EDUCATIONAL ESCAPE ROOMS IN PRACTICE:
RESEARCH, EXPERIENCES, AND RECOMMENDATIONS
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The following e-book 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 review of the existing body of academic literature on EERs, while capturing current approaches and practices from across the diverse line of disciplines, and challenges experienced in the adoption of EERs in the (higher) education settings. The literature review provides an overview of the status-quo of the EERs in the higher education sector, followed by UNLOCK project partner country reports (Denmark, Germany, Netherlands, Lithuania, Portugal, and Spain) for targeted insights on the adoption of EERs in the local (higher) education contexts. We also present the synthesis report provides a discussion of the major findings, along with emerging themes and recommendations for further EER research and practice.

### Definitions

<table>
<thead>
<tr>
<th>TERM</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>GAME BASED LEARNING</td>
<td>Type of game play with defined learning outcomes (Shaffer, Halverson, Squire, &amp; Gee, 2005). Usually it is assumed that the game is a digital game, but this is not always the case.</td>
</tr>
<tr>
<td>GAMIFICATION</td>
<td>Use of game elements, such as incentive systems, to motivate players to engage in a task they otherwise would not find attractive (Plais, Homer, &amp; Kinar, 2015).</td>
</tr>
<tr>
<td>EDUCATIONAL ESCAPE ROOM (EER)</td>
<td>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).</td>
</tr>
<tr>
<td>STUDENT</td>
<td>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.</td>
</tr>
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<td>GAME DESIGNER</td>
<td>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/s support staff professionals with game design specializations are referred as Game designers.</td>
</tr>
<tr>
<td>GAME MASTER</td>
<td>A game master (GM; also known as game manager, game moderator or referee) is a person who acts as an organizer, officiant 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.</td>
</tr>
<tr>
<td>HIGHER EDUCATION INSTITUTIONS (HEIS)</td>
<td>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.</td>
</tr>
<tr>
<td>FOLK HIGH SCHOOL (DENMARK SCHOOL SYSTEM)</td>
<td>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.</td>
</tr>
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Introduction

According to Nicholson (2015), escape rooms are “a 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”. Being an interactive game the concept uses elements from point-and-click adventure games, role-playing, treasure hunts, and TV shows. Before being subject to scientific literature and part of the curriculum in educational institutions, escape rooms became a popular activity for recreational purposes. At first applied in Japan in 2007 commercial escape rooms were established worldwide counting more than 7200 in 2018. In recent years, escape rooms also began to become of interest to academia. Despite being still a very small field in research, the amount of literature on this topic is rapidly growing.

This e-book 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 publication also offers some background to newcomers on this methodology and showcases how the UNLOCK project may contribute to the application of EER in HEIs.

The e-book is organized as follows:

In the first chapter, we present a review of the existing body of academic literature on EERs, while capturing current approaches and practices from across the diverse line of disciplines and challenges experienced in the adoption of EERs in the (higher) education settings.

In the second chapter, we provide insights on the status-quo of the EERs in the local (higher) education environments from Europe, supported with insights from global contexts. Finally, we discuss the emerging themes and recommendations for further EER research and practice.
CHAPTER I: REVIEW OF LITERATURE

1.1 Methodology

The basis of this e-book draws from 49 articles selected from Scopus and Google Scholar databases. The papers were selected according to two main selection criteria: (i) studies discussing adoption and experiences of EERs in the higher education context, and (ii) those that are face-to-face or hybrid in nature. The studies were then analyzed according to a previously identified framework (see Figure 1) that aimed to capture both EER development environments and design and implementation principles in the HEIs.

Figure 1. Preliminary framework for the literature review

EER DESIGN, DEVELOPMENT AND IMPLEMENTATION

- Context
- Status-quo of Educational Escape Rooms (EERs) in Higher Education

- EER DESIGN, DEVELOPMENT AND IMPLEMENTATION
- Inhibiting factors in adopting and implementing EERs
- Involved stakeholders

- Aims and Objectives
- Supporting factors in adoption and implementation of EERs
- Outcomes and impact

Figure 2. Preliminary framework for the literature review
1.2.1. EER publications across disciplines and regions

Regarding the geographical background, most of the analyzed research has its origin in North America. North American academics are responsible for the majority of the literature (61%), with the USA and Canada accounting for 50% and 11% of the publications respectively. Less dominant, the other significant share of literature was found to originate from Europe (36%), while the remaining studies were spread across multiple countries. The largest share however, can be attributed to the United Kingdom (11%). No published articles were identified from Africa, Asia, or South America. Only one of the reviewed articles originated from Australia.

Escape rooms in HEIs are used in various contexts. Multiple use cases show that EERs are applied in fields ranging from cryptography education (Ho, 2018) over to medical education (Guckian et al., 2020; Kinio et al., 2019) to foreign language teaching (Cruz, 2019).

The authors found that most of the selected studies about EERs implemented in the fields of healthcare, including medicine, pharmacy, and nursing (53%). Accounting for approximately 22%, EERs from the fields of Computer Science and Engineering correspond to the second largest group of the examined literature. Another 11% could not be attributed to any specific group of academic subjects, in most cases because there were too few articles in those fields. This group comprises EERs in areas such as Environmental Education, Earthquake Preparedness, or Foreign Languages. Furthermore, multiple use cases were found in the fields of Library Education (16%) and other Natural Sciences (8%). Surprisingly, disciplines such as business administration and law were not found to publish any studies related to EERs despite being very large fields of study (Cain, 2019). The main trends are also somewhat consistent with the literature review of Fotaris & Mastoras (2018). Only 1.5% of the studies were found to originate from the fields of business administration and law.

The interest in game-based learning has spurred a number of successful educational game-makers communities and associations internationally, regardless of the country of origin. Notable examples include:

- Games for Change Society is a non-profit organisation, that empowers game creators and social innovators to drive real-world impact through games and immersive media. We convene industry experts through our annual Games for Change Festival, inspire youth to explore civic issues and STEAM skills through our Student Challenge, and showcase leading impact-focused games and immersive experiences through live Arcades for the public. [http://www.gamesforchange.org/]

- Serious Games Society is the think tank where the future of games for learning can be discussed and put in practice. The SGS has been designed to bring together the cutting edge companies, institutions and individuals researching on and developing Serious Games. Serious Games Society publishes its international journal and runs events and conferences on Serious Games and Game-based learning. [https://seriousgamesociety.org/]

Breakout EDU is one of the largest Educational Escape Room/Box methodology community and tools provider in North America. A commercial network, it provides its members with ready-made solutions and sets of customisable puzzles for various subject areas, levels of education and learning objectives, as well as a platform to interact with like-minded educators online and offline. [https://www.breakoutedu.com/]

**HIGHLIGHTS FROM PRACTICE**

**THE COMMUNITIES OF EDUCATIONAL GAME-MAKERS**

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1.2.2. EER aims and objectives

