>)

LOGASET - Location-based games as a contemporary, original, and innovative method of seniors' teaching and learning (<http://logaset.eu/>)

## 4. Netherlands

### Introduction

In 2013, the first commercial escape rooms were introduced in the Netherlands. In 2020, there are close to thousand commercial escape rooms in the Netherlands, both physical, digital (i.e., on the World Wide Web), and hybrids<sup>7</sup>. Escape rooms are also seen its proliferation into education, from primary, and secondary to higher education.

In this report, an overview is presented about the state-of-the-art of escape rooms in education, also referred to educational escape rooms (EER<sup>8</sup>). Towards that end, a review is presented on the literature, a general overview of EERs based on in-depth interviews with 15 experts<sup>9</sup>, and six case study of EERs in practice. The scope of the report is on EERs, either implemented in educational programs as part of modules, or implemented outside of an educational program but within an educational setting, such as an EER for professionalization of teachers/researchers. The EERs are *Escapedemic*, *Escape the Classroom*, *Escape the EU*, *MasterMind*, *Number Systems*, and *RSM Escape room*. Commercial escape rooms fall beyond the scope of this report.

### Status of EER in the Netherlands

In general, EERs in the Netherlands are still in the early stages of development. Dispersed groups of individuals, mostly teachers and researchers, can be identified who work on developing EERs for their own education, or for research purposes. Most experts have indicated not to be affiliated nor aware of any association of EER developers in the Netherlands.

Although these individuals recognize the potential of EERs as a pedagogy to be used in education, they are of the opinion that the general (macro) view of EERs is rather negative. Educational escape rooms are seen as games that occasionally can be used in education but not as a method to transfer knowledge or permit learners to train skills. Despite this negative view of EERs in general, there are increasingly more initiatives with EERs. It is noticeable that the greater part of these initiatives is taking place at lower levels of education such as the primary education with higher education being the laggard. Reflecting on this development, an expert remarked that 'it seems that more [*experimenting with new pedagogy*] is possible at the primary levels of education.' The general view of EERs as not a serious pedagogy but just as a game

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<sup>7</sup> <https://www.rtlnieuws.nl/editien/artikel/4761831/bijna-duizend-escaperooms-er-komt-een-nieuwe-generatie-kamers-aan>

<sup>8</sup> In this study, EER is the singular and EERs is the plural of educational escape room.

<sup>9</sup> The experts interviewed for this report are, in no particular order, Bakkum, Jagersma, Jaoana, Koot, Meijer, Mesie, Suppers, Thijssen, Van den Bogaart, Van den Meer, Van Winden, Van Zundert, Veldman, Vink, and Voet,

and the relatively informal approach to education at the primary levels could be an explanation for the diffusion of EERs in the Netherlands.

With regards to the study fields (i.e., educational disciplines) in which EERs is implemented, the EERs is well presented in formal sciences such as biology, chemistry, mathematics, and physics. Educational escape rooms are also increasingly adopted in health such as nursing. For example, an inter-disciplinary group at a University of Applied Science created an EER to create awareness regarding patient safety among professionals at a regional hospital<sup>10</sup>. Another example is the EER named *Ria's Escape Room*<sup>11</sup>, that regards the delivery of personal care. To a fewer extend can EER be identified in social science such as business studies.

All the EERs that we have studied in this project concern puzzles that train the cognition. To solve the puzzles, the players need to combine their knowledge and skills. Soft skills such as cooperation have shown to be vital for solving the puzzles. Although we are aware that EERs can also include puzzles that require physical efforts to solve, such puzzles have not been found in the studied EERs. One reason for this finding is that the (informal) educational programs to which the studied EERs are attached are organized for obtaining and improving cognitive challenges. It is possible that EERs in other disciplines and programs, such as sports management might also include physical challenges.

There is a plurality in stakeholders that are involved in EERs. It is not only internal stakeholders (e.g., teachers, researchers, students, facilities, and ICT departments) that are involved in designing and implementing EERs, but also external stakeholders (e.g., industry professional organizations). The stakeholders depend on the discipline of the EER. For example, an expert indicated that when developing an EER regarding the awareness in prescribing opiates for medical students at a research university, he collaborated with the Institute for Responsible Use of Medicine. In the case of languages, an external stakeholder involved in the design process was Stichting Praktijkleren. Also, professional escape room builders are approached for consultancy, design and construction by educational institutions. For example, the initiators of *RSM Escape room* outsourced all development of its EER to a professional escape room builder. There are also online repositories (e.g., yurls.net), initiatives (e.g., kraakm.nl and e-wise.nl), conferences (e.g., UpTheGame.nl), and stores (e.g., breakoutedu.com) that are referred to by our experts as useful resources and develop EERs. The Library of VU Amsterdam is also working towards a national network of EERs in higher education. But general knowledge of these initiatives among the community of EER developers in the Netherlands remains poor.

Educational escape rooms can take many forms and a dedicated physical space should not be a constraint for implementing an EER. The interviewed experts indicated that there are physical (e.g., in a room or a breakout box), digital and hybrid forms. Hybrids are popular (i.e., most evident in our cases) as it comes the strength of physical aspects with the facilities offered by digital technologies (e.g., have players enter their solutions to the puzzles on iPads to monitor their progresses). However, EERs with rich physical aspects are considered more fun by students. There is a proliferation of using an ordinary classroom with puzzle boxes and games.

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<sup>10</sup> <https://www.saxion.nl/nieuws/2020/02/door-studenten-bedachte-escaperoom-moet-mst-helpen-bij-patientveiligheid>

<sup>11</sup> <https://escaperoom.andhappy.nl/>

But it is also possible to integrate the institutional premises to create a physical EERs like commercial ones or create a pop-up EER. It is even possible to make use of open public spaces such as in scavenger's hunts.

Educational escape rooms have many strengths. For example, EERs are less teacher-driven compared to other pedagogical methods and multiple skills can be addressed during the gameplay. There is a time pressure that continuously activates the students, and there is heterogeneity in the skills that the students contribute in a team. It also forces students to communicate and cooperate with each another. In addition, EERs are fun activities for students and the students receive immediate feedback which motivates students to remain engaged in the learning process. Despite the many strengths of EERs, it has a few weaknesses. It is difficult to monitor the progression of an individual student.

## Development and Implementation

### *Development process*<sup>12</sup>

In the development of EER, it is noticeable that a process similar to curriculum and course design is used. Starting with establishing the schedule of requirements, followed by approaching the stakeholders (if necessary) and acquiring required resources, and finally building and testing the EER. The intended learning outcomes (ILOs) are leading in the development of the EER. Once the ILO are established, it is possible to design the puzzles that fit the objectives of the EER. Design blueprints and guidelines can aid professionals to progress through the steps to develop an EER.

The interviewed experts indicate that the design of the puzzles should remain flexible. This flexibility allows the adaptation of the EER to continuous changes in the ILOs. The EER has been suggested as a cupboard that can be filled with random objects. Hence, the strength of the EER does not lie in a rigid structure but in the involvement that it generates from the players. When playing the EER, the students learn unconsciously.

From the interviews, it is noticeable how much attention is devoted towards exploration and research in the development process. For example, the development of the *MasterMind* was set up as a research into how to motivate teachers who lag behind in the use of digital educational technologies to also start using these technologies. In the development of the *RSM Escape room*, the entire Rotterdam School of Management (RSM) community was approached regarding their opinions of the themes that should be incorporated in the escape room. There are two explanations for this finding. First, the experts indicated that EERs are still in its infancy thus, suggesting that the developers of EERs are still exploring the design requirements of EERs. In addition, due to the early stage of the development of EERs, scientific researchers are also drawn to this topic. There is the question (also from educational professionals and practitioners) if there is a scientific basis for using EERs to foster students' learning.

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<sup>12</sup> We use development to indicate entire process of doing research to establish design criteria, the design to create the mockups, the building of the EER and the testing of the EER.

To our knowledge, the first development of EERs as research projects started in 2017. The research team are interdisciplinary, for example, a team consisting of game developers, education scientists, and civil engineers. It is also noticeable that the development or bottom-up processes, are usually initiated by teachers.

### ***Resources in the development process***

The opinions regarding the resources that can be used in the development of EERs are in opposition. On the one hand, some experts reported that there are support in forms of training and coaching, and it is possible to receive grants to support the time and material expenses. It is also indicated that there are online resources (e.g., *breakoutedu.com*) that includes examples of EERs that can be translated to the Dutch context. On the other hand, some experts stated that there are hardly any resources to support those that are developing EERs. The difference between these two views might be the experience and exposure the professionals have with designing learning innovations for education. As one expert indicated, "... there are certainly means in the Netherlands, but you have to approach it creatively. There are many workshops in escape rooms, you can often declare materials through your employer in addition to the subsidies that you can use creatively."

The resources that are used falls into four categories, 1) human, 2) financing, 3) material, and 4) housing facilities. First, the human resources are referring to the educational professionals, researchers, students, alumni, and external individuals that contribute to developing EERs. Second, the financing refers to internal (see e.g., *MasterMind*, *Number Systems*, and *RSM Escape room*) and external (see e.g., *Escape the Classroom*). It is noticeable that most of the escape rooms studied in this report have received funding, thus signifying its importance. Third, material refers to the physical resources to create the components of the escape room. The physical resources are very diverse, and ranges from decks of playing cards to recycled paper, plastic, and textile. Finally, housing facilities regards were physical location where the EERs are played, either temporary locations such as classrooms or fixed spaces on campus.

### ***Challenges in the design process***

The development of EERs is not without challenges. There are many challenges to be confronted, which can be traced back to the inhibitor factors (discussed later in this report). One of the challenges relates to the pedagogy to be used in the EER. What is the new pedagogy that can be used with EER? The EER method is fairly new and there is limitation regarding the knowledge of the suitable pedagogy. Hence, it is been indicated that finding the right pedagogy for the use of an EER to attain the ILO is a challenge. For example, the level of difficulty of the puzzles, the sequence of the puzzles should align with the ILOs. Also, knowing how the students react to the games, where they can get stuck so to design the proper hint was indicated as a challenge. This is especially difficult for complex cases where the main ILO is for targets groups that have shown low dispositions to acquire the ILOs (see e.g. *MasterMind*).

Other challenges are unique to the nature of the EERs in the cases. For example, *Escapedemic* was a digital escape room, and a challenge was converting the designed puzzles and structure

into a software (i.e., the software programming). *MasterMind* chose a pop-up format, which brought challenges regarding logistics, finding temporary rooms to host the escape room, and the associated planning. The *RSM Escape room* was a full-fledged escape room similar to commercial escape rooms. A major challenge was finding a fixed location on the university campus. The developer of *Number Systems* used a minimal budget (Euro 1000) to develop the escape room and hence had to invest a lot of personal time. The challenge was how to develop a high-quality escape room with the limitations in budget and time.

It is also noticeable that the more elaborate EERs (i.e., *MasterMind* and *RSM Escape room*) faced a different set of challenges compared to the less elaborate escape rooms. For example, both escape rooms faced challenges regarding the housing of the escape room (though the former is a pop-up and the latter a fixed escape room). Whereas, the simpler escape rooms (see, e.g., *Escape the EU*, *Escape the Classroom*, and *Number Systems*) that were mostly the use of puzzles in a classroom did not face the facility aspect as a challenge.

Finally, there is the development process under policy measures to combat the COVID-19 pandemic. One of the experts expressed that the communication during development of the *Escapedemic* took place virtually. Although there are many tools for assisting digital meetings, the free form of offline meetings (e.g., one can easily draw an idea on a piece of paper) does not cause constraints as with virtual meetings. There are no packed solutions that can incorporate the facilities of offline meetings.

### ***Design elements***

The design elements of EERs fall into three categories, 1) the elements regarding the ILO (i.e., the knowledge, skills and attitudes that the students should acquire with playing the EERs), 2) the pedagogical elements, and 3) elements regarding the gamification of the EERs (e.g., the game rules, hints, and narrative<sup>13</sup>). First, the experts have indicated that the ILOs are essential for developing EERs. The ILO gives direction in how the EER should be as the latter is only to support the realization of the ILOs. All sorts of ILOs can be designed for EERs. For example, creating awareness of prescribing opiates, gaining new experiences with new educational technologies, and repeating knowledge regarding cell division and protein synthesis for biology students. However, the EER is more suitable for the development of skills and repetition of already offered knowledge. It is not an adequate method for offering large amounts of new knowledge to students. It is more suitable to permit students to practice with skills and work on their attitudes. However, as they practice a skill, a knowledge component is necessary and hence, the EER allows the knowledge to internalize to the student.

Second, to guide students to realize the ILOs through EERs, several pedagogical elements have been mentioned by the experts. The EER is an active teaching method. Students work in groups and where students can take on specific roles and contribute their personal competencies to the

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<sup>13</sup> Goksen, S., Martina, R. A., & Sormani, E. (2019). Exploring the Design Elements for Developing Educational Escape Rooms for Experiential Entrepreneurship Education. In P. Bula, T. Baaken, K. Kurzhals, & H. Lyszczarz (Eds.), *Management Sciences and Future Challenges* (pp. 161–173). Cracow - Munster.

success of the gameplay. It is even possible that due to the spontaneous gameplay involved in escape rooms, students give more peer feedback than in normal lecture and workshop settings. It has been also frequently stated by the experts that next to having the students play the EERs, students can also learn and develop their skills by participating in the development of an EER. The latter especially promote 21<sup>st</sup> century skills. These active teaching methods ultimately foster student motivation and learning.

