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EDUCATIONAL ESCAPE ROOMS IN PRACTICE:

RESEARCH, EXPERIENCES, AND RECOMMENDATIONS

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Title: Educational Escape Rooms in Practice: research, experiences, and recommendations

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UNLOCK

EDUCATIONAL ESCAPE ROOMS IN PRACTICE:

RESEARCH, EXPERIENCES AND RECOMMENDATIONS

CONTENTS

Introduction

TO THE DOCUMENT

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

TERM	DESCRIPTION
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.

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 EERs research and practice.

CHAPTER I:
REVIEW OF LITERATURE

1.1 Methodolody

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.

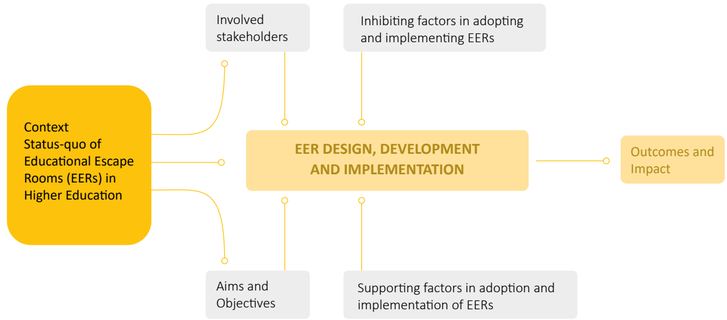

Figure 1. Preliminary framework for the literature review

1.2 State of Art

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 (8%) 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 (2019). Only 1.5% of the studies were found to originate from the fields of business administration and law.

HIGHLIGHTS FROM PRACTICE

THE COMMUNITIES OF EDUCATIONAL GAME-MAKERS

The interest in game-based learning has spurred a number of successful educational game-makers communities and associations internationally, regardless of the country of origins. 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://seriousgamessociety.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/]

1.2.2. EER aims and objectives

As manifold, the contexts are the purposes and goals of 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 (Friedrich 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; Mac Gregor, 2018; Walsh & Spence, 2018). Others rather pursue the objective of teaching and or reinforcing learned course contents (Cain, 2019; Duggins, 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 reviewing course content and the students´ learning achievements at the end of the semester (Musil et al., 2019; Vergne et al., 2019), or even implement an EER as part of the course examination (Järveläinen & Paavilainen-Mäntymäki, 2019).

HIGHLIGHTS FROM PRACTICE

REINFORCING LEARNED COURSE CONTENT AND FILLING IN THE GAPS

Escape Box Business Policy and Strategy Course - The University of Queensland, School of Business (Australia).

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 examples 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 areas, 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,
- 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.

EERs can further vary with respect to the type of knowledge they aim to teach. While many EERs are used to promote learning of theoretical knowledge, especially in the context of medical education aim to teach as the application of specific practical skills, such as the preparation of a chemotherapy (Berthod et al., 2020; Kinio et al., 2019). In these rather practical settings, students ,for instance, have to perform surgical techniques (Kinio et al., 2019) or diagnose a patient. EERs can also be real-world experiences within the knowledgebuilding process (Franco & DeLuca, 2019) by simulating real-life challenges (Berthod et al., 2020; Kinio et al., 2019).

HIGHLIGHTS FROM PRACTICE

SIMULATING REAL-LIFE CHALLENGES

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 synergised 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.

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)(Cain, 2019). 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 analyze 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 in. Most commonly the initiators take over the responsibility for ideating and designing the EER (Chang, 2019; Järveläinen & 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).

HIGHLIGHTS FROM PRACTICE

THE ROLE OF LEARNING (INSTRUCTIONAL) DESIGNERS

International good practices from Australia and the UK demonstrated, that apart from the academics, delivering the course, it is quite common to involve specialised learning (instructional) designers into the process of designing and delivering the escape room. At times, the activity might even be initiated by the instructional designers, residing either within the respective faculty or in university-wide learning & teaching centres, developing innovative teaching methods projects.

In two cases, in fact, the escape rooms have been initiated, developed and led by the learning (instructional) designers instead, where the learning designer created the game mechanics mostly on their own and co-develops the narrative and alignment of the puzzles with the learning outcomes together with the academic, responsible for the course.

HIGHLIGHTS FROM PRACTICE

INSTITUTIONAL SUPPORT

Educational Escape Room for SDGs - Rotterdam School of Management (RSM) of Erasmus University (The Netherlands)

Many stakeholders were/are involved in the RSM escape room. Students helped to find, information gathering to create the themes/ narrative of the escape room. A management trainee is responsible for coordinating everything around the escape room e.g., talk with customers, manage student assistants, work on improvements such as implementing the online booking and payment system, remain in contact with the builder of the escape room in case additional information is needed, and work on press materials). Academics help to create the narrative, and support with providing materials to construct the escape room. Facility services were needed to find a location where the escape room was to be housed. They also helped with constructing the room/ outer shell itself.