As manifold, the contexts are the purposes and goals EERs. Many of the EER use cases though, mention increased motivation and engagement (Kinio et al., 2019; Walsh & Spence, 2018). By its participative approach, EERs further are eligible to integrate multiple perspectives into problem-solving (Cruz, 2019; Franco & DeLuca, 2019). While most of the examined EER studies focus on teaching educational topics (Chang, 2019; Jambhekar et al., 2020; Lopez-Pernas et al., 2019b), with the EER experience, others solely aim to promote soft skills such as team-building and leadership (Gordon et al., 2019; Wu et al., 2018). However, one cannot draw a clear line between EERs only teaching soft skills and those only teaching knowledge. Most of the time there are interrelations between both aspects. A commonly mentioned reason for the implementation of escape is to promote the adaption of so-called “21st century skills” (Cruz, 2019). In this context, EERs should stimulate the participants’ ability to out-of-the-box thinking (Karageorgiou, Mavrommati, Christopoulou, & Fotaris, 2019), fostering creativity and critical thinking and using all these skills collaboratively (Cruz, 2019). Moreover, EERs aim at promoting interdisciplinary communication and teamwork between participants (Prinsloo et al., 2020). Furthermore, EERs are implemented in different stages of the learning process. Some settings aim to raise awareness (Chang, 2019) or to introduce and familiarize participants with certain topics (Guckian et al., 2020; Max Spenger, 2018; Walsh & Spence, 2018). Others rather pursue the objective of teaching or reinforcing learned course contents (Cain, 2019; Duggan, 2019; Lopez-Pernas et al., 2019b). Depending on the implementation of the EER within the course of a subject, the required knowledge of the participating students differs. While EERs aiming at introducing a topic require little to no initial knowledge (Guckian et al., 2020; Mac Gregor, 2018), others implemented in the mid-term of a course, presupposes an initial knowledge (Franco & DeLuca, 2019). Others go a step further and also apply EERs for the purpose of relearning course content and the students’ learning achievements at the end of the semester (Maud et al., 2019; Verge et al., 2019), or even implement an EER as part of the course examination (Jänneskam & Pesonen-Mäntymäki, 2019).

While it is quite costly to build a professional “escape room” at the university site and its potential transferability might be limited, the learning designers team from The University of Queensland, School of Business introduced a more cost-effective format – Escape Box. One example of a successful educational Escape Box was implemented in Business Policy and Strategy course for third-year undergraduate students. Notably, apart from a broader goal to encourage more interactive learning at the School of Business as well as increase the students’ motivation and interest in the respective subject area, the Escape Box for Business Policy and Strategy course aimed to strengthen the performance of the students on the areas that have been identified as weak in the previous semester and reinforce the course learning.

Areas which had been performed poorly in the previous semester’s exam included:
• Identification of opportunities and threats in a firm’s external environment,
• Identification of the threat level of factors in a firm’s industry environment,
• Identification of the threat level of factors in a firm’s industry environment,
• Bundling internal resources into capabilities.

Thus, the puzzles within this escape box were designed to directly respond to the learning objectives and needs within the content.
Educational Escape Room in Pharmacy  - The University of North Texas, UNT System College of Pharmacy (The USA)

The Escape room on “Transitions of care of patients with diabetes” is integrated in a longitudinal course “Integrated Pharmacy Therapeutic Recitation” at UNT System College of Pharmacy. This two-hour weekly course is application based and aims to capture what was learned during the week by the students. Within the course, the colleagues wanted to showcase the continuum of the patient treatment with diabetes, but nowhere in the curriculum did they teach the transition of care until the students get to the practical rotations in the fourth year. Literature on the transition of care of the patients with diabetes is mostly based on the data from the students in the rotation. The colleagues saw a definite gap to be filled with an interactive, realistic Escape Room exercise.

Thus, the purpose of introducing the exercise is two-fold:
• To strengthen students’ knowledge about diabetes, and
• To help students understand the complexity and continuum of patient treatment with diabetes through an in-patient/out-patient treatment simulation exercise in hospital-like settings.

The organisers of the escape room simulated two scenarios with two escape rooms: a hospital (in-patient treatment) and a clinic (out-patient treatment), which were synchronised by the means of the common “patients”. Each room had a virtual patient, a resident (re-enacted by the facilitators as well) and three puzzles each, with which the students had to interact with the patient/resident to learn more details to escape from the first room, proceed to the second room and consequently finish the game.

According to the organisers, the simulative escape room exercise has been highly successful in showcasing the realities of transition of care of the patients with diabetes, so needed for the students with insufficient experiences.

SIMULATING REAL-LIFE CHALLENGES

1.2.3. Implementation and Activities

1.2.3.1. Roles

In most of the EERs educators take over the role of game designers, moderators, and observers (Berthod et al., 2020; Cain, 2019; Eukel et al., 2020). While the task of moderating can also be conducted by trained assisting personnel, academics invest much of their time in ideating and designing the game. Depending on the use case, researchers are interested in observing the behavior and performance of the participants in the escape game. Thus, they are responsible for setting up an implementing methodology to analyse the participants in order to derive insights from the experiments.

1.2.3.2. Stakeholders

The literature identifies the stakeholders of educational EER activities as (i) as project initiators, (ii) students as participants or team members, (iii) institutional administration as infrastructure or funding providers, and (iv) businesses of private EER providers as collaborators.

i Project initiators

Initiators of EERs are most of the time the academics and educators who are responsible for the teaching of the respective subjects. The EERs are implemented (i) Most commonly, the responsibility for ideating and designing the EER (Chang, 2019; Järvelläinen & Paavilainen-Mäntymäki, 2019; Lopez-Pernas et al., 2019a). Furthermore, the initiators can be responsible for moderating the experience as well as observing the behavior and the performance of the participants (Chang, 2019; Eukel et al., 2017).

ii Students as participants

An essential stakeholder group of EERs are the participating students, who are the main beneficiaries of the experience. The participating students thereby can vary with respect to their initial knowledge and their educational experience. Also, within the EER members of a team can take on different roles. While some take over leadership responsibility and allocate tasks others prefer to receive tasks and work rather silently within the group (Cain, 2019).
The examined literature did not directly report much about involved institutional parties nor their specific roles within the EER process. However, a few examples were found where institutional administration parties provided funding for the EER projects. In one case the project was co-funded by the European Union and the national government (Karageorgiou, Mavrommati, Christopoulou, & Fotaris, 2019), in another case, it was a more domain-specific stakeholder – the Association of Program Directors in Radiology – who financed the project (Jambhekar et al., 2020). On the other side, institutions can serve as a source for required materialistic and technical resources which are necessary to set up the EER, not to mention the physical infrastructure such as facilities to conduct the project (Adams et al., 2018).

Some cases illustrate the possibility to cooperate with commercial EER facilities on the design aspects of the EER to create a more immersive experience (Jambhekar et al., 2020; Karageorgiou, Mavrommati, Christopoulou, & Fotaris, 2019). Interestingly, these were also, those projects where the authors reported to have received funding from external parties. This relationship indicates the relevance of financial resources for a more sophisticated room design. Also, other initiators draw back on the knowledge of the industry, when designing challenges or the narrative of the escape games. For instance, Novak et al. (2019) collaborated with the California Earthquake Center to set up their EER about earthquake preparedness. In the case of EERs for medical education, EERs were created with the support of hospitals or medical centers which provided the physical room and necessary materials (Adams et al., 2018; Kinio et al., 2019).