Another pedagogical element that is often used is the reflection through debriefing. In a few situations, the reflection does not take place through the structured debriefing due to limitations in time. However, the majority of studied EERs incorporate structured debriefing. It is through the reflection that causes the majority of the learning. The reflections are on the content and skills related to the ILOs.

The nature of EERs lent itself well for self-regulation and collaborative learning. The development of EERs fits well with problem-based learning and inductive learning. The increasing difficulty of the puzzles ties into the scaffolding theory of self-directed learning. The teacher can take on the role of coaching and observe the students when they are playing the EER. These observations can be used to provide students with additional guidance and even (formative) assessments.

Third, many gamification elements are included in the EERs. Examples are game rules, hints, immediate feedback, prizes, progression levels, rewards, and time limit. Time limit is a vital design element. The pressure to finish the EER within a certain time limit activates students. The experts have also indicated that time is part of the competition element as students do not only compete against each other but also compete against the time. It should be noted that simpler escape rooms have less gamification elements that have been integrated compared to elaborate escape rooms.

Hint management is an important element of EERs. All the escape rooms in this report make use of hints. The distinction lies into how the hints are administered. Here again, we noticed that the comprehensiveness of the EER determines how the hints are administered. Comprehensive escape rooms use digital facilities such as tablets and through WhatsApp to administer hints, whereas simpler escape rooms administer hints on a personal level (i.e., the teacher that is present during the gameplay).

In summary, creating an adequate blend of the design elements is not a small endeavor. Good EERs have in common that the ILOs, the puzzles and the experience of gameplay are well aligned. In addition, players should be able to progress through the EER without the assistance of a coach, and each player should be able to contribute to the game. Also, the puzzles should be varied and become increasingly more difficult.

### ***Implementation***

The developed EERs are implemented both within and outside education. The latter regards the use of EERs for promotional activities such as during study open days, or outside educational institutions (e.g., for recruiting new personnel).

With regards to the implementation within education, EERs are usually integrated in a module (see e.g., *Escape the EU* and *Number Systems*). This integration of EERs in curriculum, we would like to make a distinction between the purpose of the integration and how it is integrated. First, there are several purposes for integrating EERs into the curriculum. They are integrated to introduce new topics, or to complete teaching blocks on a particular topic. In the former, the EER is used to generate curiosity about a topic with the students. In the latter, the EER is used as repetition of the lessons taught and as an assessment tool. Educational escape rooms are also introduced to permits students to practice particular skills such as cooperation, create awareness regarding a topic or their attitude, and to foster group ties and insights into the roles that the students can assume within a group. The EER are also used as icebreakers. In the latter two occasions, EER is a fun activity and the promotion of competences is not central. Thus, EERs can be integrated as professional products, as pedagogical instruments, and as assessment tools.

Second, how is the EER integrated. It can be integrated at the start of a new module, but also during and at the end of the module. It can also be used during the project weeks.<sup>14</sup>

There is also a special category of the use of EERs within educational institutions but not within educational modules. For example, the *RSM Escape room* is embedded in its ‘Positive Change Initiative’ and is open for everyone. The *MasterMind* is embedded in the ‘Educate-IT’ program and is targeted specifically to teachers at the university.

### ***Daily operation***

The daily operations of the EERs vary. The comprehensive escape rooms have online booking (and payment) systems that allows automation for the formation of teams and other scheduling activities. Also, these EERs have other stakeholders besides the initiator/ teacher that help in running the escape room. For example, both *MasterMind* and *RSM Escape room* have employed student assistants that help with the scheduling activities and act as gamemasters. Simpler escape rooms (see, e.g., *Escape the EU*, *Escape the Classroom*, and *Number Systems*) are run by the teacher who is implementing it in his/her module.

In summary, an EER is a versatile work method that can be integrated in the curriculum for several purposes and in several placed. However, EERs need to be used to a limited extent so it remains a special activity for the students.

### ***Assessment and evaluation***

In the EERs, both formative and summative assessments are used. However, the majority of the experts have indicated that the EER is best suitable for formative assessment since it is difficult to test the students individually. With regards to formative assessments, EERs are adequate for allowing students to exercise as in professional situations. The formative assessment can take place through the reflection during the structured debriefings. Students can reflect on their skills and attitudes of themselves and their peers and discuss the peer reflection with each other. It is

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<sup>14</sup> We noticed that EERs are used also used outside educational activities such as promotion of educational programs.

also suggested to explain and show the solutions of the puzzles with the students in the reflection. The peer reflection encourages the development of peer feedback.

With regards to summative assessments, EERs are adequate for skills such as cooperation. This assessment can be done by observing or filming the students during the gameplay.

### ***Roles of stakeholders***

There are many stakeholders involved in EERs, such as teachers, researchers, students, facilities, ICT departments, funding organizations, industry professional organizations, professional escape room builders, and online repositories. The far most important role is hold by the educational professionals and they have several roles in the development of EERs because these processes are often initiated by them. The experts interviewed indicated that their roles were initiating the development of the EER, inspiring other members to join the development team or commit resources and acting as the champion behind the EERs. The educators coordinate the different stakeholders and commitments to develop an EER. The educators also coach students when the latter join the development of an EER.

Another prominent role is hold by the students. In a few instances (see e.g., *MasterMind* and *RSM Escape room*), students are involved in all the development phases of the escape room and also in the daily operation. Students help gather research data, they aid in designing logos and physical components, they function as testers, and they also run the daily operations, and function as gamemasters.

As for the other stakeholders, they are mainly active in the early development stages of the EERs. For example, a (internal) fund provides financial resources at the initiation of the project. Other academic staff aided in the research process and helped building the escape rooms. Management (i.e., mainly the Dean) supports and facilitates the escape room by among others approving plans. Other internal stakeholders (e.g., ICT department) aids in creating the ICT infrastructure if it is necessary. External third parties (e.g., professional escape room builders and software providers) help to build the EER and make it operational (note: in a few occasions, other academic staff such as educational advisers aid in the debriefing after the participants play the escape room).

## **Supporting and inhibiting factors**

Developing and implementing EERs is a new form of activating didactics in education. This, in turn, also requires new skills and knowledge from teachers, as it is not yet included in the teacher training curriculum. Examples of this knowledge and skills are design skills, solution-oriented skills, creativity, ICT skills, financial literacy, entrepreneurial skills, etc. Educational escape rooms are also compared with a practicum in subjects such as science, suggesting that teachers with a medical background have less trouble with it than teachers without a medical background. Nevertheless, learning these skills and knowledge requires time and resources, just like hiring professionals. However, the early adopters in education take it up with great enthusiasm and inspire other teachers by sharing examples and / or material or even providing workshops (e.g., [escapetheclassroom.nl](http://escapetheclassroom.nl)). These initiatives ensure that teachers realize that there

are different formats of EERs; next to very elaborate EERs (e.g., commercial ones), there are also simpler EERs (e.g., puzzles in a classroom). Finally, teachers are still searching for the time investment of the EER versus the cognitive development of their students' knowledge and skills. For this, the teacher's vision or the belief in the added value of an EER on learning performance is important.

In addition to the skills of teachers and designers, the development and implementation of EERs also requires additional resources in the form of time and money. Teachers indicate that they need more materials, time and staff for an EER compared to a normal lesson. The comparison is made with practical courses in science and / or technical subjects, which always include a technical teaching assistant (TOA) for setting up, assisting during the practical training and cleaning up the room. The comparison is also made in the education layer, where it is stated that teachers in primary and secondary education have more limited access to time and resources, compared to higher education.

Teachers are often enthusiastic, so they often develop EERs in their own time and invest their own resources. Nevertheless, there is a huge need for a concept / blueprint and / or elaborated step-by-step plan, which any education professional can use for his / her context. Because there is a lot involved in developing and implementing an EER, it is also seen as large and complex. Especially designing, testing, and editing the puzzles and determining the level takes a lot of time. Teachers sometimes choose to use students to develop an EER.

In addition to physical EERs, there are also more and more digital / online escape rooms. The escape rooms that are offered online cost less money (in terms of material costs), but more time to be able to design the games digitally. In addition, more and more material are being shared online, which helps teachers to design their own escape room. Lecturers therefore argue in favor of an online platform where escape rooms can be exchanged, and material and knowledge become available. Just like a sustainable toolbox, containing ready-made puzzles and locks, which you could use again for any context. This would help reduce the huge time investment.

Teachers also need time and space to collaborate with colleagues or other stakeholders. By looking for cooperation in the development of EERs, teachers are given the opportunity to work in a multidisciplinary team, making use of each other's talents.

Resources are often available for different projects through different channels, but this requires new skills, time and is unknown to many schools and teachers. It is also important that the school and the supervisors support it and give the teachers the necessary space, time and autonomy. The challenge is to integrate EERs into the curriculum, rather than offering it as an additional unit. Creating support and investing in good EER / methodologies is very important for this. Just as part of the vision in the school for a learning culture, acceptance and further development of the EER in order to do more research into the learning efficiency of the educational escape rooms.

## Preparation of Educators

To develop and implement EERs, the experts have indicated that several skills are important such as game design, creativity, and curriculum design. It is not only crucial to master game design, but fundamental pedagogical skills remain important. For example, it is been indicated that one major challenge in developing EERs is to align the escape room with the ILOs.

To aid the educators in acquiring these skills, four support mechanisms have been identified from the interviews with the experts. First, gaining experience with EERs is crucial. On the one hand, the experts have indicated that educators need to play EERs to gain experience as players. This experience allows educators to develop a view of EERs. It places educators in the shoes of the players and view the game mechanisms from that perspective. Playing an EER also allows to reduce the negative images that educators might have. The participation in an EER can be organized as a component of a professionalization day. On the other hand, the experts have indicated that educators need to experiment with creating EER. The development of EER has been suggested as a trial by error process. It is not a difficult process, but a time-consuming reiterative process of creating and testing.

Second, training, workshops, and conferences can support educators in developing EERs. Especially workshops on the pedagogy of EERs have been indicated as important, since this element is one of the challenges the design of an EER. In addition, educators have the need for instructions on how to proceed from teaching materials to an EER, how to develop ILO, and how to ask questions. However, the training and workshops should not necessarily be focused on the development of EERs, but these can also be focused on the skills required in developing and implementing EERs. For example, educators can follow workshops in creativity to is suitable to develop engaging narratives and divers set of puzzles. Many of the experts interviewed provide workshops in developing EERs. These workshops are provided based on request from educational institutes, but also provided in conferences (e.g., Upthegame.nl).

Third, coaching can also be used to aid educators in acquiring the competences for developing EERs. Colleagues with experience in EERs can coach novice colleagues who would like to learn. Many of the experts interviewed provide similar coaching. However, they have indicated that coaching should be accompanied with other support mechanism such as training and workshops. In addition, institutional support is required to make coaching effective.

Finally, the experts almost unanimously agreed that examples of EERs, including corresponding blueprints, design schemes, roadmaps, and lessons plans is of immense value to educators that want to develop and EER. There is a need for a European EER toolbox, i.e., a platform that includes examples of fully developed EERs, that offers a wide selection of materials (e.g., puzzles, boxes, and key locks), and that is accessible to everyone. The platform must be flexible so that every teacher can adapt it to her discipline and needs. A database with puzzles is also suggested as ideal. Current initiatives are limited (e.g., focus on only a few disciplines) as experts have pointed towards breakoutedu.com as an example.

## Outcomes and Impact

With regards to the outcomes of EERs and impact on students, it is noticeable that students like EERs. It is considered fun, and it aids students to develop relationships with their classmates. It also fosters mastery learning (i.e., self-directed and incremental learning) and behavioral changes.

In addition, there is emphasis on skills and attitude. A stable factor through the different types, comprehensiveness, and disciplines of the EERs is the impact on the skills of the students. Impact on cooperation skills is the most observed in the cases. Other frequently mentioned skills are 21<sup>st</sup> century skills, creativity, and communication. Less frequently mentioned are research skills, reflection, higher cognitive skills (e.g., association, analytical, critical thinking, and problem-solving skills), ICT and reading skills.

Knowledge is not considered as an outcome of EERs. Although students need to make sure of knowledge to solve the puzzles, the acquisition of new knowledge is usually not integrated into EERs. It is indicated that EERs are not well suited for the latter since due to the active play of solving puzzles, there is no room to acquire new knowledge. However, students engage in repetition of already acquired knowledge through the application of these knowledge with associated skills.

Change in attitude, awareness, and intention and effects on emotions also are also mentioned as impact areas of EERs. For example, EERs promote student motivation due to the distinction of this method compared to traditional methods. It is still fairly new and not greatly implemented. In addition, EERs are active pedagogical methods that integrate immediate feedback to the students. Both of these elements stimulate student motivation. Educational escape rooms are fun and are used to spark curiosity of students and generate enthusiasms for learning.

The learning efficiency generated by EERs is dependent on the ILOs. The experience of playing an EER and the use of the knowledge is sticky because students apply the knowledge, skills and attitudes unconsciously. Therefore, the impact of EERs is long-term when compared to traditional pedagogical methods, especially if the classroom is also modified to resemble a commercial escape room instead of only using puzzles in the classroom.