As the escape room was used, some improvements were made such as online payment. The legal services helped in these processes. Marketing & communication created the content on the website to promote the escape room. The dean of RSM was responsible for clearing the budget required for the design and creation of the escape room, and also to cover the daily operations. The IT department aided in installing the software and online booking and payment systems (daily operation). Alumni helped providing information about SDGs they find interesting (design). Finally, a vendor provided services for online booking and payment system.

iii Institutional administration

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).

iv Businesses and private escape rooms

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.

HIGHLIGHTS FROM PRACTICE

COLLABORATIVE APPROACH TO EER DESIGN AND DEVELOPMENT

Educational Escape Room in Chemistry - Technical University of Madrid (Spain)

The game has been designed in order to help students acquire specific competencies in the area of Chemistry as well as general competencies like group work and creativity. The EER was carried out by a team of academic staff from the Chemistry-Physics; Industrial Chemical Engineering and Environment; and Mechanical Engineering, Chemical and Industrial Design departments. At the pilot implementation phase, a total of 22 people participated in the EER, 16 of which were students from the UPM degrees, 12 were students and teachers from high schools and 2 were former graduates.

1.2.3.3. Resources

Regarding the necessary resources required to develop and execute an EER, we identified four different categories: Physical resources, materials, time, and financial resources.

- ***Physical resources:***

Most EER *settings consist of two separate rooms. While one room is set up as the actual EER for the players, the moderators monitor the participants from a separate control room, which is mostly done via a live video. (Berthod et al., 2020; Clarke et al., 2017; Kinio 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; Shakeri 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 (Cain, 2019; Eukel et al., 2017) 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 (2019), 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; Eukel et al., 2020). Further, some facilitators used already existing* EER *templates such as the BreakoutEDU kit. (Duggins, 2019; Mac 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 already be set up with an investment as low as $12 (Cain, 2019). Also, other authors reporting their costs only made comparatively small initial investments ranging between $100 (Eukel et al., 2020; Liu et al., 2020) and $200 (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 certain grants, which allowed for a more sophisticated* EER *design (Jambhekar et al., 2020; Karageorgiou, Mavrommati, Christopoulou, & Fotaris, 2019).*

Figure 2. Input estimation example

HIGHLIGHTS FROM PRACTICE

INPUT ESTIMATION EXAMPLE

Fig 2. Escape Box Business Policy and Strategy Course - The University of Queensland, School of Business (Australia) by Shakira Moss, Learning Designer, The University of Queensland, School of Business. The currency is Australian Dollar (2017)

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., 2019b). Most of the existing EERs, however, are of a physical nature. Further, one can distinguish between breakout boxes and rooms. While in the first case players must unlock a box with the help of puzzles (Cain, 2019; Hermanns et al., 2017), in the latter case participants are actually locked within a room (Kinio 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 (Mac Gregor, 2018). Furthermore, alternative scenarios are possible, where the goal of the players is to e.g. save a patient (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 introduction and debriefing could take up to four hours (Franco & DeLuca, 2019). The size of the participating groups can vary between two and 14 members (Fotaris & Mastoras, 2019). Nevertheless, the EER method can also be integrated in courses with larger enrollments by dividing the whole class into smaller subgroups (Cain, 2019).

Structure of the EERs

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., 2019a), 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., 2015).

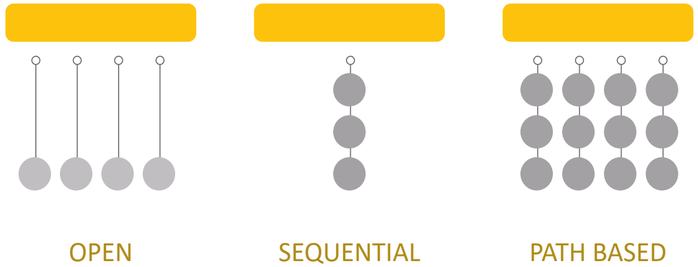

Figure 3: Structure types of EERs

WHILE A LINEAR GAME PROCESS PROVIDES A CLEAR STRUCTURE, NON-LINEAR GAMES GIVE THE PLAYER MORE CONTROL OVER THE GAMEPLAY EXPERIENCE

(NICHOLSON, 2016).

1.2.3.5. Implementation

Regarding the procedure of EERs, three stages can be identified. Planning/Design, Implementation, and Debriefing

I. The first stage comprises all activities prior to the actual escape game. During this phase, the instructors explain the rules of the game, provide materials and introduce the scenario of the game (Adams et al., 2018; Snyder, 2018). Also, groups are formed either by the students or by selection through the instructors (Franco & DeLuca, 2019). Monaghan & Nicholson (2017) suggest that a preselection through the instructors might be more beneficial since students would tend to group themselves with peers of similar academic performance. For the formation of heterogeneous groups metrics such as students´ GPA or certain personality metrics could be supporting factors. (Gordon et al., 2019). The introduction can take place either immediately before the escape game or in a prior class session which may save time for the execution of the actual escape game (Cain, 2019). Depending on the complexity of the game and the prior knowledge of the participants the introduction can take up five to 30 minutes (Cain, 2019; Franco & DeLuca, 2019).