Academics and experts in the field of EERs can serve as a source for creative input as well as providing criticism on how to improve the room design (Novak et al., 2019). Further, projects can comprise team members from different fields such as computer science or e-learning to work on different aspects of the EER each member is specialized on (Karageorgiou, Mavrommati, Christopoulou, & Fotaris, 2019). The respective fields of origin of the involved stakeholders however, vary with the respective requirements and topics covered in every individual EER.
Regarding the necessary resources required to develop and execute an EER, we identified four different categories: physical resources, materials, time, and financial resources.

**1.2.3.3. Resources**

### Physical Resources

Most EER settings consist of two separate rooms. While one room serves as the actual EER for the players, the moderators supervise the participants from a separate control room, which is mostly done via a live video. (Berthod et al., 2020; Eukel et al., 2017; Li et al., 2019). Additionally, moderators can use microphones and speakers to remotely provide hints to the participants in case they are stuck (Clarke et al., 2017). Since most of the examined EERs were developed with a low budget, they do not consist of very sophisticated puzzles or decorations in the rooms.

### Time

Regarding the invested time for ideating, designing, and testing the EER facilitators report different numbers. Depending on the respective setting and the complexity of the EER, these processes can range from 19 hours (Eukel et al., 2019; Li et al., 2020) to multiple weeks (Berthod et al., 2020) while up-front work can be compensated by offering the EER experience in subsequent periods (Eukel et al., 2020). According to Cain (2018), the time commitment needed should be considered as the costs of using this education method. But he further suggests that there might be similar effective methods requiring less of a time investment (Cain, 2019).

### Materials

In many cases, already existing educational material was used for the design of EERs in available teaching facilities such as classrooms (Adams et al., 2018; Eukel et al., 2017; Li et al., 2020). Furthermore, some facilitators used already existing EER templates such as the BreakoutEDU kit. (Duggan, 2019; Gregor, 2018). This kit consists of common equipment (such as locks and cue cards) and access to a platform with a collection of escape games. Despite the mostly relatively small set-up costs, elements such as physical space supplies and available class time must be considered as required resources.

### Financial Resources

EERs can be set up with an investment as low as $52 (Cain, 2019). However, authors reporting up-front costs only made comparatively small initial investments ranging between $0 (Eukel et al., 2020; Li et al., 2020) and $2,500 (Adams et al., 2018). Also, the costs per game further diminish by offering the escape game multiple times (Eukel et al., 2020). Other use cases, however, could draw back on funding from various grants, which allowed for more photorealistic EER design (Jambhekar et al., 2020; Xaverparguzam, Christopoulos, & Fotaris, 2019). In general, EERs consist of a challenge, a solution, and a reward. The structure of an EER can be linear with the puzzles in sequence (Eukel et al., 2020; Lopez-Pernas et al., 2018), open where the puzzles can be solved in any sequence (Jambhekar et al., 2020) or path-based which is a combination of multiple sequential or open paths (Wiemker et al., 2020).

**1.2.3.4. Design**

Nature of the EERs

EERs can be physical (e.g., using boxes and locks), (Berthod et al., 2020) or digital (e.g., QR codes, social media platforms). But there are also forms of EERs that combine both aspects, digital as well as physical puzzles (Cain, 2019; Lopez-Pernas et al., 2018). Most of the existing EERs, however, are of a physical nature. Further, one can distinguish between break-out boxes and rooms. While in the first case players must unlock a box with the help of puzzles (Cain, 2015; Herrmann et al., 2017), in the latter case participants are actually locked within a room (Kriso et al., 2019). There are also examples of escape games that are spread across a university building (Gordon et al., 2019) or even an entire campus (MacGregor, 2018). Furthermore, alternative scenarios are possible, where the goal of the player is to e.g. save a pattern (Eukel et al., 2020) or to free a hostage in a room (Clarke et al., 2017).

With respect to the time limit most of the EERs lie in a range between 20 and 150 minutes (Clarke et al., 2017; Franco & DeLuca, 2019), while the whole experience including introductions and debriefing could take up to four hours (Franco & DeLuca, 2019). There are also examples of EERs that take up to 10 hours (Wiemker et al., 2015). Apart from the game duration, the participating groups can vary between two and 14 members (Fotaris & Mastoras, 2019). Nevertheless, the EER method can also be reformulated for teaching large classes with smaller groups by dividing the whole class into smaller subgroups (Cain, 2019).

**Figure 3. Structure types of EERs**

### HIGHLIGHTS FROM PRACTICE

**Input Estimation Example**

<table>
<thead>
<tr>
<th>COST</th>
<th>TIME</th>
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</thead>
<tbody>
<tr>
<td>locks</td>
<td>10 hours</td>
</tr>
<tr>
<td>stationsery</td>
<td>8 hours</td>
</tr>
<tr>
<td>printing</td>
<td>10 hours</td>
</tr>
</tbody>
</table>

**Figure 2. Input estimation example**

**Fig 2. Escape Box Business Policy and Strategy**

**Fig 3. Structure types of EERs**

### OPEN SEQUENTIAL PATH BASED

While a linear game process provides a clear structure, non-linear games give the player more control over the gameplay experience (Nicholson, 2016).

**Figure 1. Structure types of EERs**

**Figure 2. Input estimation example**

**Figure 3. Structure types of EERs**

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**Figure 2. Input estimation example**

**Fig 2. Escape Box Business Policy and Strategy**

**Fig 3. Structure types of EERs**
Regarding the procedure of EERs, three stages can be identified. Planning/Design, Implementation, and Debriefing. DeLuca, 2019). Monaghan & Nicholson (2017) suggest that information of heterogeneous groups metrics such as students or by selection through the instructors (Franco & Snyder, 2018). Also, groups are formed either by the students themselves or by the facilitators allowing (Nicholson, 2016). Compared to a traditional class setting, the narrative enables the players to make mistakes, and it should not serve as barriers to winning the game. Instead, As claimed by Nicholson (2016), tasks in the escape game should not be developed simultaneously with the puzzles and should be given equal priority in their design. Additionally, it is advised to have a extra set of simplified hints if the activity is being implemented for the first time to avoid negative experiences of the activity by the students and thereof reaching the organisation of hints is crucial to the completion of the activity. As showcased by the international good practices’ examples of the activity by the students and thereof reaching the organisation of hints is crucial to the completion of the activity (Eukel et al., 2020). Hints can be provided by the moderators remotely through a designated channel (Fotaris & Mastoras, 2019). There is also an example of an EER spreading over the course of three weeks, while the experiences had a duration of more than 75 minutes (Fotaris & Mastoras, 2019). With this introduction, the students have been immersed into a scenario with concrete physical settings (4ZZZ radio station), protagonists (the students who run the radio station), antagonists (police officers), problem (being kidnapped), and the experiences of team in handcuffs, and throw you into the back of their paddy van. As your face hits the floor, you hear opening the door, and in come five burly police officers. They shut down your production, put you and your on-air team in handcuffs, and throw you into the back of their paddy van. As your face hits the floor, you hear...
While it is usually the purpose of hints to ease the difficulty of the game, creating paths to mislead the players — red herrings — can provide an additional challenge and thus, increase the difficulty of the game. However, red herrings should be implemented with caution, as they may be a reason for confusion and frustration (Nicholson, 2010).