In all, EERs should lead to personal formation of students as students feel appreciated and acknowledged by their peers because they can contribute to the group endeavors of solving puzzles. In other words, the mutual dependency between students help students develop self-efficacy.

## Aspirations

In terms of aspirations of the initiators of the EERs studied in this report, these can be separated into two types of aspirations. On the one hand, it has been mentioned that an aspiration is to

further improve the EERs that they have developed. For example, there are those who would like to incorporate structured debriefing. On the other hand, there are aspirations to develop new EERs. For example, the initiators of *Mastermind* and *RSM Escape room* both have indicated the desire to develop new EERs that focus other themes.

## Final comments and suggestions

Educational escape rooms have many advantages but are not the holy grail. The level of comprehensiveness is a determinant factor in the complexity of the development process, the involved stakeholders, the necessity for funding, and the gamification elements. There are many forms and formats and possibilities, but constant are well developed ILOs and pedagogical aspects.

It is noticeable that all the EERs we studied are on the medium or difficult skills levels. There is no explanation at this point, and we suggest this as a point of attention for future research.

# 5. Portugal

## Introduction

This country report aims to highlight the present status of Educational Escape Rooms (EER) and Game Based Learning (GBL) in Portugal, where it is noticed that it is still in its infancy. Only few educators apply this kind of tools and methodologies for teaching purposes or when they do, they do not spread their results not letting others know if these methods are used for educational purposes. This was reflected in the difficulty the Portuguese UNLOCK team had while trying to collect data, information and fill the case studies. Some Escape rooms have been applied, but few on the teaching/learning higher educational context. This led us to infer that ER and GBL is only starting to become a practice for the advantages they may bring in many knowledge areas. However, advantages and disadvantages have been pointed through the interviews and analysis of case studies: these factors may explain why they are still in its infancy. A lot of initial effort is required and the fact that these tools are time-consuming may be the two main reasons for this current development stage in the country.

To sum up, it is interesting to take from the interviews and case studies the assessment of skills gained by students, the difficulties felt by educators and also learn about aspirations and impacts. In the general evaluation, we may observe in the case studies that the students had the opportunity to interpret, share their ideas, work together, and show themselves committed to the achievement of the team objectives. In some case studies, students helped to created their escape room, and felt more motivated and reflective, being able to manage their goals and time. Concerning the transversal skills acquired, collaboration, critical thinking and creativity were highlighted, namely by the students who collaborated in designing an "Escape Room".

The report starts by analysing the status of EER and GBL in Portugal, and afterwards presents EER methodology and implementation inferred mainly from the interviews and case study reports. Here follows the list of the case studies which will be under analysis in this report:

- *Letras Galegas*: implemented by Adelina Moura, Ph.D., teacher at the Secondary School Carlos Amarante (Braga / Portugal), in the scope of an EU-funded project (eTwinning), in the field of Literature (for a complete description of the case study, see Annex 1);
- *Fernando Pessoa*: also implemented by Adelina Moura, Ph.D., focusing in the field of Literature, particularly poetry (for a complete description of the case study, see Annex 2);
- *MatPorBib*: implemented by Adelina Moura and Idalina Lourido Santos, Ph.D., teacher at secondary school Joaquim Ferreira Alves (Porto /Portugal), in the field of mathematics and Portuguese language (for a complete description of the case study, see Annex 3);

- *Portuguese Literature Escape Room*: also implemented by Adelina Moura and Idalina Lourido Santos, focusing in the field of Portuguese Literature (for a complete description of the case study, see Annex 4);
- *Escape 2 Educate*: implemented by João Almeida, Master's Student., and Mário Cruz, Ph.D., Associate Professor at the Polytechnic Institute of Porto, in the scope of the project of degree in Foreign Languages and Cultures from School of Education of the Polytechnic of Porto. (for a complete description of the case study, see Annex 5);
- *Escapando de la clase tradicional / Escaping from traditional classroom*: also implemented by Mário Cruz, Ph.D., focusing in the field of Foreign Languages, particularly Spanish (for a complete description of the case study, see Annex 5).

In the following sections we identify and expose summarily, from the analysis of national case studies and expert/practitioner interviews:

- facilitating and inhibiting factors in the development and implementation of the EERs;
- the preparation of educators to use escape rooms;
- the outcomes and impact of EERs and aspirations.

Final comments and suggestions are also provided at the end of this report.

## Status of EER and GBL in Portugal

### State of the art in GBL

In Portugal, there has been a considerable reflection and practice around GBL in Education, in the past decade. In this relevant production of scientific and practical knowledge, we can find a wide range of topics covered in the articles, for example:

- The definition of gamification (e.g. Carvalho, 2017);
- The development of frameworks for implementation of GBL (e.g. Piteira, Costa, & Aparicio, 2017);
- Student profile analysis in the context of GBL (e.g. Barata, Gama, Jorge, & Gonçalves, 2014);
- The reflection on GBL in different educational levels and target groups (e.g. specifically in Adult Education: Lencastre, Bento, Spanu, İlin, & Milios, 2019).

A significant portion of this literature is based on pilot experiences and case studies and covers an extensive variety of knowledge-specific fields in different educational levels. Concurrent with this expansion of GBL in Education, through practice and research, other initiatives and resources have been launched and developed in Portugal, such as:

- Funded projects targeting GBL (e.g. the JML project, which was implemented between 2010 and 2015, focused on games and interactive activities for mobile learning<sup>15</sup>);
- The development of GamiLearning, a prominent project funded by the Foundation for Science and Technology (FCT), supported by the UT-Portugal project and the University of Texas at Austin, which focused on “research about the uses of digital;

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<sup>15</sup> More information at: <http://jml.fpce.uc.pt/publicar.htm>

- Game creation in the classroom to support critical and participatory dimensions of media literacy for children ages 9-14 in Portugal and in the US<sup>16</sup>;
- A broader national Program, entitled Portugal INCoDe 2030, presented as an “integrated initiative of public policy dedicated to the reinforcement of digital competences”<sup>17</sup>, which integrates the promotion and dissemination of GBL practices and reflections.

Considering GBL more broadly, its application is happening in a faster and more transversal way. The possibility of using online simulation games acts as a catalyst for your application.

### State of the art in EER

Contrarily to the rapid development of GBL in Portugal in the past decade, the use of Escape rooms in Portugal is not yet a widespread methodology. The EER are now in their “embryonic state”, as defined by Adelina Moura, one of the experts who were interviewed and currently collaborate with the UNLOCK project. Consequently, a limited number of research groups are currently addressing the theme of EER, such as the *Games Interaction and Learning Technologies* (GILT), at the College of Engineering (ISEP), University of Porto<sup>18</sup>, who have benefited from the possibility of sharing their knowledge and getting acquainted with worldwide experiences in international meetings, such as the *5<sup>th</sup> Encounter on Games and Mobile Learning*<sup>19</sup>, promoted by the *Laboratory of Educational Technology* (LabTE), at the University of Coimbra, as well as participating in EU-funded projects, such as the *Letras Galegas* e-Twinning project reported in one of our case studies<sup>20</sup>.

Yet, through the different levels of teaching, there are colleagues who seek to incorporate this strategy in their way of teaching, overcoming some of the gaps that more traditional methods of teaching entail, particularly in motivational terms, in a context of great evolution and exposure of students to new and more advanced technologies.

The low use of Escape Rooms was particularly visible at the time of researching case studies, namely when trying to highlight case studies observed in schools. Escape rooms in other contexts, more entrepreneurial and playful, are beginning to gain their space at a higher speed than what is applied within teaching spaces.

Among the situations found and most interesting to report, the authors/promoters are among the pioneers at the national level in terms of implementation and consistent use in the classroom. Little by little, the message of the potential of escape rooms has been reaching wider audiences and, albeit slowly, the visibility of the disseminated positive results is beginning to gain new adepts.

### The potential expansion of the use of EER

The possibility of the escape rooms to extend from the physical space to the virtual space may contribute significantly to a wider use, since it can enhance a better temporal use in its creation,

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<sup>16</sup> Extracted from <http://play2learn.ulusofona.pt/>

<sup>17</sup> Extracted from <https://www.incode2030.gov.pt/incode2030>

<sup>18</sup> Further information at: <http://gilt.isep.ipp.pt/>

<sup>19</sup> <https://labteuc.wixsite.com/ejml2020>

<sup>20</sup> e.g. <https://sites.google.com/view/escapadela/home?authuser=0>

through the standardization of procedures, as well as allowing savings in terms of financial and physical resources to be applied. The reported applications of escape rooms in higher education are motivated by the consolidation of new teaching and learning approaches that are increasingly being disseminated and shared by educators. These motivations include the acknowledgement of the importance of multi-sensorial environments to stimulate student engagement because such experiences allow “them to recreate similar paths in other contexts” (Cruz 2020), i.e., promoting knowledge activation. The immersive characteristics of escape rooms are acknowledged as offering the opportunity to increase students’ engagement and as the combination of the several elements (e.g. the problem solving, the completion, etc.) allows for the creation of a continuous flow that contributes to gains in the teaching and learning process.

## Development and Implementation

### Study fields and narratives

The cases analysed in this research were centred in the areas of humanities and formal sciences teaching. In the area of humanities teaching, studies were carried out in the learning of the Portuguese, the Spanish, and the English languages.

The narratives of the Educational Escape Rooms were based on works of Portuguese literature, such as the 19<sup>th</sup> – century novel of Camilo Castelo Branco entitled "*Amor de Perdição*", the poetry works of Fernando Pessoa (late 19<sup>th</sup> and early 20<sup>th</sup> centuries), the literary patrimony from Antón Fraguas (*Letras Galegas*), the work of Sophia de Mello Breyner, in the novel "O cavaleiro de Dinamarca", as well as in the context of language teaching and learning (English and Spanish), with narratives of TV series and cartoons.

In formal science education, the experiences occurred with case studies in the teaching of Mathematics, with puzzles and challenges related to the theme of Algebra and mathematical problem solving.

### Target groups/Educational levels and stakeholders

The implementation of these escape rooms occurred in primary schools (in the fields of Portuguese and English language, and Mathematics), in secondary schools with VET students (in the field Portuguese Language), and foreign language teaching in modules A2 and B1 of Spanish in the language and culture centre of the University of Porto.

Concerning institutional support and dissemination, these case studies were mentioned in the documents of the class council meetings, in the planning and activity plans of the courses. In the reported studies, several partnerships were made so that the experience could occur, both locally and at a European level. The involvement of different actors in the school community was therefore used as a transversal strategy in the scope project-based approaches in learning activities and, specifically, in the development of these particular educational escape rooms.

### Aims and goals

The goals and objectives of the studies were related to a paradigm shift from the traditional classroom approach to promoting greater student involvement and motivation for action, thus facilitating immersion in learning and critical thinking. The objective of the case studies also concerned the knowledge of Educational Escape Rooms, and the motivation for their use in Portugal.

Some of these cases included the aim to analyse students' perception of escape rooms, what skills students can develop when they participate and implement EERs, and what strategies are most appropriate for educational purposes.

### Design

Concerning the methodologies used according to Cruz (2020), to achieve these objectives, first of all, it was necessary to understand how the teaching of each subject should be like in the 21<sup>st</sup> century, to gather information on pedagogical approaches appropriate to this type of teaching and to analyse those in which EER can easily be more related, and help explain why these approaches can be effective.

In the case studies *Escape 2 Educate* and *Escaping from traditional classroom* a documental analysis was carried out on articles and books related to the "Escape Rooms" methodology, considering their characteristics and application in teaching and learning contexts. This analysis contributed to the planning of an "Escape Room" and its implementation in a formal education context, during which some field notes were taken. In Adelina Moura's and Idalina Santos's cases some educators also participated in escape rooms (non-educational), to finally put this strategy into practice.

### **Design of the narrative**

In the cases of *Letras Galegas* and *Fernando Pessoa*, the teacher began by introducing the EER to the students and suggesting an initial challenge to all students, which consisted of creating different narratives for the EER. The students were able both to create and actively participate in escape rooms, following the experiential communicative approach reinforced by pedagogy strategies. Involving students in the activity from scratch, promotes greater student involvement in the activities and the development of a diversity of skills and competencies:

- In the case of *Fernando Pessoa*, the design process included research, creative processes, problem-solving activities and syntheses, for the presentation of each group's proposal. For this purpose, a computer room was made available to the students, so they could train and expand their ICT competencies in the development of the challenges for the EER.

In order to design the challenges, the students used ICT-based tools to:

- research relevant information about the author's biography and his literary patrimony;
  - translate numerical information into binary codes and the reverse;
  - create and use QR codes for different purposes and activities.
- In the case of *Letras Galegas*, after an initial research phase about the writer, the working groups presented different narratives and created different activities for the

EER. Students voted for the narrative they preferred, and the class produced a video for the dissemination of the EER, translated into English with the help of the English Language teacher.

The fact that the students had previously been involved in an EER with the same teacher, led the teacher to challenge them to be co-developers of the EER within the e-Twinning partnership. This engaged the students in reinforcing their competencies in the area of narrative construction, writing and storytelling (Portuguese language curriculum-specific contents). In this process, it is crucial to create not only a "good story" but also appropriate puzzles and thought-provoking activities that can involve students.