Scenario/Narrative

There are EERs with but also without a theme. Additionally, many EERs have a certain narrative that places the game participants in a specific role (Nicholson, 2015). In the context of game-based learning, the theme and the narrative of the EER are crucial to providing an immersive experience that enables the players to reach the state of flow (Järveläinen & Paavilainen-Mäntymäki, 2019; Wiemker et al., 2015). Unlike other games, players of EERs have a very strong connection with the characters they are playing. Since players are not watching an avatar in the game world (e.g. on a computer screen), they become more sensitive to elements in the game that are not consistent with the narrative. Thus, players experiencing differences between the narrative and the game might become frustrated (Nicholson, 2016). Compared to a traditional classroom setting, the narrative can further provide context by telling a story that illustrates the relevance of the taught course material (Eukel et al., 2020; Monaghan & Nicholson, 2017). Additionally, tasks and puzzles must be connected with the rest of the experience in a consistent way in order to create context and make the players engage in a meaningful way (Gómez-Urquiza et al., 2019; Wiemker et al., 2015). Using a consistent overarching theme can support to creating a consistent storyline and interconnections between different tasks and topics rather than just a disjointed set of puzzles (Brady & Andersen, 2019). "The players should have a meaningful reason for taking on a task" other than just doing the next thing they have to do (Nicholson, 2016). According to Monaghan & Nicholson (2017), the narrative is just as important for the player experience as the physical components and challenges of the game.

HIGHLIGHTS FROM PRACTICE

A CAPTIVATING NARRATIVE EXAMPLE

Escape Box Business Policy and Strategy Course - The University of Queensland, School of Business (Australia)

"It's 4:30 am and you're on radio station 4ZZZ playing REM's Orange Crush, when the studio door bursts open, 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 the clinking sound of metal and chains behind you. They've locked up the studio! Now you have to escape the paddy van, get back into the radio station, and put radio 4ZZZ back on air, or the voice of the students will be silenced forever. Can you do it in 45 minutes?"

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), consequences to the problem if not resolved (shutting the radio station down), and ultimate goal (freeing the students' voices). Importantly, not only does the introduction set the stage for the activity, it outlines the steps in the escape room game and the introduction of puzzle sets:

1 – escape the paddy van
2 – get back to the radio station
3 – put the radio back on air.

2. The second stage consists of the actual execution of the game. In this phase, participants are challenged to perform given tasks and puzzles in the required time to eventually escape the room or unlock a box. Students are now required to evaluate, collaborate, and think strategically (Franco & DeLuca, 2019). Depending on the setting and the scope of the EER this activity can range between 15 and 150 minutes (Franco & DeLuca, 2019; Mac Gregor, 2018). While most of the examined games last between 30 and 60 minutes, some experiences had a duration of more than 75 minutes (Fotaris & Mastoras, 2019). There is also an example of an EER spreading over the course of three weeks, while the participants had to solve one riddle each week (Mac Gregor, 2018).

Tasks and activities

Activities performed in EERs are often of a mental nature. These are cognitive puzzles, which involve the player´s logical and thinking skills (Järveläinen & Paavilainen-Mäntymäki, 2019). Physical tasks on the other side, require the manipulation of physical objects to get to the solution of the puzzle. Physical challenges could be drawing (Brady & Andersen, 2019), solving Rubik´s cubes (Friedrich et al., 2020), applying technical medical skills (Adams et al., 2018; Kinio et al., 2019)(Kinio, Dufresne, Brandys, & Jetty, 2018), or sewing (Chang, 2019). In most EER settings, however, elements of both, mental and physical tasks can be found (Chang, 2019; Kinio et al., 2019; Lopez-Pernas et al., 2019b; Walsh & Spence, 2018).

As claimed by Nicholson (2016), tasks in the escape game should not serve as barriers to winning the game. Instead, the challenges must be meaningful and integrated into the underlying narrative to provide the participants a purpose for their actions. A way to create meaningful challenges is to have the tasks an impact on the player. This could be achieved by e.g. having the player accomplish quests by overcoming conflicts. Especially in an educational context, this is a valuable method, as challenges can help players to learn or reinforce skills and knowledge (Nicholson, 2016).