Thereby the narrative is not only told by the pre-game backstory. Often, the setting and physical items in the EER can connect the players to the fictional world more effectively. Present features such as documents, pictures, or audio logs communicate the context of the story. In this context, game designers must keep in mind that elements used for the EER are coherent with the narrative. As an example, physical objects have to be consistent with e.g. the time and place the story plays in. Based on the respective context, game designers must keep in mind that elements or audio logs communicate the context of the story. In this case, physical items have to be consistent with e.g. the time and place the story plays in. Based on the respective context, facilitators must also decide to what extent players are animated to consider how they would act in a real world (e.g. sending a code to someone). In this way, connecting the escape game with the real world is a way to make the participants more immersed in the experience.

Thus, there are EERs, which allow participating teams to compete against each other by e.g. trying to escape the room more quickly than the competing teams. In other settings, points are assigned based on the performance of tasks and the time in which the puzzles are completed (Novak et al., 2019). On the other side, wrong solutions can be sanctioned with point deductions or time penalties (Ross & Bell, 2018; Wernier et al., 2015). In this way, students can be encouraged to apply problem solving rather than just guess the solutions (Ross & Bell, 2018).

By definition, there is also a reward element to EERs. In most cases, however, students are merely rewarded intrinsically by solving the puzzles or performing better than their fellows (Novak et al., 2019). Sometimes, winning teams receive a small extra recognition such as chocolate (Ross & Bell, 2019) while there can be a few cases found where students had a stronger extrinsic motivation to participate by receiving extra credits (Chang, 2019; Lopez-Pernas et al., 2019a) or even grades (Franco & DeLuca, 2019). Also, a combination of those two alternatives is possible (Chang, 2019). The required time for this stage usually ranges between 25 minutes and one hour (Chang, 2019; Franco & DeLuca, 2019; Wu et al., 2018).

Following the actual escape game, most of the structured exercises to measure the attainment of the learning outcomes, which is in line with the suggestion of Ho (2018). For example:

- A comparative analysis: scenario-based open-ended (standardised) test taken before and after the activity, both of which are graded equally and not exceeding the weight of the activity completion (in points);

- A “free-style” feedback collection with the emphasis on the “lessons learned” graded and based on the submission of the feedback.

According to educational escape rooms designers and testers from our investigated country, developing the principles of assessment for the activity is a tangible challenge, especially if the activity is integrated into the course with clear learning outcomes. However, it is stipulated that the activity and the reflection from the activity is to be graded. Most common assessment methods are suggested to be involving pre- and post-reflection exercises to measure the attainment of the learning outcomes, which is in line with the suggestion of Ho (2018). For example:

- Showcase: post-activity writing exercise on the topic of the escape room, which is graded exceeding the activity completion weight (in points);

- A comprehensive analysis: scenario-based open-ended (standardised) test taken before and after the activity, both of which are graded equally and not exceeding the weight of the activity completion (in points);

- Reflection: “free-style” feedback collection with the emphasis on the “lessons learned” graded and based on the submission of the feedback.
1.2.4. Challenges and supporting factors

1.2.4.1. Resources

The literature suggests that there are a few challenges game designers, moderators, and participants experience in the design, development, and execution phase of EERs, that impedes success. Many use cases of EERs in higher education report challenges including limited resources and budget constraints. Especially when financial resources are scarce designing an immersive narrative can be difficult (Chang, 2019). Designing an escape game within these constraints might also lead to limited flexibility that restricts the immersion of the participants from physical tasks to a digital setting can be helpful. Choosing an adequate time limit for the EER can be challenging. The time limit should be a challenge for the participants, the tasks should be considerable. Of course, the duration of the game depends on its extent and complexity. However, too short a game might cause frustration and consequently decrease the motivation of the participants (Chang, 2019). On the other hand, more extensive games provide the opportunity to implement more meaningful tasks (Lopez-Pernas et al., 2019b). Educators are therefore challenged to find the optimal duration that addresses both of these problems.

One frequently mentioned challenge is to make the EER an immersive experience that fully engages the players and keeps them somewhere between boredom and frustration (Lopez-Pernas et al., 2019b). In this context, the narrative plays an important role. It must be closely aligned with the tasks performed to avoid confusion among the players (Järveläinen & Paavilainen-Maure, 2019). Looking for clues players will go in the wrong direction (Joshi & Fotaris, 2019). It is likely to be helpful to consider a storyline theme of the escape game. This can help students to understand the logic of escape processes (Brady & Anderson, 2016). To establish a flow in the EER experience guidance and moderation is important. However, it can be challenging to prepare adequate clues that are equitable for all groups (Chang, 2019; Musil et al., 2019). Additionally, the guidance of the participants through the game must be carefully balanced so that the starting point might be challenging but not so difficult that the players go in the wrong direction (Joshi & Fotaris, 2019).

Facilitators of EERs are constantly challenged to provide an immersive experience that fully engages the participants. They are responsible for making sure that the game remains challenging without being either too hard to solve or too easy. To provide a challenge for the participants, a very common recommendation in the literature is allotting the EER activity. The design can then be optimised for the next iterations (Kan, 2010; Friedrichs, 2004; Hermanns et al., 2017). When designing an escape game, it is recommended to think about the game experience level of the players. While it can be hard to create a meaningful gameplay experience, looking for a phase of piloting, Mäntymäki & Nicholson (2017) suggest that in later stages it is important to have testers who can provide feedback and a new perspective.

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Game designers must consider the legal feasibility of the escape game. Designing an EER can involve legal and safety challenges. Thus, game designers must consult and ensure legal feasibility of locking or unlocking players. Also, some participants may feel uncomfortable or even experience anxiety in those situations (Nicholson, 2015). Looking for clues players will examine, move, or try to open all objects in the room, even those that might be irrelevant for solving the puzzles. Therefore, potential hazards in the room must be identified and eliminated beforehand (Wiemker et al., 2015). Additionally, moderators and participants should be informed about the real world way to facilitate a sustainable EER experience (Brady & Anderson, 2016).