- In the case of *MatPorBib Escape Room*, began by introducing an initial challenge to all the students, consisting in creating different narratives. The Promoters presented a video about ER and asked students to propose the narrative. There were many proposals and regarding their interest it was decided to make a compilation of several parts of the narratives. It was on the basis of these who created a scenario of abduction of the Maths teacher, in which the students were asked to help in the release of the victim. The puzzles were related to the subject of Algebra (within the scope of Mathematics) and to the literary work of Sophia de Mello Breyner, in particular the novel "*O Cavaleiro da Dinamarca*".
- In the case *Portuguese Literature Escape Room*, a motivational video was created to introduce students to the Escape Room concept and prepared them for the learning and understanding aims. The intended educational goals were mapped and created a script, with the quizzes and riddles, for the students to decide which was to be distributed on paper. The students worked in teams of four and the classroom was prepared in advance. A narrative was created to engage the students in the game serving as a guideline during its development. The students take a detective role because they would have to find the stolen literary work.

According to Adelina Moura, during the design phase, the persistence and guidance of the teacher were crucial, as some students reported lack of inspiration and a highly demanding challenge, which caused some feelings of frustration and withdrawal. This phase is especially demanding for the students and the teachers, as there is a first contact with the content-specific information, which hampers the selection of relevant material to include in the challenges. It is therefore important to find strategies that keep students motivated and grant them structured supervision and guidance to design the scripts for the EER.

The creation of the games involved a combination of physical and cognitive challenges with several puzzles that can be executed in parallel, although sequentially and with different levels of difficulty (beginners, intermediate and advanced), requiring a cognitive complexity of the participants. These combinations are categorized as a mental approach because they are based on the use of students' reasoning and logical thinking. The promoters used different materials in the elaboration of the puzzles, such as different codes (Morse, binary, ASCII), Egyptian writing, QR codes, puzzles, and crosswords, among others.

- In the case *Escape 2 Educate* the challenges were designed considering the Goals of the English curricula and the contents that the English teacher stated that he had already

covered in his classes so far. The students were informed a few days before the activity, but nothing was revealed to them regarding the history or the challenges they would have to overcome. Considering the general interest of the students in the “The Amazing World of Gumball” cartoons, a narrative was elaborated in which they would be responsible for saving Gumball and his family.

- In the case *Escaping from traditional classroom*, two educational escape rooms were created, having into account Two Spanish TV series, namely ‘Money Heist’ (‘La casa de papel’) and ‘Elite’ (Élite). Within the first escape room (developed by the teacher), students from the Spanish B1.2 classroom had solving a series of puzzles related to the revision of some topics, including vocabulary (clothes, trips, environment, mass media), verb tenses, linking words, etc. The second escape room was created by the participants in the first escape room, the Spanish B1.2 level students, and it was developed for the students in the Spanish A2 level classes. These students had followed a couple of leads and solving puzzles and tasks related to the “love and friendship” unit, in which students had to learn vocabulary related to the topic, verb tenses, etc.

## **Implementation**

The implementation of these EER involved in the case of *Portuguese Literature Escape Room* and *MatPorBib Escape Room* 44 and 60 students and, in the case of Fernando Pessoa and Letras Galegas, 16 and 19 VET students, respectively. Already in the case studies *Escape 2 Educate* and *Escaping from traditional classroom* have participated 43 and 38 students, respectively. In addition, there were other stakeholders, such as teachers, and other national/international researchers and practitioners, who were involved the challenges.

The escape rooms lasted about 90 minutes and needed about two to three weeks for planning. These experiences took place in classrooms, computer rooms and libraries of the educational institutions, benefiting from the logistical support of the educational institutions where they took place.

In the experiences that involved students in creating the escape rooms (*Fernando Pessoa, Letras Galegas, MatPorBib Escape Room and Portuguese Literature Escape Room*), a pair of clues and puzzle-solving related to different cultural and grammatical topics were collected, and a script was created, with quizzes and puzzles, for students to decide which one would be implemented. As such, students had the opportunity to review the content-specific elements of the curriculum, while creating the puzzle and narrative series.

In the case of *Letras Galegas*, a fully online EER, the activities involved the following challenges:

- Finding fields of knowledge addressed in the literary work of the writer – by means of resolving a labyrinth;
- Identifying the most recent author and title of the biography of the writer through deciphering symbols
- Finding the title of one of the writer’s text about one specific subject by answering a specific question;
- Discovering one of the writer’s work title using hieroglyphics to decipher a message;

- Researching about the contest Letras Galegas 2019, using the Internet to discover the number of votes on the winner of Letras Galegas 2019.

In the *Fernando Pessoa, Portuguese Literature Escape Room and MatPorBib Escape room* case studies, the EER involved:

- Direct question about biographical data of the writer and convert into binary number;
- Word game using a part of a writer's text;
- Using a QR code to participate in a quiz;
- Using ASCII language to decipher a message;
- Solving a letter soup;
- Using morse code to decipher one stanza of the writer's poems;
- Solving a puzzle.

In the *Escape 2 Educate* Case study, the challenges were designed considering the Goals of the English curricula, the ERR involved:

- Write words in English according to pictures;
- Find the challenges through clues in English;
- Colour and cut geometrical forms correctly;
- Find the words in a box;
- Create sentences in English;
- Get the password the computer;
- Watch a video and answer the questions correctly.

Finally, in the case *Escaping from traditional classroom*, two different escape rooms were applied, taking into consideration contents Spanish as foreign language. The activities involved:

- Find and solve puzzles and crossword puzzles;
- Solve exercises on subjunctive verbs;
- Solve multiple-choice exercises, and complete a text in order to obtain an alphanumeric code;
- Using a QR code watch a video and solve some filling-in gap exercises;
- Unveil a numeric code through in a letter written backwards which could only be unveiled by reflecting it on a mirror;
- Search for clues in books;
- Solve exercises on past verb tenses and reading comprehension.

In short, in the Escape rooms the promoters explained in advance to the students what their role was, what they were supposed to do, and what was going to happen inside the escape room. After the review of the scenario and the rules, some students first heard a recording message, others an introductory video and then challenges were posed. The challenges contained various puzzles, with a degree of difficulty that gradually increased, there were still final plots with specific tasks to decipher the puzzle. In most of the challenges, the groups used tablets, smartphones, or computers to support the resolution of the puzzles, which included diverse activities such as deciphering codes and alphabets, access to websites, QR codes, crosswords, filling in gaps, among others.

Concerning the material and technological resources used, these were very diversified accordingly to each educational escape room, but in general the total expenditure/investment was not significant. Promoters used digital padlocks, wooden safes, envelopes, photocopies of scripts, tables, chairs, a bin with crumpled paper inside, computers, projectors, mobile phones, papers with written challenges, letters or numbers, boxes, books, maps, water bottles, tissue packets, suitcases, keys and various apps. Different digital apps were used to support the EER activities, such as Google Forms and Animoto.

During the implementation of these cases, teachers observed how students were managing the tasks and helped the teams when they are called to support. The teachers reported that it was interesting to see the different ways in which students collaborated to overcome challenges, thinking together, distributing tasks, or sharing search sites among themselves to find a clue or solve a challenge more quickly. Throughout the process, students were motivated to work as a team and the atmosphere in the class improved because of the engaged and committed way students got involved in the tasks.

### **Impact/outcomes**

According to the experts/teachers interviewed, most students appreciated participating in the EER and considered it an intermediate difficulty game. Although some students considered that there were no less positive factors, others highlighted the technological problems (e.g., access to the Internet was very slow), the lack of organisation and collaboration of some members of their team and the venue where the Escape Room took place.

In the general evaluation, we can observe in the case studies that the students had the opportunity to interpret, share their ideas, work together, and show themselves committed to the achievement of the team objectives. These characteristics are related with the skills people must have to solve escape room games, such as communication, listening, brainstorming, time management and teamwork capacity.

In five of the case studies, where the students had the opportunity of creating their escape room (*Letras Galegas*, *Fernando Pessoa*, *MatPorBib*, *Portuguese Literature and Escaping from traditional classroom*), they felt motivated and reflective, being able to manage their goals and time. Concerning the transversal skills acquired, the skills of collaboration, critical thinking and creativity were highlighted, especially by taking roles as supervisors/tutors in the implementation of the EER, which enhanced peer learning and strengthened cooperation between them.

Regarding Escape 2 Educate and *Escaping from traditional classroom* cases, it was observed that the correct decisions regarding the degree of difficulty of each challenge and the number of challenges for the defined time limit were not well balanced and there was a failure in this aspect. Although there was a concern to show the activity plan to teachers and to ask for their advice and opinions, too many challenges were included and some too difficult, especially in primary school classes (Escape 2 Educate). When the trainers realised that the pupils could not find some answers or that they were taking much longer than expected, they had to improvise with more tips and solutions.

## Supporting and inhibiting factors

According to the evaluation ran by the case studies' promoters, students had the opportunity to learn in an engaging, interactive, and meaningful way while participating in the EER. Educators have realised that having good access to the Internet on students' mobile devices is fundamental for games to flow. Also, it is necessary to create a narrative with an appropriate story to the age group as in the cases *Escape 2 Educate* and *Escaping from traditional classroom*, where the age group was completely different, to involve and motivate students in discovering the answers to puzzles.

In addition, as highlighted by Adelina Moura, when most of the students are not acquainted with the EER methodology, and/or had never experienced being involved in one, the inclusion of examples and the exploration of different materials for the design of the challenges in the initial phase of the process is very important and structuring.

The teacher's previous and continued experience in gamified approaches to learning and willing to innovate with particularly resistant groups of students is one core factor for the success of these experiences, as shown in the case *Fernando Pessoa*. Also, in all cases described by Adelina Moura, the fact that the students had computers available in the design phase was very important. Some of the digital tools used by the students at this stage (e.g. quizzes, letter soup) were regularly and previously used by the teacher in other subjects, which aroused curiosity among the students on how to use them in the design of the EER.

As a limitation, educators noted that the Escape Room methodology is a time-consuming one. According to Adelina Moura, the main challenge is to design the idea of what is intended with the EER. Other main challenges pointed out by the educators is the time needed to think about the narrative, to find the enigmas and the tests that relate to the curricular contents: it is not something that can be done in a short time period and requires an adequate profile and specific competencies to enhance this ability.

During the activities, in those experiences where the number of pupils was very large the promoters had difficulties in developing any teamwork and in maintaining the cohesion of the group. The educators in cases *Escape 2 Educate* and *Escaping from traditional classroom* also reported that they tried to make the activity a challenge for the students and this involved choosing challenges with a high degree of difficulty thus requiring too much time for resolution.

## Preparation of Educators

The joint work of the teachers and the interdisciplinarity between the promoters were essential for the success of the experience. The previous teacher's expertise in creating the EER, preparing the environment where it will take place and monitoring the development of the game are also elements of success, as clearly shown in Adelina Moura's cases.

Most of the interviewees had some experience of gamification in the classrooms, including in the application of an Escape Room. The previous expertise and mastery of this teacher concerning technicalities and technology, gamification applied to education and EER

development, was certainly a forming base for the conception and implementation of successful EERs.

In the Mario Cruz's cases, since his doctoral thesis, the instructor had the opportunity to develop gamification practices with his students. Thus, in this case, he followed a holistic methodology based on an experiential communicative experience approach, which encourages students to develop their interests and motivational needs. The creativity, flexibility, the need to take risks and take leadership characterize this approach. The escape room methodology worked as one of these practices and as a synthesis activity to undertake the self-evaluation of the students. The method was adopted in *Escape 2 Educate* and *Escaping from traditional classroom cases* due to the promoter's participation in conferences related to game type teaching experiences, namely the Play2Learn Conference.

In addition to these aspects, and speaking from her experience as a teacher trainer, Adelina Moura affirms that "teachers surrender to the EER", and calls for attention to the professional development of educators regarding the opportunity to getting acquainted and training these gamified approaches to their teaching practices. In her perspective, the implementation of this approach might promote teachers' motivation, addressing also the emotional dimension of teaching.

## Outcomes and Impact of EERs

According to the evaluation of these case studies, as the benefits of this pedagogical approach, students emphasized teamwork and interaction. They felt that this type of methodology fostered collaborative work, allowed the development of critical thinking and communication skills. These experiences are impregnated with very positive emotions, which makes the learning process more attractive and pleasant, thus reinforcing the will to continue learning.

From the answers of the students to questionnaires about their participation in the EER, the advantage perceived was obvious, as they helped the students in the development of values such as perseverance, the ability to work as a team or to promote proactivity. Therefore, involvement, concentration, and (healthy) competitiveness were some of the perceived skills/competencies acquired during the escape room activities.

The students involved in case *MatPorBib* expressed great enthusiasm for the activities: "Very interesting, appealing, and exciting. It was a fun experience, we all worked together and learned to work as a team". The way they engaged in the activities was also evident and the feedback obtained was very positive, with the report that most participants would like to repeat the experience. Most students in case *Escaping from traditional classroom* felt they had developed their skills of collaboration, communication, and critical thinking: "I think the Escape Room had an appealing and funny narrative, and the games used were appropriate for developing our critical thinking". The biggest advantages pointed out by the students were learning to work as a team, interdisciplinarity and also learning and applying the acquired knowledge in a different and more fun way as reported in the case *MatPorBib*: "The change in school routine to something more fun, helps us to work better as a team and learn to listen to each other as we

learn". In addition, the students felt that the supported the evaluation of the knowledge acquired in the subjects involved and that other skills were developed.