Hints and clues

To establish a flow and to manage the difficulty of EERs hints could be given by the EER moderator. These clues can be provided in various ways. Hints can be given unlimited depending on the assessment of the moderator (Brady & Andersen, 2019; Musil et al., 2019) limited to a certain number (Eukel et al., 2020), earned by some achievement like solving puzzles in time or in exchange for a penalty (Chang, 2019; Wiemker et al., 2015). Also, clues can be provided after a certain amount of time lapsed (Gómez-Urquiza et al., 2019). Furthermore, combinations of these rules are possible (Adams et al., 2018; Chang, 2019). Also, there are various ways to provide these clues (e.g. vocally, or by cue cards) (Hermanns et al., 2017; Wiemker et al., 2015). Hints can be provided by the moderators remotely from a separate room, (Clarke et al., 2017; Shakeri et al., 2017) or automatically by a computer (Ross & Bell, 2019). However, in some examined cases hints can also be given by moderators who are actually present in the EER (Brady & Andersen, 2019; Chang, 2019). Eukel at al. (2020) additionally allowed the participants to access online resources as an alternative to ordinary hints.

HIGHLIGHTS FROM PRACTICE

HINT MANAGEMENT

As showcased by the international good practices' representatives in Australia, the UK, and the USA, the organisation of hints is crucial to the completion of the activity by the students and thereof reaching the learning outcomes envisioned. Hints should be developed simultaneously with the puzzles and should be given equal priority in their design. Additionally, it is advised to have an extra set of simplified hints if the activity is being implemented for the first time to avoid negative experiences of a failed game. It is equally important to devise a principle of hint award (as mentioned above) and pilot-test it among the peers, paying close attention to their perception of the hint and the context in which it is given.

An example from Educational Escape Room in Pharmacy - The University of North Texas, UNT System College of Pharmacy (The USA)

In the first year of the activity, using hints was penalised by withdrawing points from the total grade for the activity. Yet, the organisers noticed that this approach discouraged interaction with the facilitators, created a negative stimulus to approach with the questions, and significantly decreased the speed and learning curve for the students. Therefore, in the second year of the activity the students were entitled to 5 "free" hints in each room, which significantly increased their interest in interaction with the facilitators, alleviated stress and opened possibilities for experimentation.

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, 2016).

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 narrative, facilitators must also decide to what extent they can implement technology as part of the game. Also, connecting the escape game with the real world is a way to make the participants more immersed in the experience. For instance, players may have to communicate with the real world (e.g. sending a code to someone). In this way, players are animated to consider how they would act in a real-life situation. (Nicholson, 2016).

Competition elements and rewards

EERs often incorporate competitive aspects of play. 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, 2019; Wiemker et al., 2015). In this way, students can be encouraged to apply problem solving rather than just guess the solution (Ross & Bell, 2019).

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 (Järveläinen & Paavilainen-Mäntymäki, 2019) for their performance in the EER.

3. **Following the actual escape game, most of the examined use cases implemented a post-game debriefing session.** This phase caters to the purpose of providing room for reflection and critique on the EER activity, reviewing problem-solving approaches, but also giving the opportunity to further discuss the underlying educational topics (Eukel et al., 2020). This session can either be conducted as a moderated group discussion immediately after the escape experience (Adams et al., 2018; Brady & Andersen, 2019) or as a written assignment where students must reflect individually on their EER experience (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).

1.2.3.6. Students designing EERs

Next to playing escape games, it can be an engaging experience for students to create one themselves. This task requires students to have a deep understanding of the course content and at the same time create the excitement of playing games (Nicholson, 2018). Projects of students designing an EER are often carried out in technical subjects, such as engineering allowing students to experiment with practical tools and software such as 3D printers and CAD (Davis & Lee, 2019). Karageorgiou et al. (2019) further extended the skill set by incorporating elements of creative writing and theater. In the class of Davis & Lee (2019) students work in small groups making individual puzzles, which are later combined to a large EER. Students not only learn practical technical skills but further acquire project planning and managing skills by carrying out a project over the course of two semesters. Moreover, giving students the opportunity to ideate and develop their own designs, this method enhances their creative thinking skills (Davis & Lee, 2019; Karageorgiou, Mavrommati, & Fotaris, 2019). Also, students seem to enjoy experience. According Davis & Lee (2019) the majority of the participants evaluated the experience as enjoyable. Thereby, students highlighted the opportunity for creative thinking as well as being responsible for their own project. Before completion of the project, students played the games of their peers and must review them. This allows students to experience multiple puzzles and to receive feedback for their work (Davis & Lee, 2019).

Also, students seem to enjoy the experience. According to Davis & Lee (2019), the majority of the participants evaluated the experience as enjoyable. Thereby, students highlighted the opportunity for creative thinking as well as being responsible for their own projects. Before completion of the project, students played the games of their peers and must review them. This allows students to experience multiple puzzles and to receive feedback for their work (David & Lee, 2019).