Initiators can be confronted with basic organizational challenges as well. The idea of an escape game might be accompanied by many unexpected situations (Nicholson, 2015). When designing an escape game, facilitators could also tell the story incrementally instead of introducing an extensive narrative before the game. Facilitators also should consider a storyline theme of the escape game. The journeys of the game can be guided by the narrative. Instead of introducing an extensive narrative before the game, facilitators could also tell the story incrementally. It is necessary to identify and address deficiencies that might revolve around the design and execution of escape games. The design can then be optimized for the next iterations (Kan, 2010; Friedrichs, 2004; Hermanns et al., 2017). When designing an escape game, it is recommended to think about the game’s experience level of the players. While it can be hard to create a meaningful gameplay experience, looking for a phase of piloting, Mäntymäki & Nicholson (2017) suggest that in later stages it is important to have testers who can provide feedback and a new perspective.

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Implementing EERs in higher education teaching mainly revolves around deciding on the type of games. The factors, the findings can be divided in three categories:

1. Learning Outcomes
   Regarding the impact on students learning the most common findings are that EERs promote teamwork and collaboration (Fortas & Matorsa, 2019; Gordon et al., 2019; Ho, 2018) and are beneficial for interprofessional education (Fotaris & Mastoras, 2019; Gordon et al., 2019; Ho, 2018) and are beneficial for interprofessional education (Fotaris & Mastoras, 2019). Not only do EER activities facilitate the more active participation of the students but also allow the facilitators to better observe the learning and problem-solving approaches of the students (Brady & Andersen, 2019) which could help to further improve teaching activities.

2. Emotions and behavior
   On the other hand, not well-designed EERs can also cause adverse effects. Some participants reported feeling frustration and even anxiety due to high time pressure and adverse effects. Some participants reported feeling frustration and even anxiety due to high time pressure and adverse effects. Some participants reported feeling frustration and even anxiety due to high time pressure and adverse effects. Some participants reported feeling frustration and even anxiety due to high time pressure and adverse effects. Some participants reported feeling frustration and even anxiety due to high time pressure and adverse effects. Some participants reported feeling frustration and even anxiety due to high time pressure and adverse effects. Some participants reported feeling frustration and even anxiety due to high time pressure and adverse effects. Some participants reported feeling frustration and even anxiety due to high time pressure and adverse effects.
1.2.3.5.2. EERs as teaching & learning methods

Other studies found that EERs are an effective learning method. This finding is supported by significant increases in students’ knowledge after the experience (Eukel et al., 2017; Lopez-Pernas et al., 2019a; Snyder, 2018). According to Berthod et al. (2020) students have shown a significant knowledge gain by 51% on average. Furthermore, students were found to have improved retention of the acquired knowledge (Brady & Andersen, 2019). Not only can the experiences contribute to improved knowledge, EERs can also cater as an educational tool to increase learners’ confidence in the application of knowledge and certain techniques. As Berthod et al. (2020) have found in their study participants’ certainty in their given responses increased by more than 30%. Further, the EER experience can increase the students’ confidence in the participants in the treated topics (Guckian et al., 2020; Kinio et al., 2019). In general, EER experiences are perceived as a valuable learning method (Eukel et al., 2017; Friedrich et al., 2020).

Escape games not only allow to deepen the understanding of already taught course material (Lopez-Pernas et al., 2019a) but also, to understand interrelations between these topics (Guckian et al., 2020; Kinio et al., 2019). In general, EER experiences are perceived as a valuable learning method (Eukel et al., 2017; Friedrich et al., 2020).

Some other findings indicate that EERs are more effective for students with existing initial knowledge and thus, be better suited for the improvement of prior knowledge (Lopez-Pernas et al., 2019b). However, this statement contradicts with escape games that aim to give students an introduction to certain topics (Walsh & Spence, 2018) or to ease stress (Guckian et al., 2020).

1.2.3.5.3. EERs as teaching & learning methods

The teacher’s role is to explicitly create spaces for dialogue about gaming experiences and discussion of perceived ambiguities in the puzzles. At this stage, the players’ physical presence and experience in space can be the subject of theoretical reflections, where the interaction between practice and theory is prioritized in relation to both the Problem Based Learning (PBL) approach and the pragmatic learning understanding. Going forward, the authors see potential in the learners’ process of creating didactic designs for others (Sørensen & Levinsen, 2018) - in this case, didactic puzzles - can form the basis for new investigative approaches to knowledge in various disciplines.

Furthermore, Lopez-Pernas et al. (2019a) found a correlation between learning effectiveness and whether the learning material was perceived as easy by the students. Despite their mostly very specific narrative, escape games can be transferred to other educational topics by altering the puzzles and or their narrative (Sørensen & Levinsen, 2018).

1.2.3.6. Determinants of EER Performance

The performance of the participants within the EER team dynamics has found to have a strong effect. According to Cain (2019) those groups who had a strong collaboration between their members and structured their team by assigning different roles to their members achieved better results. Furthermore, active participation in escape games put the learners in the focus and thus generates motivation of students (Brady & Andersen, 2019; Lopez-Pernas et al., 2019b). Also, the heterogeneity of contributing groups might be a factor influencing performance. Chang (2019) - who implemented an EER for environmental education - found that when working in mixed groups – consisting of friends and strangers – students felt more empowered to act sustainably.

One technique to ensure a more balanced group dynamics is pre-identifying the group composition based on personality types, such as Myers-Briggs Type Indicator (MBTI). At the start of the course and forming the teams based on the finding is found to be a practice among a few of the UNLOCK cases. According to the representatives, who have also undertaken escape rooms with the teams based on the personality test results, it is an effective method to ensure the completion of the task and higher probability to achieve the learning outcomes through a more productive work within the team. However, this method might decrease the development of some soft skills of specific students, who would otherwise find themselves in the team that lacks leaders, doers, organizers, creative, etc.

An example from Educational Escape Room in Intercultural Management - Montpellier Business School (MBS) (France)

In the Intercultural Management Escape Room Game at Montpellier Business School (MBS), the course instructor introduced the three categories of the Lewis Model (Richard Lewis, 1979) When Cultures Collide, 1996) in an effort to help teams understand each other’s reactions/behaviour better in a time-pressured and challenging environment. With reference to this model and experience, the course instructor makes sure she assigns students to culturally diverse teams, for better intercultural experience and mutual learning. When there is lack of cultural diversity among students, the course instructor sets up the teams according to their personality type, as reported by the students themselves after taking the Myers-Briggs indicator (MBTI) test.
3.3. EER Frameworks

1.3.1. EscapeED Framework

Developed by Samantha Clarke (Researcher and Serious Games Designer) and her colleagues from Disruptive Media Learning Lab, Coventry University, the EscapED programme is a project within the Game Changers initiative (gamify.org.uk) that aims to “conceptualize interactive experiences and aid other educational facilitators in creating their own, live-action games for the purposes of education and positive behavior change in higher/further education settings”. EscapED programme is based on the principles of commercial (entertainment) EERs, however masterfully incorporating educational themes, tangible learning objectives, and behavior change metrics.

The framework was developed based on the previous work by Arnab & Clarke and Nicholson. The framework introduces six main areas – steps to be considered while developing an EER: (1) Participants; (2) Objective; (3) Theme; (4) Puzzles; (5) Equipment; (6) Evaluation, ideally undertaken in consecutive order.