In the Fernando Pessoa case, the teacher asked students to complete a survey in order to assess the impact of this learning experience. Students reported a very positive opinion about this activity (87,5% liked creating the Educational Escape Room with their colleagues), because: it allowed them to interact with their colleagues; it gave them an opportunity to put their knowledge about Fernando Pessoa into practice; all the students were able to contribute to the final product; Escape Rooms are an interesting way to learn specific contents. According to these students, the most positive aspects of this experience was "team work, cooperation, group dynamics, experience, learning and organization" (Moura, 2018, p. 121). Most of them agreed that experiencing the actual participation in educational Escape Rooms surmounted the process of co-creation.

The educators report that it was interesting to see the different ways in which the students collaborated to overcome challenges, thinking together, distributing tasks, or sharing research sites to find a clue or solve the challenge more quickly. Educators report in case Escape 2 educate that the experience has had a positive impact on learning and skills development: "students have had the opportunity to interpret, share their ideas, work together and be committed to achieving the team's goals". The promoters consider that the activities were very positive and that there were significant learning moments. In summary, this experience allowed students to: enhance assertiveness, recognize the importance of being involved in different curricular activities, understand and relate concepts, develop group work competences, practice content-specific knowledge, train leadership roles, learn through trial-and-error, making decisions and learning, interact with their colleagues, contribute to one final collective proposal, acquire and develop digital competences for critical search for information and work under pressure.

The impact of using EER is also significant for teachers, as it promotes: the capacity to motivate student to use digital technologies inside and out the classroom, being acquainted with varied web resources in order to complement different subject contents, being acquainted and able to implement active and collaborative educational methodologies in the digital era, the ability to formulate and specify practices mediated by technologies and implement them in class, competencies in software, hardware, and specific applications management, being able to use digital technologies to design resources and implement practical activities.

One of these Escape Rooms was developed as part of an EU project which therefore promotes its transferability. In addition, material outputs such as videos, tutorials, different scripts, enigmas and challenges, online freely accessible educational material, websites, and other online platforms have been developed to support and disseminate EER information to other educators and researchers. These experiences might be the starting point for the subsequent exploration of more complex contents, building up on the knowledge acquired by means of the development, implementation, and participation in this learning activity.

## Aspirations

The high quality of these experiences has been recognised by different means:

- the *Fernando Pessoa* case was disseminated in different national scientific events<sup>21</sup>;
- the *Letras Galegas* EER was awarded a European Quality Label 2019. The European Quality Label is a second mark of success and indicates that the project has reached a certain European standard<sup>22</sup>;
- the *MatPorBib* and Portuguese Literature escape room the output results was reported in a book chapter available in English<sup>23</sup>;

Educators conclude that an escape room has enormous potential for use in teaching and learning contexts. All macro skills of understanding and expressing content have been integrated. With these activities, it is also possible to test the knowledge and train the skills of students, in practical and dynamic reality.

At the same time, the Escape Room will not act as a single activity. It should be a frequent activity within the school, to be integrated with the practices of schools and universities, as it presents a case of potential exploration of areas related to specific curricular contents (for example, writing, mathematical problem solving, literature, foreign language learning).

The design and development approach can be replicated with other students from different levels of education or other courses at the same level. The Escape Room can improve students' motivation for content and increase learning in different curricular subjects.

The involvement of different stakeholders can be used as a cross-cutting strategy for project-based approaches in learning activities and specifically in the development of educational escape rooms.

## Final comments and suggestions

The application of escape rooms in a classroom context, and as an enriching form of teaching methodology, undoubtedly has enormous potential. From the cases analyzed, teachers, students and other agents involved, all reveal an extremely positive opinion of the experiments performed.

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<sup>21</sup> E.g., <https://www.slideshare.net/linade/o-professor-criador-de-experencias-educativas-para-captar-a-ateno-dos-alunos-digitais-116645416> (slides 18-22); <https://www.slideshare.net/linade/educar-para-a-digitalizao-na-sala-de-aula> (slides 10-11); <https://www.slideshare.net/linade/ensinar-e-aprender-na-era-digital-competncias-globais> (slides 12-13); <https://www.slideshare.net/linade/o-jogo-como-ferramenta-de-aprendizagem> (slides 5-6)

<sup>22</sup> It is awarded by the Central Support Service (CSS) to teachers in a project which: has been proposed for the European Quality Label by at least one National Support Service, after a screening process. Every National Support Service puts forward the top third of awarded National Quality Labels based on their quality score; and includes at least two partners that have received the National Quality Label. The European Quality Label is awarded only once a year and is featured on the eTwinning Portal.

<sup>23</sup> Book Chapter Published: Chapter 12 - Escape Room in Education: Gamify Learning to Engage Students and Learn Maths and Languages in Silva, B. D., Lencastre, J. A., Bento, M., & Osório, A. J. (eds.) (2019). Experiences and perceptions of pedagogical practices with game-based learning & gamification. Braga: Centro de Investigação em Educação. Instituto de Educação da Universidade do Minho. ISBN: 978-989-8525-66-6

Due to the flexibility that the methodology makes possible, its adaptation to different levels of teaching and different areas of knowledge gives its use even more merits. In fact, the use from the initial level of primary school to its use in higher education can be carried out with equal property and reaching extremely high levels of knowledge and skills transmission. The different levels of demand for the challenges involving an escape room, the possibility of teamwork can act as a form of integration and involvement of students at different levels of development, thus making it possible to take advantage of teaching that is increasingly adapted to the different rhythms of learning.

In addition, this methodology helps students to increase memory capacity, improve social abilities, increase their satisfaction and involvement among the students, and to learn in a motivating and relaxing way.

It is therefore urgent to make a work of dissemination, demonstration, development of materials, and training of teachers so that the full potential of this strategy reaches the largest number of students, thus enriching their learning and their path. Moreover, it is needed to trace the profile of educators involved and create guidelines for easier implementation of both EER and GBL. From the case studies analyzed by all countries within the UNLOCK consortium, and considering the feedback provided by the participants it will be easier to define a set of skills developed turning even more relevant the application of this type of learning into practice. In this context, the UNLOCK project can be an extremely important vehicle.

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## 6. Spain

### Introduction

The purpose of the following country report is to offer an overview of the state of art of the Educational Escape Room (EER) games, trends, practice and evolution in the Spanish higher education context. A review of the academic literature published in national and international journals has been also addressed.

The report summarizes the information of Spanish case studies, academic literature and expert interviews, with reference to the followed elements: design, creation, activities, implementation and daily operation, assessment and evaluation. Finally, the roles of educators and other involved individuals/stakeholders are also analyzed. In this report six interviews were conducted with six university experts selected by their relevant literature on game design in learning environments. Interviews attended questions such as: background, aims & objectives, duration, mode, team size, target audience, skill level, activities, challenges, supporting factors, stakeholders, inputs, outputs, outcomes, awards and recognition and transferability.

The text shows the innovative potential of EER as an emerging methodological instrument, which are starting to be used successfully in experiences from different areas of university knowledge. Expert narratives show how EER favor breaking boundaries of conventional learning, emphasizing the role of reasoning, creative thinking & reflection in developing collective intelligence. Published research show an effort to identify and model activities that promote different types of collective thinking, identify obstacles and opportunities for university learning in different academic fields.

Our sample includes six innovative experiences of EER focused on Higher Education from different Spanish universities (Valencia, Madrid, Granada, Cádiz and Salamanca) and coming from different disciplinary fields such as training English teachers, nursing, mathematics, computer science and chemistry.

A brief summary of the cases can be found in the following section.

#### ***Research question***

- What is the state of the art of the EG & EER research in Spain (trends and evolution)?
- What role does its application play in HE compared to other educational levels?
- How are they being used, in which areas of knowledge are there significant contributions?
- What methodological innovations contribute to conventional learning?
- What kinds of competencies and thinking skills do it promote?
- How to characterize and typify the different dimensions of the collective intelligence involved in EER methodologies?
- What are the main obstacles and opportunities offered by methodologies based EER?
- What are the main research evidences on its application to HE?

# Status of EER and GBL Spain

## *GBL & EER: An Spanish overview*

### *Trends & evolution in the Spanish context*

A preliminary non-exhaustive search in national (DIALNET) and international (Scopus) databases has been carried out in April 2020. In the following table we show the records obtained in the Spanish database that include those records in international databases.

<b>DATABASE</b>	<b>GBL GAMIFICATION (Gamificación)</b>	<b>EER Scape Room (Escape Room)</b>
<b>DIALNET</b>	<b>691</b> records: (Spanish Journal Paper: 401; Spanish Book Chapter: 241; Spanish Book: 37; Doctoral Thesis: 12)	<b>98</b> records: (Spanish Journal Paper: 82; Spanish Book Chapter: 8; Spanish Book: 1; Doctoral Thesis: 7)

Three predominant areas of work have been identified in the review of experiences in Spain: 1) Non-University area, 2) Teacher training 3) Higher education. In these three areas it has been selected several representative cases that illustrated the experiences found in the Spanish case.

#### *1) Non university experiences (Primary, Secondary & Vocational Education Level):*

In the case of non-university experiences, the bibliography regarding examples of escape rooms carried out in primary, secondary, high school and vocational training has been analyzed.

Numerous examples have been found in this regard relating to experiences carried out by teachers in classrooms, where they tell in detail, how they have elaborated the project and in some cases even attach files to download and carry out in other contexts.

The experiences are very diverse in terms of the subjects where they have been carried out. We can find experiences in subjects such as mathematics, biology, physics, chemistry, history, Spanish language and literature, music, physical education, driver education, among others. An example of this thematic diversity can be found in examples such as “EscapeBOOM”, a mathematical Escape project in my classroom” in which students have to deactivate a bomb solving different mathematical problems and using a "bomb" designed using an Arduino board. Or “Escape room as a didactic experience for the promotion of healthy habits in primary education” that presents a didactic proposal for the promotion of healthy habits in Primary Education based on an Escape room. This activity is designed to be carried out in the Physical Education area in the sixth year of Primary Education. The escape room presented consists of 12 challenges corresponding to the 12 keys to health. Students must overcome the challenges to leave the room before the established time ends. During the various challenges, active participation, peer collaboration and cooperation, and the development of linguistic,

mathematical, digital competence, learning to learn and a sense of initiative and entrepreneurship are encouraged.

Other topics found in the review, presented escape room experiences focused on integration and education for students with specific educational needs, such as the example of "Brailin and the awarded coupon": adaptation of an escape room activity for students with visual disabilities in Primary and Secondary Education" presented on improving the quality of life and social inclusion of people with visual disabilities in their time. free, both in Primary Education and in Compulsory Secondary Education. In this case, through a fun family activity: an inclusive escape room.

All these experiences have a common link, the use of active methodologies to make the contents worked on in the various subjects for students more attractive. Working with them aspects related to motivation, teamwork, critical thinking and problem solving.

Some of the most representative cases can be found in the table attached below. All the reviewed cases can be found at the following link: <https://cutt.ly/WaIEtCl>

## 2) *Initial training teachers experiences:*

After reviewing the state of affairs regarding the escape room-based experiences for teacher training in Spain, it should be noted that unfortunately the experiences found are not very numerous.

Most of the bibliography found is related to gamification in general terms, where articles and book chapters focus on delimiting and clarifying key concepts. Some very striking examples have been found in this regard such as infographics for example "An infographic to help you create your educational Escape Room / BreakOut / Gymkanas". That helps readers create their own educational Escape Room / BreakOut / Gymkanas with the basic guidelines to help teachers create their own escape room so they can use it as a teaching resource in their subject. It can be consulted at the following link: <http://www.musikawa.es/como-hacer-un-escaperoom-breakout-educativo-infografia-musikawa/>. Or texts that indicate the main phases to take into account to implement an escape room in the classroom or interviews with the creators of the main escape rooms in Barcelona where they comment on the key aspects to have in mind to create a striking story as well as didactic.

This is very good to enter the world of active methodologies, and have a first contact with these terminologies, but it is necessary to have more specific experiences related to the training of teachers in the use of the escape room as a teaching methodology as is the case of "Who murdered Pedro?": a gamified experience of Escape Room in teacher training. This activity was carried out within the training of teachers "Conference of Experimental Sciences" of the CEP of Córdoba. It is a game that encourages teamwork and the application of scientific knowledge and can be used in subjects such as biology, physics and chemistry. Another example that we have been able to analyze is "Technology and learning for my teaching staff". Where the author presents two workshops that he taught to discover the world of technology and to improve and optimize digital resources. Each workshop consists of four tests, in the article a detailed review of each one is made, with explanations and materials that have been used for this purpose.

The design of concrete courses that give teachers the tools and skills to carry out this type of methodologies in their classrooms. In the bibliography found some examples of these are shown that show the great reception they have had, but they are only isolated examples in specific contexts, so it would be interesting to extend this practice to other similar contexts.

In this type of workshop, aspects related to the world of technology are usually worked on, for the improvement and optimization of digital resources in the classroom. Proposals of this type are very interesting in order to give that push that sometimes it is necessary to dare to carry out a project of this nature, since uncertainty often paralyzes.