HIGHLIGHTS FROM PRACTICE

ASSESSMENT FOR THE GAMES, INTEGRATED INTO THE COURSE

According to educational escape rooms designers and testers from our investigated country regions, 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 revolving 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 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);*

- ***Reflection:*** *a "free-style" feedback collection with the emphasis on the "lessons learnt" and graded 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 ideation, implementation and execution phase of EERs, that impedes success.

Many use cases of EERs in higher education report challenges including limited resources and budget limitations. Especially when financial resources are scarce designing an immersive narrative can be difficult (Chang, 2019). Utilizing faculty or partner resources or moving from physical tasks to a digital setting can be helpful remedies (Adams et al., 2018; Eukel et al., 2017). Even though most educators can resort to the facilities and equipment of their faculties, facilitators who lack these resources may be limited in implementing such activities (Eukel et al., 2020). Also, available facilities might not be perfectly suitable for the EER setting, e.g. curtaining off the room is not possible (Mac Gregor, 2018). Furthermore, applying a low-budget design of the EER increases the risk of losing the immersive aspect of the EER experience. Other use cases received funding from external entities for the purpose of the game design (Friedrich et al., 2020).

1.2.4.2. Prior to the Game

Facilitators of EERs are constantly challenged to provide an experience that ensures a continuous game flow 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 piloting the EER activity 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 (Cain, 2019; Friedrich et al., 2020; Hermanns et al., 2017). When testing the escape game, it is recommended to consider the experience level of the playtesters. While it can be beneficial to have experienced playtesters in the early phase of piloting, Monaghan & Nicholson (2017) suggest that in later stages it is important to have testers who can take the player's perspective.

Choosing an adequate time limit for the EER can be difficult. The time limit should be a challenge for the participants yet still be manageable. Of course, the duration of the game depends on its extent and complexity. However, designing more extensive games might be accompanied by problems. Next to logistical issues (i.e. timely schedule and room provision), longer games might cause exhaustion and consequently decrease the motivation of the students (Hsu et al., 2009). 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 (Wiemker et al., 2015). In this context, the narrative plays an important role. It must be clear and coherent with the tasks performed to avoid confusion among the players (Järveläinen & Paavilainen-Mäntymäki, 2019). Looking for the solution, players will take everything as a clue, even things that are not meant to be ones. Facilitators thus must therefore clearly communicate which elements are important for the quests of the game and which are not (e.g. which elements can be manipulated). Often it is helpful to keep the narrative rather simple so the participants can better understand how the tasks are linked to the backstory. Instead of introducing an extensive narrative before the game, facilitators could also tell the story incrementally through the challenges during the game. (Nicholson, 2016). Nicholson (2016) further suggests that game designers should ask themselves during the ideation and development stage why certain elements matter. In doing so, consistency with the room design and the narrative should be maintained. For instance, designers must ask themselves why participants need to escape the room in a limited time when the narrative does not imply that solving the problem is not very urgent (Nicholson, 2016).

Moreover, EER designers are challenged to create consistency of the participants' knowledge of the treated subjects beforehand. Otherwise, it could lead to an unbalanced difficulty (Fotaris & Mastoras, 2019) and consequently to a decreased involvement of some participants due to a lack of knowledge or boredom because the tasks are perceived as too easy (Chang, 2019). In that regard, motivating students to acquire a certain level of knowledge beforehand might be challenging (Lopez-Pernas et al., 2019b).

It is likely to be helpful to consider a storyline theme of the escape game. This could help students to understand the logic of stepwise processes (Brady & Andersen, 2019). 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 moderator at the starting point might be helpful to not let the players go in the wrong direction (Lopez-Pernas et al., 2019b).

1.2.4.3. Legal and organizational challenges

Designing an EER can involve legal and safety challenges. Thus, game designers must consider the legal feasibility of locking or handcuffing 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, requisites and puzzles must be designed in a robust way to facilitate a sustainable EER experience (Brady & Andersen, 2019).

Initiators can be confronted with basic organizational challenges such as finding a location, scheduling the experience with all stakeholders, or obtaining approval for the EER setting (Karageorgiou, Mavrommati, Christopoulou, & Fotaris, 2019).

HIGHLIGHTS FROM PRACTICE

FIRST-HAND EXPERIENCE WITH ESCAPE ROOMS, GAMES DEVELOPMENT AND GAME -MASTERING

Representatives of case study from our investigated country regions highlighted the importance of experiences not only with escape rooms as a methodology (including commercial applications), but also with basic principles of game-design and game-play, in any given context, and not necessarily educational. Escape rooms follow similar game-design principles as other narrative-based virtual or offline games, in terms of the design framework, narrative development, suspense and puzzle logic. For example, the representatives from the case studies include learning designers with prior experience in commercial/entertainment games and animators, or passionate Dungeons & Dragons game fans. Lack of personal experience of the academic/educator in narrative design, story-telling skills and understanding of games dynamics might serve as one of the major challenges for a successful realisation of an escape room. However, bridging the gap by visiting commercial escape rooms, participating in online narrative-based games, or reaching out to more experienced (gamers) colleagues is found helpful.