**Step 1: Participants** – the development of the game starts with a mini-needs analysis on the target population for the game, considering the user type (educational needs), time that is allotted for the activity, the level of difficulty suitable for the participants, mode (whether it is cooperation or competition-based activity), and scale (number of participants).

**Step 2: Objective** – according to Clarke et al. (2017), it is crucial to understand and devise the learning objectives at the start of the game design process to ensure that the game is cohesive and purposeful. The objectives will depend on the disciplinary field, level of the participant, integration of the game into the curriculum, etc.

**Step 3: Theme** – setting the stage, identifying player motivation, game story and the content of the story is considered to be beneficial for a more immersive experience of the players. This step will also inform the type of puzzles and equipment to be developed for the game. Does the game revolve around an escape from the room or solving a mystery? Is it a stand-alone one-off experience or is it integrated into a series of educational games (nested experience)?

**Step 4: Puzzles** – puzzles should be designed in close connection with the previous parts of the framework, and specifically Participants and Objective. Accurate reflection of the objectives in the puzzle design will allow for the assessment of envisioned learning outcomes of the game. This stage includes the development of clear instructions and hints to ensure the clarity of the game and potential issues with the complexity of the puzzles.

**Step 5: Equipment** – the facilitators/designers should consider the physical aspects for the implementation of the game, such as location and design of the space, physical props, technology-based props, actors and other stakeholders, involved in the activity.

**Step 6: Evaluation** – essentially a pilot-test, this stage pre-supposes the culmination of the design path, delivery of the activity, collection of the feedback from the participants and reflections from the organizers, adjustments based on the feedback and re-run of the improved game in the next circle.

Figure 4: EscapeEd framework (Clarke et al., 2017)
EscapED programme was piloted at the University staff training event run in 2016, after which employed in different contexts at Coventry University and beyond. The pilot focused on the following soft skills development:

- Effective communication,
- Leadership and guidance,
- Teamwork

One of the objectives of the pilot to be tested among university staff and educators was to introduce the framework to the end user and encourage the uptake of the framework among Coventry University educators and academics. The theme of the game revolved around preventing the explosion of the bomb, which was only possible by releasing an engineer hostage. Players solved puzzles to find the key code that would release the hostage’s locks. Three teams (13 players) participated in the activity. The premise of the game was to have two separate rooms: The room with the bomb and one with the engineer hostage.

Players needed to employ their communication skills to share the clues and riddles with the other room teams. A first-year drama student, playing the engineer hostage, was the main facilitator and moderator of the activity. The Disruptive media Lab staff observed the game through Skype connection to the laptops.

Example of the EscapED framework in use in the classroom with the students

Clarke et al. (‘’EscapED: A Framework for Creating Educational Escape Rooms and Interactive Games For Higher/Further Education’’) features an account of an educator (Professional Specialist in Learning Design) from the University of Southampton who adopted the escapED Framework in order to create an educational escape game prototype for teaching the subject of research methods to Southampton University first year undergraduate students. The theme was based on a fictional story “The Island of Dr. Moreau” that surrounds the controversial theme of animal testing, an area in which research methods would fit well thematically. The educator followed the framework steps and described the experience and challenges in details in the article. Important to mention, the activity was transformed into an Escape Box with the game build into a vintage portable box. For the full account of the educator, the game description, challenges and opportunities of the experience, please refer to p.9-11 of the publication.

In an experimental group participating in an educational EER and another attending a traditional lecture (Conner et al., 2016). The experimental group achieved higher scores in the post-test, however, validity might be limited due to the very small sample size. The problem of a too small sample was also a limitation found in many other studies (Chang, 2019; Jambhekar et al., 2020; Liu et al., 2020). Only very few studies did not test the outcomes of the EER method with ordinary teaching methods is therefore difficult (Brady & Andersen, 2019; Liu et al., 2020). Only one study could be found where students were divided in an experimental group participating in an educational EER and another attending a traditional lecture (Conner et al., 2016). The experimental group achieved higher scores in the post-test, however, validity might be limited due to the very small sample size. The problem of a too small sample was also a limitation found in many other studies (Chang, 2019; Jambhekar et al., 2020; Liu et al., 2020).

Additionally, some studies did not test the outcomes of their survey or observations for statistical significance (Shakeri et al., 2017; Zhang et al., 2017) which makes a scientific interpretation of the findings more difficult.

Also, group sizes within case studies are not always consistent. Offering group dynamics between teams might therefore bias the results of a study (Adams et al., 2018). Moreover, when participation in the EER experience is voluntary the sample selection is not random, which could also lead to biased results (Gómez-Urquiza et al., 2019).

There is still a need for further research in the field of EERs. To this date, there is only little peer-reviewed research about educational EERs. In particular, further studies must examine the efficacy of this method and if and to what extent EERs are more effective teaching methods than other educational formats. Furthermore, future research must analyze how learning outcomes are influenced by specific EER designs.
CHAPTER II:

EERs IN HIGHER EDUCATION INSTITUTIONS IN THE EUROPEAN CONTEXT

2.1. Regional adaptation of the EERs in the project partner regions

Physical EERs in the HEIs are still in their infancy. In all targeted countries (Portugal, Netherlands, Germany, Spain, Denmark, and Lithuania) EERs are more common in primary and secondary education, as well as in the vocational and adult education institutions than in the HEIs. There were different points posed for this discrepancy in the adoption of the EERs at different educational levels. In the German and Dutch HEI contexts, EER methodologies are mentioned to be perceived in a negative light, due to the belief that learning and gaming are not compatible, or EERs are not “serious enough”. The rigidity of curriculum and education methodologies in the HEI sector is also stated as a barrier. According to interviewees, there are more opportunities for experimenting with new pedagogies at the primary levels of education. Similar concerns were voiced for the context of Finland, where HEI educators are indicated to be restricted with the curriculum to be followed.

The interviews from Denmark, Netherlands, and Spain revealed there is a significant increase in the adoption of the EERs. In the Danish case, however, this holds true only for non-HEI institutions. Except for one case, no other EER has been identified in the HEIs in spite of a mentioned interest in GBL in Denmark. Similarly, in the case of Spain, the increase in the EER adoption is linked to non-HEI contests, with a large part of the current initiatives carried out in the past five years. In Portugal, the EERs are in an emerging state. However, there exists, despite limited, EER research and practice communities based in the universities. In the Lithuanian education context, place-based EERs are still at the very early stage of development, and current interest in GBL is more focused on ICT and digital games.

According to the literature, the medical disciplines and the disciplines science, technology, engineering, and mathematics (STEM) are pioneers in the implementation of educational EERs (Fotaris & Mastoras, 2019). However, due to the project focus on the potential of EERs in fostering creativity and entrepreneurship, the majority of EERs identified in the target countries are designed within the field of Social Sciences (including Business, Law, and Economics, Languages, and Literary), followed by Formal, Natural, Medical and Health sciences. This can also be explained by the UNLOCK project focus on physical EERs, as opposed to digital, that might be considered as a more suitable model in understanding human behavior and development of soft skills within Social Sciences.