Seeing that in other contexts it has been possible, it can help teachers to extrapolate experiences to their classrooms and provide the necessary skills to use the appropriate platforms to work an escape room or break out in their subject.

The fields of application found have been diverse and varied, as well as the topics covered by the experiences found. All the reviewed cases can be found at the following link: <https://cutt.ly/2aIklCB>

### *3) Higher Education level. Spanish case studies selected:*

Universities teaching techniques are changing as educationalists seek to achieve both quality learning and more effective teaching. Front the classical teacher approach, new methods aim to enhance knowledge acquisition by more actively involving students in their learning, thus achieving greater motivation and commitment (Bernal et al. 2017). Various methods have been proposed to increase students' involvement (face-to-face role-playing games, individual and group video games, serious games, gamoodlification, Escape Room, ...); all of them included in the generic term of gamification.

Para Ripoll (2014) “gamifying is making living game experiences in a non-recreational environment”, and for Cornella et al. (2016, 2017) "gamification consists of designing learning experiences that can be lived as a game" (Cornellà Canals & Estebanell, 2017). The principles of gamification are oriented towards processes or objectives, which may be non-playable in themselves, to make learning more attractive (Parra, et al. 2020). This approach improve motivation and thus enhance the learning experience (Gómez-Urquiza et al., 2019).

Examples of gamification with different models, methodologies and face-to-face and technological supports have been implemented in Spain in the last decade: use gamification for better business results (Laja, 2012); learning healthy lifestyles through active videogames (González et al, (2016); serious games to solve math problems (González et al., 2019); serious games and climate change (Ouarichi et al. 2019); simulation of problem-based learning in nursering (Gómez-Urquijo, 2019); flipped learning as a part of the syllabus is worked on at home before the corresponding class, them, gamification is used as a dynamic means of applying the knowledge gained (Gómez-Carrasco et al., 2020). And more recently, the use of EER in different contexts, educational levels and academic disciplines: in the field of Human Resources and Labor Relations (Moreno, 2018); in Health Sciences (Gómez-Urquizo, 2019, from Biology (Guardiola, 2019); the promotion of reading (Rondón et al., 2019); learning Greek and its culture (Bravo, 2019), learning of history (Codesal, 2019); learning English (Gómez),

learning chemistry (Ferreiro, 2019); mathematics (Zárate, 2018); architecture (Onecha et al., 2019); engineering (Queiruga-Dios, 2020).

The use of gamification based learning (GBL) and educational escape rooms (EER) as a pedagogical tool is a relatively new phenomenon and educators have tested their virtues in different areas of knowledge such as chemistry, physics, maths, biology, nursing, etc. It is generally assumed that this kind of educational game may involve learners in active learning since it helps students to retain and apply the knowledge they have learned in a game. It can inspire learners to self-regulate their learning process, help them reflect upon how the learning connects to their own lives, and develop their intrinsic motivation (Gómez-Urquiza, 2019).

Game-based learning, in which games are used as a means of heightening students' motivation and contributing to the acquisition and assessing of knowledge and skills, has attracted much research interest in recent years (Gallegos et al., 2017) and in many university fields. Games can stimulate motivation, one of the fundamental principles of learning, thus raising interest and promoting active involvement and student thinking skills. Numerous studies have been conducted to determine the influence of games on university teaching. Games which are focused on evidence-based practice, groups of students gain experience points by solving questions and performing tasks (del Blanco et al., 2019), and produce positive outcomes as for satisfaction, motivation, and learning (Gallegos et al., 2017; Fonseca et al., 2017).

The benefits of game-based learning, the popularity and a recent rapid expansion of EER games among the general population and the challenge and motivation they bring about, together with the lack of evidence of the use of this game in university teaching, in any academic disciplines. (Gómez, 2019). The term “gaMoodlification” has been used by some authors (Conde et al., 2015; Cornellá et al., 2018) to unite the best of the gamification and the Moodle platform to offer students the possibility of living a learning experience as if it were a game (through an intergalactic conspiracy that invites players to conquer planet Earth).

EER and GBL methodologies can contribute to redefine and recompose the most basic impulses and motivations that lead human beings to maintain their interest in inquiring, solving problems, questioning, contrasting, debating, criticizing, analyzing and comparing. They serve all these purposes the intentions of EER & GBL experiences that we have selected as a sample of the trends and typologies that have emerged in Spain in recent years. These methodologies help to break the traditional molds of learning, to question conventional schemes and to blur borders between disciplines.

Many of the experiences shown below emerge as spontaneous innovations by teachers, as small-scale local experiences without adequate research design to assess their impact and achievements. They are based on open action sequences with a weak initial planning structure and subject to progressive improvement of the proposals. Conceived as creative and innovative initiatives that transform the routine of a traditional methodology of work in university classrooms and stimulate student participation.

On the one hand, EER provides university students with the opportunity of learning concepts deeply (linguistic, health, maths, physic, chemistry, nursering, engeeniering,... ) and on their own (self-regulation); and on the other hand, they also create material and resources in order to

teach, learning, discuss, analyze, problem solving, decision make,... through challenges and extraordinary motivation not common in traditional classes (Gómez, 2019).

The EER is a much more dynamic option to assess theoretical and practical knowledge, and it may also promote teamwork and the ability to perform under intelligence collective pressure (Gómez, 2019; Reche & Perfecti, 2020).

Six case studies of different Spanish university and knowledge area has been selected.

- Case 1: “The Florence Nightingale Code”. Interviewee: José Luis Gómez-Urquiza. University of Granada. Nursing
- Case 2: “Learn English at University”. Interviewee: Ángela Gómez. University of Valencia. Education (English)
- Case 3: “Deactivating the bomb. Interviewee: Sonsoles López-Pernas. Technical University of Madrid. Computer Science
- Case 4: “CSI 1.0”. Interviewee: Marta Ferreiro. University of Cádiz. Chemistry
- Case 5: “Al rescate de Mendeléyev”. Interviewees: Jorge Ramírez and María Martín Conde. Technical University of Madrid. Chemistry
- Case 6: “A Virus Infected Your Laptop”. Interviewees: Araceli Queiruga-Dios and María Jesús Santos. University of Salamanca. Mathematics

## **Spanish case studies**

### **CASE 1 - THE FLORENCE NIGHTINGALE CODE - NURSING**

The Escape Room is called “The Florence Nightingale Code”. The players must save the nursing profession by locating a falsified document that claimed that Florence Nightingale and Virginia Henderson were not nurses. This Escape Room was implemented during the 2016-2017 summer semester by José Luis Gómez-Urquiza for nursing students of the University of Granada. The duration of the Escape Room was 30 minutes and students were organized in groups of 5. Students had to demonstrate the knowledge acquired during practical seminars such as techniques related to cardiopulmonary resuscitation, taking and reading an electrocardiogram, donning sterile surgical attire, blood sample collection, and insertion and removal of sutures with staples.

#### **Reference:**

Gómez-Urquiza JL, Gómez-Salgado J, Albendín-García L, Correa-Rodríguez M, González-Jiménez E, Cañadas-De la Fuente GA. The impact on nursing students’ opinions and motivation of using a “Nursing Escape Room” as a teaching game: A descriptive study. *Nurse Education Today*, 72, 73–76. <https://doi.org/10.1016/j.nedt.2018.10.018>

### **CASE 2 –THE USE OF ESCAPE ROOMS TO TEACH AND LEARN ENGLISH AT UNIVERSITY - EDUCATION**

The aim of the Escape Room was for students to find out through the clues who was the killer of a doctor. The story dealt with a doctor who had discovered a medical treatment which can cure cancer. The doctor’s employees knew the secret and made a plot to steal it and sell it. One of these characters betrayed the rest and murdered the doctor. Ángela Gómez, the teacher, wanted to work on skills such as autonomy, organization, and teamwork. Rather than making

students to play an Escape Room, Ángela Gómez thought that it could be more engaging if they had to create the game. Therefore, the designers and players of the Escape Room were first year students of the Education Degree enrolled in the subject of Foreign Language (English) for Teachers of the University of Valencia. A session of 90 min was needed to put into practice the escape room.

**Reference:**

López, Á. G. (2019). The use of escape rooms to teach and learn English at university. In S. Pérez- Aldeguer & D. Akombo (Eds.), *Research, Technology and Best Practices in Education* (pp. 94–102). Adaya Press.

**CASE 3 – DEACTIVATING THE BOMB – ENGINEERING**

The narrative of the game consists of defusing an explosive device that has been placed in the university. In order to do so, students from the bachelor’s degree in Telecommunications Engineering from the Technical University of Madrid have to complete a deactivation software by applying techniques they have seen in class and decrypting some clues left by a kidnapped professor. After watching the introductory video, students are given two hours to run the bomb-deactivating application before the bomb is detonated at the end of the countdown. The aim of the teachers–Sonsoles López-Pernas, Aldo Gordillo, Enrique Barra and Juan Quemada– was to reinforce the most important concepts covered in the programming course through a fun activity.

**Reference:**

López-Pernas, S., Gordillo, A., Barra, E., & Quemada, J. (2019). Examining the Use of an Educational Escape Room for Teaching Programming in a Higher Education Setting. *IEEE Access*, 7, 31723–31737. <https://doi.org/10.1109/ACCESS.2019.2902976>

**CASE 4 – CSI 1.0 – CHEMISTRY**

**Design:** The Escape Room is called “CSI 1.0”. Participants play the role of forensic scientists to solve a crime in 60 min by following the scientific method and applying the different steps of the analytical process while working in a team. The Escape Room consisted on three scenarios. The game started at the front door in The Scientific Police Station. There, the participants were given initial instructions, and they then had free access to the first stage. The Scientific Police Station (zone 1) and The Crime Scene (zone 2) were separated by a jail door with a padlock that must be unlocked by using a key hidden in the safe-deposit box. It was developed by Marta Ferreiro-Gonzalez, Antonio Amores-Arrocha, Estrella Espada-Bellido, María José Aliaño-Gonzalez, Mercedes Vazquez-Espinosa, Ana V. Gonzalez-de-Peredo, Pau Sancho-Galan, José Ángel Álvarez-Saura, Gerardo F. Barbero and Cristina Cejudo-Bastante. The first implementation of the activity took place during the European Researchers’ Night 2017 and the intention of the authors were to test and improve the activity with the aim of incorporating it into the practices of the subject of analytical chemistry in the degree in chemistry offered by the University of Cádiz.

**Reference:**

Ferreiro-González, M., Amores-Arrocha, A., Espada-Bellido, E., Aliano-Gonzalez, M. J., Vázquez-Espinosa, M., González-De-Peredo, A. V., Sancho-Galán, P., Álvarez-Saura, J. Á., Barbero, G. F., & Cejudo-Bastante, C. (2019). Escape Classroom: Can You Solve a Crime Using the Analytical Process? *Journal of Chemical Education*, 96(2), 267–273. <https://doi.org/10.1021/acs.jchemed.8b00601>

#### CASE 5 – MENDELÉYEV RESCUE – CHEMISTRY

The Escape Room is called “Al rescate de Mendeléyev”. The players have to travel back in time in order to save Mendeléyev’s life, who has been poisoned. To find the antidote, they will have to solve different puzzles related to basic Chemistry. Secondary students and first year undergraduate students from scientific degrees can play this Escape Room which is based in the history and discovery of the periodic table. The game was designed in order to help students acquire specific competencies in the area of Chemistry as well as general competencies like group work or creativity. To participate in the game, the players are organized in groups of four, five or six. They have 60 min to solve the puzzles presented in the room.

The Escape Room was designed by Pablo Rosales-Peláez, Freddys R. Beltrán, Marta Ruiz-Santaquiteria, Victor M. Díaz-Lorente, María M. Conde and Jorge Ramírez, teachers of the Technical University of Madrid.

#### Reference:

*Escape Room Mendeleiev – Año Internacional de la Tabla Periódica*. (2019). Retrieved July 15, 2020, from <https://blogs.upm.es/escaperoom/>

#### CASE 6 – A VIRUS INFECTED YOUR LAPTOP

The Escape Room is called “A virus infected your laptop”. During a meeting on a European project, a ransomware virus called Wannacry infects the laptops of the partners. Students will have to work together to defeat the hackers by solving math related puzzles. It was designed by Araceli Queiruga-Dios, María Jesús Santos Sánchez, Marián Queiruga Dios, Víctor Gayoso Martínez and Ascensión Hernández Encinas for first-year undergraduate engineering students attending a Calculus, Linear Algebra or Cryptography course, and it started to work in January 2019 at the University of Salamanca.