An example from Educational Escape Room in Entrepreneurship Education - Ruhr-Uni Bochum (Germany)

The idea of an Escape Room for educational purposes came into fruition during the delivery of a course on entrepreneurship when the course instructor Yvonne Braukhoff invited a guest speaker among the university's alumni, who has launched an Escape Room company called "Think Square" (https://www.think-square.de/). A spinoff from the Ruhr University Bochum, the staff of Think Square have built a profile for themselves as experts in the game design. Conversations started for potential cooperation opportunities, that game elements can be embedded in the course module to investigate the concept of uncertainty. The conversations led to the launch of "Think Space", a learning and research laboratory that represents a new teaching-learning infrastructure for entrepreneurship education. The implementation of the laboratory environment Think Space as a multimedia teaching serves further development of the course module "Coping with Uncertainties in Entrepreneurial Contexts- simulation-based learning approaches".

1.2.4.4. Execution

When it comes to the execution of an escape game, it is important to identify an adequate group size that allows for collaboration but also is not too large to reduce the involvement of the players (Adams et al., 2018).

Administering an escape game with larger groups can create logistical challenges, such as scheduling the experience for all students or finding enough room for all participants (Cain, 2019). Though one can counteract this challenge by digitalizing parts of the escape puzzles and thus saving time and physical space. However, digital puzzles might be limited to certain EER designs and scenarios. When the EER setting aims to teach the practical application of specific techniques (e.g. surgery procedures), the use of digital puzzles might not be adequate (Berthod et al., 2020; Kinio et al., 2019). Second, integrating physical objects can provide a more kinesthetic and immersive experience. Moving the EER into the digital world might therefore bear the risk of loose engagement of the students as well as reduce aspects of interpersonal communication and interaction (Cain, 2019; Liu et al., 2020). Furthermore, the limited time available for the players might affect their hands-on learning experience since the participants might not be able to solve the puzzles in time (Chang, 2019). Another remedy to cohort larger groups is to also allow the participants to complete the puzzles outside the room, which, however, again might negatively affect the game experience (Gordon et al., 2019). Monaghan & Nicholson (2017) propose a third way – implementing a ticketing system. Applying this approach, participants would have to fill out a ticket with their guess and then bring it to the front to stand in a queue to try the lock of a box. This tactic would facilitate allocating more students to a restricted number of resources.

According to Nicholson (2016), the future of EERs consists of dynamic puzzles that change every time the game is played, making EERs replayable. To logistically manage a larger group of participants, Wise et al. (2018) suggest using a central booking system, that allows the timely schedule of time slots for the participating groups (Cain, 2019).

1.2.4.5. Post-game

When it comes to evaluating the performance of participants in the EERs, different opinions are found in the literature. Grading participants based on their performance could be an approach to motivate them extrinsically. However, evaluating the EER performance is difficult since the outcomes are binary (i.e. escaping vs. not escaping) (Lopez-Pernas et al., 2019b). On the other side, putting the students in an exam situation, again, might reduce the voluntary aspect of the game (Whitton, 2018).

Ho (2018) proposes a grading scheme based not only on the performance within the escape game but also on other factors such as preparation and post reflection. While students might be motivated extrinsically by extra credits (Järveläinen & Paavilainen-Mäntymäki, 2019) the voluntary aspect of games might be reduced when EERs are implemented in formal education when games are part of a mandatory curriculum (Whitton, 2018). Nicholson (2018) further argues that escape games serve the purpose of supporting students to develop an intrinsic learning motivation that is guided by curiosity instead of motivating them with grades. Moreover, grading the students´ performance in the escape game might increase the anxiety of the participants. Instead, giving participation points could be an alternative solution to improve participation (Chang, 2019; Eukel et al., 2020). However, Ross & Bell (2019) report that students requested to be marked for their EER activity. According to their statement, a partial grading accounting for approximately 5% of a subject´s mark is reasonable. Within the game, a competitive design can be motivating for some players, for others it might induce stress and, thus might be demotivating. Competitive settings always create an incentive to cheat. Thus, cheating opportunities must be identified and eliminated (Nicholson, 2015).

Very often EERs are a one-time experience. Hence, taking advantage of it by letting students play it again is mostly not possible. By e.g. modifying puzzles or their outcomes, however, EER experiences can be made re-playable (Nicholson, 2015). Another opportunity to ensure repeatability is to let the students sign a confidentiality agreement, stating that the topics, as well as the puzzles, cannot be discussed with fellow students (Eukel et al., 2020).