2.2. Disciplinary focus
2.3.1. Hybridity
EEIs are observed as hybrid learning environments in the EERs, in the form of:
- merging of physical and digital learning spaces, e.g. in the EER MasterMentors at University of Utrecht;
- collaborative learning environments involving mixed groups of players, e.g. students and public, as in RSM Escape Room at Rotterdam; School of Management and mixed group of academics and students at “Open Access" Escape Room at KU Leuven University of Technology; and;
- students and educators as co-creators, e.g. in the collaborative EER experience at Valdahon Adult School and Aalborg University IT, Learning & design Lab, and in the English language course of the first-year students enrolled in the subject of Foreign Language (English) for Teachers of the University of Valencia, Spain.
UNLOCK cases have also shown how students are be -
coming key players and active knowledge -
both participating in and being observed within EER set-
ing data, designing physical components, functioning as -
-• external stakeholders, including:
-• HEI ICT units, e.g. intermediary organizations such as Educate-IT, a program within the University of Utrecht to support teachers and students in the transition towards blended learning, in the EER case of MasterMentors;
-• educators, e.g. The Escape Artist at Rock Space;
-• regional authorities, e.g. Sandbergen Municipality and private entity Rubi Lee’s Escape House. As recognized for the example the forms, these collaborations are found to be successful in German, Dutch, and Danish educational contexts.
The creation and implementation of EEIs are initiated and coordinated by educators. However, as understood, this process does not take place in a vacuum. In the higher education context, students are observed to work in and interact with an ecosystem that enables or hinders efforts placed in developing EERs. Roles of the stakeholders in this ecosystem can be summarized as below:
- Educators and staff as game designers and game masters. Educators in EER initiatives, along with support staff, are responsible for moderating the game experience as well as observing the behavior and facilitating reflection upon the performance of the participants.
- Students both co-creators and participants: The participating students vary with respect to their initial knowledge and their educational experience. As most beneficiaries of the experience, students are responsi-
ble for the development and daily operations, gathering data, designing physical components, functioning as testers, and running daily operations;
- Teachers of the University of Valencia, Spain.

2.3.2. Institutional boundary spanning
EEIs are also observed as tools for institutional boundary spanning. European EEIs are designed and implemented in collaboration with HEI internal and external stakeholders, including:
-• Hub ICT-units, e.g. intermediary organizations such as Educate-IT, a program within the University of Utrecht to support teachers and students in the transition towards blended learning, in the EER case of MasterMentors;
-• regional authorities, e.g. The Escape Artist at Rock Space;
-• stakeholders in education, e.g. Sønderborg Municipality and private entity Rubi Lee’s Escape House. As recognized for the example the forms, these collaborations are found to be successful in German, Dutch, and Danish educational contexts.

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ble for the development and daily operations, gathering data, designing physical components, functioning as testers, and running daily operations;
- Regional and institutional administration as sup -
porters: These stakeholders provide funding for the EER projects, serve as a source for required materialistic and technical resources, as well as physical infrastructure.
-• Public and private institutions as collaborators: Ed-
ucators cooperate with other educational institutions, and commercial EER facilities to create more immersive experiences.

The EER at the RSM Rotterdam School of Management (RSM) of Erasmus University has been identified to have one of the most complex settings, with stakeholder en-
gagement is extended both inside and outside the In-
stitution. Students help create the initial design of the EER, and academics/creating the narrative and providing support with materials to construct the EER. Facility services assigns a room and constructs the theme that enables the EER collaborations vulnerable. The boundary spanning is observed to be facilitated by
-• different departments in their institutions. Opening up the EERs to external participants and partners outside of the university is also seen as a pathway for both quality and sustainability of EEIs, via co-design and implementa-
tion of the games. This dimension also includes partnering by diversifying the purpose of EERs, as in scient-
ific EEIs to be used as a tool for other research purposes.

Educators are observed to move towards a more informed and strategic approach to EER adoption, e.g. starting with the single goal of motivating students, followed by a more open approach towards broader aspects such as leadership and communication, and finally aiming to inform students what gamification is and work on the development of specific competences via EEIs.

2.3.3. Educators aspirations towards sustainability of EEIs
The sustainability of EEIs is mentioned to be one of the major aspirations of the educators, meaning, making EEIs re-playable and an embedded element of the cur-
riculum. Sustainability can be achieved via integrating EEIs in the educational curriculum, and treating them as an established activity, as embedded within the existing learning and teaching structures. This is addressed by ef-
forts of educators’ EER promotion among colleagues, and support in the integration of the methodology across dif-
ferent departments in their institutions. Opening up the
-• different departments in their institutions. Opening up the EERs to external participants and partners outside of the university is also seen as a pathway for both quality and sustainability of EEIs, via co-design and implementa-
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2.4. Development
Targeting 21st century skills, clearly defining intended Learning Outcomes (ILOs), acquiring resources, and reaching out to collaborators have been recognized as crucial steps in EER development. Conducting test runs and preparing blueprints and guidelines are observed to be essential as well. Accordingly, in the regional cases, the EERs are identified to have certain knowledge, skill, and attitude-oriented goals for the involved students and educators.

- Students: Acquisition of knowledge in the subject matter, e.g., biology, mathematics, literature [knowledge]; and skills and competencies in the use of innovative pedagogies (Skills); Increase enthusiasm for learning of the subject matter, e.g. biology, mathematics, literature (Attitude).

- Educators: New approaches to teaching, student-centred learning [knowledge]; and skills and competencies for the preparation of a number of materials [skills]; Increase interest in STEM, SDGs, and problem-solving skills & hard: e.g. digital skills, coding, encryption (Skills); Increase motivation for action (Attitude); and attitude-oriented goals for the involved students and the EERs are identified to have certain knowledge, skill, and preparing blueprints and guidelines are observed to reaching out to collaborators have been recognized as.

2.4.1. Development
The interviewees pointed out the considerations related to Management EERs, and The Lost Scientist. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended. The vocabulary used in the scenario has to be carefully considered as it is culture-specific. To ensure the content of the images was not perceived as it was intended.
2.5.1. Supporting factors

UNLOCK research revealed a number of supporting factors that contribute to the development and implementation of EERs in educational contexts. Educators are on different levels of experience concerning EERs. Some consult introductory videos, guidebooks, and attend training organized by the institutions, while others already have experience with EERs due to the diverse experience at universities and companies beforehand. Additionally, the interviewees were not only interested in the subject matter they teach but also have the attitude to effectively deliver their courses via engaging and innovative pedagogies.

Educators’ knowledge, skills, and attitudes: Educators’ previous experience with EERs, knowledge of EERs and their design methodologies, creativity and entrepreneurial mindset, managing cultural & personality combination in teams, managing technical issues, setting up a digital EER, adjusting the difficulty level, and the ability to effectively design and implement the games; are mentioned by the interviewees. Further, the interviewees are also aware of the benefits of EERs such as the attitude to effectively deliver their courses via engaging and innovative pedagogies.