#### Reference:

Queiruga-Dios, A., Santos Sánchez, M. J., Queiruga Dios, M., Gayoso Martínez, V., & Hernández Encinas, A. (2020). A Virus Infected Your Laptop. Let’s Play an Escape Game. *Mathematics*, 8(2). <https://doi.org/10.3390/math8020166>

## Development and Implementation

### Design

The main aims of the analyzed Escape Rooms were to motivate students and to foster specific knowledge and competences. For instance, “The Florence Nightingale Code” (Case 1), whose narrative was focused on saving the nursing profession by locating a falsified document that claimed that Florence Nightingale and Virginia Henderson were not nurses was used both to

motivate students and to assess cross-curricular competences such as leadership, communication and observation skills. Similarly, in the Escape Room implemented by Ángela Gómez (Case 2) the narrative, centered in solving a murderer, was designed to foster the use of English Language in a real context and to work on skills such as autonomy, organization, and teamwork. The aim of Case 4 is similar, by solving a crime following the scientific forensic methods participants were able to apply to correlate and apply concepts previously studied in different subjects, thus using their scientific knowledge from a global perspective as well as fostering analytical skills creativity, decision-making, data analyses, teamwork, and critical thinking. In addition, Marta Ferreiro (Case 4) stated that other aims were promoting dissemination, creating an innovative educational environment, and fostering students' leading roles. Case 5 also works on basic Chemistry knowledge to find the antidote to save Mendeléyev's life and focused on competencies such as group work or creativity, moreover, Jorge Ramírez and María Martín aimed to make students learn while doing something fun in order to motivate them.

On their part, the teachers involved in Case 3 and 6 focused more on reinforcing the acquired knowledge rather than working on specific competencies. For instance, the Escape Room for Case 3 consisted of defusing an explosive device was designed to work on the most important concepts covered to increase the low pass rate of the course, the teachers "implemented the Escape Room a few weeks before the final exam, so if they are not able to solve it they realized that they had to work harder". Case 6 students had to work together to defeat the hackers that had infected the laptops by solving math related puzzles. The aim of this Escape Room (Case 6), according to Araceli Queiruga and María Jesús Santos was to foster students' motivation while working on abilities which are often forgotten such as "active participation, teamwork, effective communication, self-determination and creativity", they remark that "both, contents and competencies were taken into account".

In addition, all the cases included assessment and feedback of the Escape Room on the part of the students. Therefore, another of the aims common to all the cases was to assess students' perceptions and opinions concerning the Escape Room experiences.

### **Creation**

Concerning the creation of the Escape Rooms, in all the cases, except for Case 2, the teachers involved designed the puzzles and riddles of the game. In Case 2 the students were responsible for designing and implementing the Escape Room. Students created an Escape Room about course content, and their classmates could work through the challenges they have designed. Thus, there was a combination of game creation with the discipline of understanding course content deeply enough to create challenges about it. In that way, both productive (speaking and writing) and receptive language skills (listening and reading) could be worked at the same time. For Case 2, a month was needed to write the story, the clues, and prepare the setting. It was devoted some time of the regular lessons to guide students in this elaboration. Students worked cooperatively and they were connected via Google Drive so that everybody could have access to the story and the clues. The teacher helped them with the linguistic aspects. Eight clues were designed around a story, which was about the murder of a doctor.

Concerning the creation of the rest of Escape Rooms, for Cases 3, 4, 5 and 6 the game was designed and implemented by a group of teachers who worked together. For instance, Sonsoles López Pernas (Case 3) says that “the idea came up by chance, we were in the café talking and the topic jumped into the conversation and we thought that it would be great to create one for our programming courses” since then, the three teachers that work together for designing and implementing the Escape Room have developed three different Escape Rooms, some of them were carried out several years, so, in total, they have developed 5 Escape Room experiences.

In this regard, Marta Ferreiro (Case 4) remarks that there are two main aspects to take into account when designing an Escape Room: 1) hints and puzzles should be organized with increased difficulty, the first ones should be easy so that students do not get frustrated; 2) using each thing only once, as it is important to have a single guiding thread. To sum up “it is important to have everything very well thought and planned: roles, hints and environment. Similarly, Sonsoles López Pernas (Case 3) also organized riddles following a linear structure in which the difficulty is progressively increasing as students progress in the Escape Room and this “allow us to monitoring the activity easily (...) via Escapp platform (a platform that the teachers developed for designing educational Escape Rooms)”

Ten teachers and two students (with an internship) participated in the designing of Case 5 Escape Room. This Escape Room was initially planned for first-year undergraduate students but, given the high amount of students enrolled in first-year, the teachers decided to change its scope for High School students and include it during the “Science Week” to show “the innovative activities done by the teachers and to prove that learning Chemistry can be fun”. The scenario for Case 5 Escape Room included two different atmospheres a futuristic one and one set in the 19<sup>th</sup> Century decorated with ancient objects, furniture, books...and music was used to help to create the different atmospheres.

On the contrary, for Case 1, the teacher responsible of the course (Adult Nursing I) designed the Escape Room on his own. In this case, students had to perform nursing techniques related to cardiopulmonary resuscitation, taking, and reading an electrocardiogram, donning sterile surgical attire, blood sample collection, and insertion and removal of sutures with staples. For example, one of the tests to unlock a padlock with three digits indicated the clue ‘heart rate’. In a computer located in the classroom, there was an electrocardiogram, with which the heart rate could be calculated, thus obtaining the three digits required to open the padlock. The whole Escape Room included around 10 puzzles and riddles.

Finally, Cases 3, 4, 5 and 6 were created by several course staff and some of them reported the creation of the Escape Room to be a complex process. This is the case of Case 5, which took three phases for planning: designing of the plot, assembly and pilot test and performance of test and analysis of data. The Escape Room included 9 puzzles and riddles divided in two different atmospheres. The riddles were related to 1) basic Chemistry concepts and 2) Periodic Table history because they wanted to “mix scientific aspects with others related to the idea of discovery. We wanted participants to feel the “Eureka” feeling when a scientist discovers something new”

Finally, other cases such as Case 3 followed a longer process composed of eight steps including deciding the approach for incorporating the activity into the course, as well as its requirements

and general design, defining the learning objectives and the kind of puzzles appropriate to address them, among other steps. For instance, Araceli Queiruga and María Jesús Santos (Case 6) stated that it is “impossible to assess how much time was devoted (to create the Escape Room). After a well-designed activity there are many working hours”. Similarly, Marta Ferreiro (Case 4) reported that it is essential to “know when to give the clues so students do not get stuck, to control times and support the process” in addition, it is important to have everything in duplicate (locks, etc.) in case any problems arise.

### **Implementation and the daily operation**

Concerning the periodicity of the Escape Rooms, Case 5 was the only Escape Room which was played periodically as it was intended for Secondary students and first year undergraduate students from scientific degrees and their schools/faculties could book a session of the Escape Room to play it. In this case, to participate in the game, the players were organized in groups of four, five or six. They have 60 min to solve the puzzles presented in the room. Concerning Case 4, although planned as a one-time activity, it is important to note that the Escape Room has been implemented several times. The first time it was implemented during the European Researchers Night, so it was played both by students and general public. The next editions of the Escape Room included graduate and postgraduate students. In addition, the teachers involved in Case 4 have recently developed a virtual Escape Room with a videogame structure.

The rest of the Escape Rooms was designed to be one-time activities and their duration was between 30 and 120 minutes. Case 3 was the longest Escape Room as 120 min were devoted to play it and Case 1 was the shortest one (30 min). Moreover, another interesting feature of the Escape Room of Case 3 was that students were organized in pairs rather than in teams, which is the case of the rest of the cases, group formation is carried out using Escapp platform. In addition, it is remarkable the fact that the hints for Case 3 were provided using Escapp platform and to access hints students had to correctly answer some questions which were randomly selected by the platform.

Case 2 was the second longest Escape Room as 90 min were needed to put it into practice. In this case, there were eight guides –students– who led the players to the different scenes, where an actor/actress was awaiting to present them the puzzles and clues. This Escape Room needed several places from the Faculty such as the classroom, corridor, stairway, hall...The implementation of Case 4 was similar as it also consisted of different scenarios: The Scientific Police Station, The Crime Scene and The Laboratory. However, its duration was shorter, 60 min were given to players to scape. The rest of the cases only had one scenario where the Escape Room was developed. For instance, Case 1 and Case 6 were implemented in the same classroom where the lessons of the courses took place

Another interesting fact about the implementation of the Escape Rooms is that Cases 1, 3 and 4 used videos as an introduction to present the Escape Room or to give students the instructions to play it.

### **Assessment and Evaluation**

Concerning students’ evaluation, Case 1, 2 and 3 included points that were added to students’ course final mark. For instance, in Case 1, the fastest group to scape was awarded 5 questions

out of the 100-test questions of the final exam, the second team was awarded 4 question and the third team 3 questions. José Luis Gómez-Urquiza, the teacher, says that this kind of award served to prevent students to tell the other groups the solution of the puzzles and riddles. In addition, it is worth mentioning that José Luis Gómez-Urquiza also used rubrics (Likert-scale) for assessing cross-curricular competencies. For Case 2, students were awarded 20% of the final mark for the elaboration of the Escape Room. Ángela Gómez, the teacher, states that she was very surprised as she realized that students did not pay much attention to the mark to participate in the Escape Room, they were involved in it because they were motivated and the mark was not important for them. The teachers of Case 3 offered the Escape Room as a voluntary activity, but students got a “couple of extra tenths for their final mark no matter if they were able to solve the Escape Room or not”

Finally, concerning Case 4, the activity was graded on a scale of 0 to 10 by the students and the teacher, who is accompanying the groups of players, used rubrics and questionnaires to assess the activity. On the contrary, other cases, such as Case 6 and 5, did not include any extra points concerning students’ grades. Case 5 had a sponsor company which gave them gifts for the winning teams. On the other hand, the teachers of Case 6 say that the “activity is a reward itself”.

Regarding students’ feedback, all the cases included questionnaires to gather students’ opinion about their experience participating in the Escape Room. These surveys, which were in the form of Likert-scales, were collected via online or in class once the Escape Room was finished.

### **Roles of educators and other involved individuals/ stakeholders**

For most of the Escape Rooms, the teachers planned them on their own and there were not any other stakeholders involved. José Luis Gómez-Urquiza (Case 1), for example, stated that he planned the whole Escape Room on his own, however, the Department supported his proposal and gave him complete freedom to carry out the Escape Room. In this case, the teacher was the only person present during the Escape Room to assess performance and to ensure that the techniques required were being correctly carried out. He did not give any assistance, but only spoke to provide the two clues and, if necessary, to indicate that a technique was not being correctly performed and should be repeated before further progress could be made. Similarly, in Case 3 and 4 three course teachers were present during the activity in order to supervise it and to give hints to the students and, in Case 4, they also performed a role during the game (witnesses, etc.).

In Case 5, a total of 10 professors participated in the design and implementation of the activity and they were also supervising its development during disclosure day. Regarding Case 5, apart from funding from external agencies, the teachers counted with an external collaborator to participate as an expert due to his wide experience as a participant (more than 30 escape experiences) and as organizer (4 designed escape experiences). During the game, 2 or 3 assistants were present: one was in charge of the reception of participants and was the gamemaster, other was hidden in the room and the other one helped to rearrange puzzles and riddles in-between groups.

In addition, Cases 1, 3, 5 and 6 carried out pilot test to identify some issues with the puzzles and modify them before setting up the final Escape Room.

Finally, for Case 2, the teacher acted as a supervisor as the students were in charge of creating and implementing the Escape Room. In this sense, a group of students were supervising the development of the Escape Room the day it was played

## Supporting and inhibiting factors

Concerning facilitating factors, the main personal factor is the motivation of the actors. For instance, José Luis Gómez-Urquiza (Case 1), Ángela Gómez (Case 2) and Sonsoles López Pernas (Case 3) reported that they were motivated to try something new in the classroom. Moreover, another of the factors reported in Case 1 is the fact that the teachers felt supported by his Department, as he had complete freedom to use Faculty resources to carry out the Escape Room. In addition, José Luis Gómez Urquiza (Case 1) also reports that the fact that he had also expertise from previous years was a facilitating factor, as he stated “I always say that the first one demands a lot of effort, the second one a little less, the third one less..” so, with time, he was capable of organizing a huge variety of Escape Rooms. On the contrary, Ángela Gómez (Case 2) who only had one experience with Escape Rooms states that she was “overwhelmed, 95 students (...) sitting there in the hall of the Faculty, you can imagine..., I thought ‘this is not going to work, it is impossible’” although she says that “thanks to the previous planning everything went well, but you feel overwhelmed all the time”.

Another important aspect is the fact that most Escape Rooms were planned as a one-time activity, being Case 5 the only Escape Room who has been implemented in the long-term. However, some of the teachers, such as José Luis Gómez-Urquiza, Sonsoles López Pernas and Marta Ferreiro (Case 1, 3 and 4) continue to design and implement Escape Rooms through the time, although José Luis Gómez-Urquiza and Sonsoles López Pernas vary their theme and objectives. In this respect, all the actors of the cases agree about the great amount of time, in many cases several months, that they invested when planning the Escape Room, which can be an inhibiting factor. In addition to be time consuming, the authors of Case 4 comment that there are some limitations that should be resolved before the implementation of the activity in a scientific degree. It has to be considered that the development of this Escape Room as a practical lesson has some drawbacks: i.e., the fact that the number of members per group should be reduced, the level of scientific knowledge of the participants should be similar, or a fair distribution of work between members should be sought.