HIGHLIGHTS FROM PRACTICE

EDUCATIONAL TECHNOLOGIES FOR MORE FLEXIBLE USE OF EERS

An example from Educational Escape Room in Entrepreneurship Education - Kaunas University of Technology (Lithuania)

One of the UNLOCK good practice cases show Virtual Reality (VR) escape room games can be useful in the teaching of subjects where repeated practice is necessary, as in Chemistry. The VR technology, which is currently being developed at Kaunas University of Technology target students of formal education, e.g. of bachelor and master's degrees, as well as those who like to have the basic knowledge of chemistry and school students who like to perform experiments.

1.2.5. Outcomes and impact

Implementing EERs in higher education teaching mainly results in positive results. When reviewing the outcomes, the findings can be divided in three categories:
(1) Results on the learning outcomes, (2) impact on the emotions and behavior of the students, and (3) results on EERs as a teaching method (Roman, et al., 2019). Finally, we want to elaborate on the factors that (4) drive the performance of participants within EERs.

1.2.5.1. Learning Outcomes

Regarding the impact on students learning the most common findings are that EERs promote teamwork and collaboration (Fotaris & Mastoras, 2019; Gordon et al., 2019; Ho, 2018) and are beneficial for interprofessional communication (Friedrich et al., 2020; Guckian et al., 2020). Moreover, use cases of educational EERs report to promote problem-solving and creative skills (Adams et al., 2018; Gómez-Urquiza et al., 2019; Karageorgiou, Mavrommati, Christopoulou, & Fotaris, 2019). According to Brady and Andersen (2019), EER experiences can further promote the confidence of students to communicate with their peers about complex topics. Furthermore, Chang (2019) showed that an EER experience heightened the awareness of participants about environmental problems. In addition, it has shown to be closing the gap between the values and their corresponding behavior. While participants tend to allocate different roles among the team members (Cain, 2019), EERs provide also an opportunity to teach leadership skills and coordination (Roman et al., 2020). Having to escape from a room in a limited time frame also helps players to learn to work and make decisions under time pressure (Liu et al., 2020; Snyder, 2018).

Cain (2019) further found that the EER experience was successful at eliminating "free-riding" as more participants were actively involved in the activity compared to more traditional group-based discussions. Thereby, players who show a stronger engagement in the EER activities also have a higher (perceived) learning effect (Lopez-Pernas et al., 2019b). 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.

1.2.5.2. 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 a lack of instructions and guidance (Hermanns et al., 2017). This, on the other hand, contradicts the findings of Roman et al. (2020) who found with their qualitative analysis that an EER can provide an environment where students can explore knowledge with calmness and less stress than in exams. However, the subjective perceptions of students might vary between individual EER settings. Hence, factors such as time pressure or extrinsic results might have an impact on the stress level of students. Moreover, studies consistently report that EER experiences produce high levels of enjoyment (Brady & Andersen, 2019; Fotaris & Mastoras, 2019; Snyder, 2018) and cause a stronger engagement of students compared to other traditional learning activities (Berthod et al., 2020; Fotaris & Mastoras, 2019; Lopez-Pernas et al., 2019b), by allowing students to take on a more active role in the learning process (Brady & Andersen, 2019).

1.2.5.3. 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 53% 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 interest of 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., 2019b) but also, to understand interrelations between these topics (Brady & Andersen, 2019). Furthermore, EERs show to positively influence the confidence in not only the knowledge (Guckian et al., 2020) but also the application of learned topics (Adams et al., 2018; Musil et al., 2019; Snyder, 2018). Results showing significantly higher exam pass rates support the findings of positive learning effects and the effectiveness of EERs as a method to recap lecture contents (Lopez-Pernas et al., 2019b). Furthermore, EER activities can help students seeing a bigger picture of the course material by understanding interconnections between the topics (Brady & Andersen, 2019) or even to facilitate teaching across multiple subjects (Clarke et al., 2017).

HIGHLIGHTS FROM PRACTICE

ASSESSMENT FOR THE GAMES, INTEGRATED INTO THE COURSE

Educators interviewed from Denmark find learning potentials in the use of EERs at universities. They advocate that EERs are dynamic learning spaces, which are adjusted and discussed in collaboration with the learners, game designers and players.

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 (Jambhekar et al., 2020).

1.2.5.4. 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 in the escape game. Furthermore, active participation in escape games puts the learner in the focus and thus increases the learning motivation of students (Brady & Andersen, 2019; Lopez-Pernas et al., 2019b). Also, the heterogeneity of participating 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.

Some other findings indicate that EERs are more efficient 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 raise interest (Guckian et al., 2020).

HIGHLIGHTS FROM PRACTICE

GROUP COMPOSITION BY PERSONALITY TYPE

One technique to ensure a more balanced group dynamics is pre-identifying the group composition based on the mixture of personality types. The use of personality tests, 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, organisers, creatives, 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: 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 types, as reported by the students themselves after taking the Myers-Briggs indicator (MBTI) test.