Methodological factors: Involving students in the game design, integrating different stakeholders, both inside and outside educational institutions, in order to succeed in implementing EERs.

Resource and community factors: Ready-made EER packages, guidebooks, societies and networks, blueprint and/or elaborated systematic plan, online resource platforms, toolboxes.

Among the stakeholders, the Dutch and German national and regional funding programmes and institutional initiatives are found to provide financial incentives, methodologies and resources to educators to invest in innovative/creative/implement EERs. Accordingly, the support provided by the regional governments and HEIs, as captured in the case studies, is evident.

2.5.2. Inhibiting factors

Inhibiting factors reported by the interviewees include several factors, such as educators’ own competencies, institutional barriers, students’ preparedness, lack of technical skills, storytelling skills, and regional funding programmes and institutional initiatives who would be interested in knowledge exchange and innovative pedagogies. Further, the sustainability of EERs as an integral part of teaching and learning is also ensured by exploring options for further funding, through collaborations with public and private organizations that would be interested in knowledge exchange generated by the experiences.

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Supporting and inhibiting factors in the HEI adoption of EERs

2.4.4. EER assessment & evaluation

It is reported that evaluating the performance of students within the game is difficult since the performance in the game is a group effort, which makes assigning individual grades a challenge. Further, there are different players and learning types among groups, that hinder making a fair assessment. Among the EER cases investigated, formative assessment is found to be common. It takes place during debriefing, reflects on oneself and others. The assessment also relies on self-reporting through reflections during debriefing, and notes, pictures, and videos recorded.

Another challenge was stated as adjusting the level of complexity where students had to develop the escape plan. Another challenge was the pre-existing knowledge that the students need to be the designers of their own learning. It is suggested that this form of EER format should be used, for example in an explorative learning process and not necessarily in an explorative learning process.

2.4.4. EER assessment & evaluation

Time pressure, group dynamic, and the game frame - influenced the level of contemplation and reflection of puzzle selection. The problems that students face are expected to be clear enough and at the same time sufficiently demanding.

In the EER cases investigated, form also exists between appealing/demanding in terms of puzzle selection. The problems that students face are expected to be clear enough and at the same time sufficiently demanding.

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2.6. Reported outcomes and impact of EERs

Regarding the outcomes and impact of EERs, the findings are mainly consistent with those mentioned in the extant literature, in particular, e.g. acquired skills of students, such as creativity, teamwork, communication, and problem-solving skills. Current literature on EER primarily focuses on the impact of EERs on students and their learnings. UNLOCK research findings additionally shed light on the impact EERs on educators and the broader stakeholder landscape. Regarding more concrete outputs, the results of some of the EERs from partner regions include:

- Professional recognition, e.g. the EER Letras Galegas being awarded with a European Quality Label;
- Scientific outputs, e.g. research papers, and the outputs of the EERs MatPorBib and Portuguese Literature having been published in a book chapter;
- Novel data to be analyzed, e.g. video recording data collected in the EERs Lost Scientist and Think Space.

Reported impact of the EERs on students include mastery learning (i.e., self-directed and incremental learning) and behavioral changes, 21st century skills, creativity, and communication, as well as research skills, reflection, higher cognitive skills (e.g., association, analytical, critical thinking, and problem-solving skills), ICT and reading skills. The EERs are reported to have a positive impact on the attitudes towards acquiring content knowledge, as well as increasing awareness and intention that stimulate student motivation, and overall enthusiasm for learning.

Impact of the adoption of EER practices on educators are reported to include increased awareness and effective practice of innovative pedagogies, development of own professional portfolio, growing familiarity with varied resources in order to support the effective delivery of the subject matter, and being acquainted and able to implement active and collaborative educational methodologies.

As per our observations, the HEIs where the EERs are being adopted gain visibility and recognition among other HEIs for their exploitation of innovative teaching methodologies, benefit from increased HEI-admin staff engagement via support in development and active participation in EERs, and tap the opportunity with third party income generation via integration of external groups of EER participants. EERs with open public involvement lead to strengthened community-HEI engagement. And businesses that cooperate with the HEIs in the development and delivery of the EERs benefit from the synergies, in developing the knowledge base for new business models (i.e., EER companies), as well as gaining a new customer base and diversifying sources of income.

2.7. Preparing educators for successful adoption of EER methodologies

Interviews have revealed the urgency of supporting educators in preparing themselves in game design theory and EERs as innovative pedagogies. This can be realized via the provision of relevant knowledge and opportunities for educators in experiencing EERs themselves, and experimenting with developing EERs towards the development of a theoretical understanding of the approach, gaining practical experiences, and embracing an entrepreneurial attitude. In the HEI context, this support can be organized as part of continuous professional development (CPD) programmes offered to educators.

Setting up of a European EER online platform for sharing and dissemination of EER tools and methodologies is emphasized as crucial. Such platform is suggested to contain examples of EERs, along with blueprints, design schemes, and replicable EER modules classified in accordance with disciplines and curricular considerations across European regions, as well as manuals and guidelines for the educators on how to modify and integrate them in their courses. Working as a network hub, such a platform would bring together educators as EER enthusiasts, and lead the creation of new synergies and collaborations among involved network participants.
Recommendations FOR EER RESEARCH AND PRACTICE

2.8.

PRACTITIONERS:

• Access resources, e.g., knowledge, partners, budget to design and implement impactful EERs: Educators are expected to pull together available resources and explore new forms of value co-creation with external stakeholders. The results show deeper partnerships between academia and non-academia is required to reap all the benefits that EER has to offer. This can be achieved via e.g., opening up commercial premises for the HEIs, and commercialization of HEI EERs for external participants.

• Create legitimacy within own institution: Educators are recommended to drive a bottom-up interest among colleagues, and create a momentum in the demand for a more common use of EERs in own institutions.

• Advance EERs as a pedagogy via research and knowledge exchange at events: Educators are encouraged to share their experiences both in internal events, and externally organized workshops and conferences, to build network and share experiences, towards the advancement of knowledge and development of a strong EER support community in Europe.

RESEARCHERS:

• Future research is suggested to focus on:
  • how learning outcomes are influenced by specific EER designs;
  • potential of EERs as behavioral assessment tools to identify, e.g., group dynamics and leadership;
  • transdisciplinarity in EERs, e.g., social sciences and engineering;
  • reusability and organizational sustainability of the EERs;
  • digitalization of place-based educational/educational designs.

STRATEGY AND POLICY MAKERS:

• Drawing on the research findings, there is a recognizable discrepancy observed among the project partner regions in the availability of governmental and institutional funding allocated to the HEIs for the adoption of innovative GBL pedagogies. In the Northern and Western European regions, primarily in the Netherlands and Germany, there are financial incentives available for the HEIs, in comparison to the Southern and Eastern regions, e.g., in Portugal and Lithuania where they rely more on European projects funding and own resources. This calls for recognition of the importance of innovative pedagogies in all European regions, and stronger incentive schemes by the HEIs that will help educators better mobilize EER resources.
References


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