Finally, one of the most common inhibiting factors is the lack of funding, as many of the teachers did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. This entails that the teachers have to spend their own money to buy the materials, as in Case 1 “you have to buy some locks and things. I normally say that the investment is about 50-100 € and once you have the material you can reuse them”. In the case of Ángela Gómez (Case 2) she comments that students did not invest money as they “did it with the resources they had: papers, pens, markers...everything that they had. I was surprised because they did not use any digital resources (...) but they did it handmade”. Similarly, Case

3 did not receive any funding for the first Escape Room, although they received some funding in the following experiences from teaching innovation projects and they used it for buying material, paying students' internships and attending conferences for dissemination actions. However, they reported that "material cost was very low as all the riddles were digital or only a piece of paper was needed" and they add that the investment of time was very high and "entailed a great effort",

Three of the cases (Cases 4, 5 and 6) received funding from research projects or organizations. In particular, Case 6 was included in a European Project called "RULES\_MATH New Rules for assessing Mathematical Competencies Erasmus+ Programme of the European Union", whose objective is to develop evaluation standards for a competence-based teaching-learning system. It is worth noting that Case 4 received only 300 € from University of Cadiz's scientific unit for the presentation in the European Researchers Night. Regarding Case 5, the teachers received funding from their university and two organizations (Real Sociedad Española de Química and Obra Social de La Caixa); their Department offered them the facilities to implement the Escape Room; the theater group of the university let them materials for creating scenarios, lighting, etc.; and one company sponsored them and gave them gifts for the winning teams.

Another important aspect is that given the generalized lack of resources, most of the teachers used Faculties facilities and resources to carry out the Escape Rooms. For instance, Araceli Queiruga and María Jesús Santos (Case 6), despite having funding, state that they lacked "an appropriate facility to be able to carry out this kind of activities". This is the case of Sonsoles López Pernas (Case 3) who says that they "lacked help for putting the activity into practice: monitoring students' progress, team formation, shifts control, providing hints, etc." and that is why they developed a platform called Escapp which aims to facilitate the process of developing educational Escape Rooms, both on-site and on-line"

Finally, it is worth mentioning that Jorge Ramírez and María Marín (Case 5) remarked that they would have liked more human resources to include graduate students in the Escape Room, not only Secondary students. However, the personnel cost was too high to assume it as "2-3 people had to be fully involved in the Escape Room sessions" and each session lasted 1h30 so "the personnel cost was too high because we had other obligations concerning teaching, researching and management"

## Preparation of Educators

Concerning the preparation of Educators, after revising all the cases and literature related, there is no record of specific preparation such as going to courses or playing Escape Rooms to gain experience. However, three of the cases stated that the idea to plan an educational Escape Room occurred to them thanks to their own experiences playing them. For instance, José Luis Gómez-Urquiza (Case 1) says that:

"I went to many Escape Rooms with my family, friends and so on. I went to one of them in Granada called The Virus and I thought that it could be related to health or nursing, which are my expertise areas. When I played it I realized that the Escape Room had nothing to do with

health (...) but I thought ‘why don’t I try to adapt this kind of game that I enjoy and motivates me, and even pay for it, for the classroom’”.

Something similar happened to Ángela Gómez (Case 2) who says that “I developed it at the beginning of 2018 academic year because this summer I had participated in a Harry Potter themed Escape Room in Valencia and I saw its potential for education, for any kind of subject or skills.”. Once Ángela Gómez (Case 2) decided to implement the Escape Room methodology in her classes she “started to research and to read about the student being also an active actor”. Similarly, Jorge Ramírez and María Martín (Case 5) thought that, after visiting some Escape Rooms, “it would be fun to try to do something similar with scientific content, with the aim not only to entertain but to teach something”. On her part, Marta Ferreiro (Case 4) reported that she was inspired by CSI TV series and also by the Escape Room that she had visited.

In addition, some experts like Segura-Robles & Parra- González (2019) recommend to perform a full rehearsal before implementing the Escape Room in order to check that everything is placed correctly and work so that the students can enjoy this learning experience. This was the case of various of the case studies. Sonsoles López Pernas (Case 3) and her colleagues tested the Escape Room through a simulation with one faculty member (knowledgeable of the course materials) who volunteered to participate. Finally, some minor refinements were made to the escape room based on the lessons learned from the simulation and the participant’s feedback. Jose Luis Gómez-Urquiza (Case 1) tested the Escape Room with students from last course to check difficulty appropriateness. On its part, the experts of Escape Room CSI 1.0 (Case 4) premiered it at the European Researchers’ Night 2017 in Cadiz (Andalusia, Spain). The objective was to collect data in order to implement the activity in the analytical chemistry subject of the university degree in chemistry offered by the university of Cádiz.

Finally, it is worth mentioning that, even if the agents of the case studies did not receive any specific preparation, José Luis Gómez-Urquiza (Case 1), after the success of his Escape Rooms in the Nursing school has done several demonstrations in international conferences and he has participated in several teacher training courses to show how to design and plan an educational Escape Room.

Concerning Case 6, Araceli Queiruga and Maria Jesús Santos reported that they had to take time for training themselves regarding Escape Rooms and, also, digital tools such as video recording and editing, apps for creating QR codes, questionnaires and virtual locks, tools for 3D visualization, among other things. After the training they “designed the activities and organized all the materials” and they also pilot tested the Escape Room. In this sense, it is important to remark that they think that as teachers they try to “keep up to date concerning educational trends” and that is why they decided to implement an Escape Room.

## Outcomes and Impact of EERs

All the Cases were implemented successfully, and the teachers reported positive experiences with regard to the design and implementation of the Escape Rooms. The main outcomes, obtained from the different questionnaires that the teachers passed to students, were that they were motivated and that the Escape Rooms served to foster knowledge and work on several

competencies such as teamwork. Therefore, the main aims of the Escape Rooms were achieved for all of the cases.

As previously mentioned, all the cases included assessment of the Escape Room on the part of students through questionnaires. Concerning Case 1, according to the students, they found the Escape Room enjoyable and useful and helped them to recall and apply knowledge as well as promoting teamwork. According to Ángela Gómez (Case 2) “students’ anxiety was reduced and they were not scared of talking (in English) because the talk to a pair, they correct among them (...) and it is interesting to explore this peer relationship”. She thinks that the outcome of the Escape Room was very positive, students were heavily involved in both planning the Escape Room and solving it. And they were very satisfied at the end of the activity because they felt highly motivated by how they had carried out the task. Concerning Case 3, the evaluation survey was completed by a total of 84 students, who volunteered to do so at the end of the activity. This sample represents 67.7% of the 124 students who attended the educational Escape Room. The results show that students had a positive overall opinion on the educational escape room and that it was a fun experience. Nevertheless, only 5 teams (8% of students) could solve all the puzzles in the given timeframe, which might be an indicator of excessive difficulty. In addition, Sonsoles López Pernas (Case 3) indicates that students “had the opportunity to see course material from a different perspective and realize about its practical utility. They were able to revise their knowledge and acquire new ones by overcoming challenges and answering the questions for obtaining hints and also by discussing with their teams”. In fact, Sonsoles López Pernas remarks that during the confinement months students were able to interact and learn together despite the distance.

In Case 4, 67% of the participants of the participants considered the activity difficult/very difficult and 100% of them answered that this kind of activity was a suitable way of learning as well as showing their interest in repeating a similar experience, in fact, Marta Ferreiro reported that many participants of the first Escape Room have helped them to organize the following editions. For Case 5 the results are similar, students reported that the experience had served them to gain knowledge and that it was a fun activity and that they “were really satisfied with the game and with how participants enjoyed it”. Similarly, around 80% of participants of Case 5 managed to escape, although, the game master had to help them with hints in most cases.

With regards to Case 6, more than 90% of participants thought that the Escape Room was especially useful for learning math and they thought that it could also be used in other subjects. Araceli Queiruga and Maria Jesús Santos (Case 6) realized that the experience had “not only improved students’ motivation and engagement but also concept understanding and key competencies acquisition”. They also remarked that they encountered difficulties when one team was not able to work together, however, “if there is cooperation among team members, they will probably success”.

This results are similar to those expressed by other authors who also reported very positive results concerning knowledge acquisition, motivation, enjoyment and improvement of skills such as teamwork or emotions such as joy or pleasure (Borrego Iglesias et al., 2016; Ferreiro-González et al., 2019; Gutiérrez Praena et al., 2019; Jiménez Sánchez et al., 2017; Sierra Daza & Fernández-Sánchez, 2019).

In what teachers respect, some of them gained recognition and popularity, this is the case of José Luis Gómez-Urquiza (Case 1) who comments that many colleagues have been interested by its Escape Room as he appeared on several media and he says that colleagues and students recognition “is more valuable than any certificate”. On her part, Ángela Gómez (Case 2) had an offer to cooperate with the Sciences Faculty although they still have not been able to work together due to time constraints. With regard to Case 3, the teachers involved received an award in a Free Software Contest for developing the platform Escapp. Marta Ferreiro (Case 4) remarks that they implemented the Escape Room with no aims for recognition but for personal fulfillment. However, the second year, a local newspaper included news of the Escape Room.

Jorge Ramírez and María Martín (Case 5) stated that they had a lot of advertising from their university Communication Services and the Faculty directing team participated and congratulated team. In addition, a local TV included their Escape Room in one of their programs. Araceli Queiruga and María Jesús Santos (Case 6) said that they did not expect any institutional recognition and, for them, “the recognition was students’ excitement”, who were looking forward for these kind of activities”

To finish with, other authors such as Borrego Iglesias and his colleagues (2016) reported that carrying out the Escape Room had served them to acquire experience and that they are prepared to expand this kind of experiences.

## Aspirations

Regarding aspirations, the experts did not report specific aspirations concerning the planned and future Escape Rooms. However, some aspects may be considered in this respect, which are explained below.

Concerning aspirations for the planned Escape Room two of the cases (Case 1 and Case 2) report that they had no initial aspirations for their Escape Rooms as their main goal was to try something new to motivate students. Ángela Gómez (Case 2) says that “it was an intuition and I decided to try and I thought ‘well, if they (the students) say no, I’ll propose a different project and if they say yes I’ll start working”. In the case of José Luis Gómez-Urquiza (Case 1) he realized that, apart from motivating students, he could use the Escape Rooms to obtain information about competencies such as leadership, communication, observation, etc.

In this sense, other authors such as Sierra Daza & Fernández-Sánchez (2019) also outline their double aspiration: firstly to make students understand what is gamification and, secondly, to work on specific competencies.

Regarding future aspirations, Jose Luis Gómez Urquiza (Case 1) states that he plans to continue designing Escape Rooms for his classes given the success of his previous experiences. In addition, he has also gone to several conferences to show how to design and implement Escape Rooms and he has worked on several themes such as management, emergencies, surgery, ...

Sonsoles Lopez Pernas (Case 3) wants to study how team size affect students performance during Escape Rooms, as she has observed that those who work in teams make more profit from the activity and are more likely to solve the Escape Room.

Marta Ferreiro (Case 4) plans to continue the Escape Room and improved, for instance, using manikins and adapting the activity to the different courses and levels and devoting several

sessions to the Escape Room.

On their part, Araceli Queiruga and María Jesús Santos (Case 6) think that “this activity can be implemented in different levels for Math students, in any country” and they remark that they conducted an Escape Room with students from 7 different countries in a meeting of the European project they participate.

Other authors such as Borrego Iglesias et al. (2016) states that they plan to keep carrying on Escape Rooms and to expand their use to other modules, being their final aim to reach all the courses of the Computer Science Degree of the Autonomous University of Barcelona.

## Final comments and suggestions

### *Own reflections on the landscape of educational ER games in your country, and future suggestions*

In Spain, the use of gamification and learning supported by escape room methodologies is only just beginning. It has undergone considerable expansion over the past decade. A large part of the EER initiatives carried out do not exceed five years, as recent publication trends show. Its application initially arises in contexts external to educational institutions, such as recreational experiences, recreation and search for shared emotions in the context of leisure.

Although their intrinsically motivating and activating potential of human curiosity makes them initiate innovative experiences at different levels and areas of knowledge of regulated educational systems.

A good number of these experiences arise linked to teaching-learning in non-university contexts, as fun learning spaces applied to science, mathematics, languages, art, ...

With different nuances each of the experiences that have emerged In the Spanish context, it places emphasis on the development of a type of competencies according to the purposes and interests of its promoters.

The low cost of the EER is a positive aspect when compared to games based on clinical simulation or on online question and answer platforms, for which appropriate software must be developed and maintained.

The planning and preparation of the EER requires a considerable time to devise and interconnect the tests involved. Its application also entails extra time for the teacher when compared to the delivery of lectures in a ‘master class’ format since each group is composed of just a few (4-5) students who have 30 min to solve the game, after which 15 more minutes are needed to prepare everything for the next group. To this we must add the effort required by the evaluation processes of this type of unconventional methodologies.

This might be considered a disadvantage as compared to other games in which all students can participate at the same time via website or any online platform (Pront et al., 2018). However, once the game has been developed, it can be further applied in successive years. Moreover, when the dynamics are well understood, it is easier to devise tests for different subjects. (Gómez-Urquiza, 2019).

An infinite space of pedagogical innovation and transformation of university education opens with the use of GBL & EER methodologies in the field of HE. The systematization, evaluation and empirical discussion of these initiatives must favor progress in the construction of a

foundation framework that more precisely defines the methodological principles that guide these experiences of innovation, their limitations, strengths and future opportunities.

These innovative resources must allow educational systems to place the value of spontaneous learning at the service of methodologies closer to the interests and motivations of students, as an example based on evidence of the explosion of authentic collective intelligence in its purest expression

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