1.3. 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, 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.

Figure 4: EscapeEd framework (Clarke et al., 2017)

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: ***Objectives –*** *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 Objectives. 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.*

HIGHLIGHTS FROM PRACTICE

ESCAPE ED FRAMEWORK IN PRACTICE

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.

Puzzles and clues were split between the two rooms and it was only possible to resolve the "problem" by communication between the remote teams. However, the teams were not allowed to physically interact and could only rely on the two laptops with Skype in each room respectively. Players needed to employ their communication skills to share the clues and riddles with the other room teams. A first-year drama student, playing a part of the 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 by Clarke et al.

Clarke, S., Peel, D. J., Arnab, S., Morini, L., Keegan, H., & Wood, O. (2017). escapED: a framework for creating educational escape rooms and Interactive Games For Higher/Further Education. International Journal of Serious Games, 4(3), 73-86.

1.4. Limitations and Future Research

Interpreting the results and drawing implications from EER experiments can be difficult. The most mentioned challenge in the review of (Fotaris & Mastoras, 2019) was a poor evaluation of the EER experience. Regarding the methodology, in most studies the educational effectiveness was assessed by surveying students, whether they found this method helpful or not (Hermanns et al., 2017; Lopez-Pernas et al., 2019b). Others even based their findings solely on their personal observations (Monaghan & Nicholson, 2017; Ross & Bell, 2019). Consequently, this method leads to very subjective findings and thus bias the validity of those findings (Fotaris & Mastoras, 2019). Only very few studies analyzed the learning effectiveness of EERs empirically by conducting a pre- and a post-test after the experience to measure the increase in knowledge (Eukel et al., 2017; Lopez-Pernas et al., 2019b). Furthermore, the evaluation of the results of many studies is limited by the lack of control groups. A comparison of the effectiveness 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 (Cotner et al., 2018). 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 surveys 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. Differing 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 again 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 cost efficiency of this method and analyze 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 contexts, 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 are at the very early stage of development, and current interest in GBL is more focused on ICT and digital games.

2.2. Disciplinary focus

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 Literature), 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.

2.3. Emerging themes

2.3.1. Hybridity

EERs are observed as hybrid learning environments in the HEIs, in the forms of:

- merging of physical and digital learning spaces, e.g. in the EER Mastermind 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 Kaunas University of Technology, and;
- students and educators as co-creators, e.g. in the collaborative EER experience at Vallekilde 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 becoming part of advancement of academic knowledge**, both participating in and being observed within EER settings for behavioral analysis, and thus contributing to the integration of new knowledge back into teaching,

2.3.2 Institutional boundary spanning

EERs are also observed as **tools for institutional boundary spanning**. European EERs are designed and implemented in collaboration with HEI internal and 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 Mastermind;
- start-ups, e.g. Think Square, in the EER case of Think Space;
- municipalities, e.g. Sønderborg Municipality and private entity Rubi Lee's Escape House. As recognized form the examples, these collaborations are found to be more common in the German, Dutch, and Danish educational contexts.

The creation and implementation of EERs are initiated and coordinated by educators. However, as understood, this process does not take place in a vacuum. In the higher education context, **academics 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 as EER initiators, 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 main beneficiaries of the experience, students are responsible for the development and daily operations, gathering data, designing physical components, functioning as testers, and running daily operations;
- **Regional and institutional administration as supporters:** 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:** Educators 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 engagement is extended both inside and outside the institution.** Students help find information to create the themes of the EER, and academics creating the narrative and providing support with materials to construct the EER. Facility services assign a location and construct the room itself. The legal services help with online payment services, while marketing & communication create the content on the website to promote the EER. The dean facilitates the budget arrangements and the IT department aids in installing the online booking systems. Alumni helps to provide information about SDGs they find interesting. Finally, a vendor of the online booking and payment system gets involved as a third party.

The boundary spanning is observed to be facilitated by network institutions as well, that are dedicated to the adoption of innovative pedagogies, as in the case of the Danish private organization House of Science. The EER-material from the House of Science is sent to potential interest groups from those network institutions, that foster recognition and adoption of the methodology by the educators. Here, it is suggested that stakeholder dependency could make the EER collaborations vulnerable. Transparency in terms of ownership (materials), facilitation (teaching EER), and responsibility (learning objectives) before initiating EERs are acknowledged to be the key to a fruitful collaboration.

2.3.3. Educator aspirations towards sustainability of EERs

The sustainability of EERs is mentioned to be one of the major aspirations of the educators, meaning, **making EERs re-playable and an embedded element of the curriculum.** Sustainability can be achieved via integrating EERs in the educational curriculum, and treating them as an established activity, as embedded within the existing learning and teaching structures. This is addressed by efforts of educators' EER promotion among colleagues, and support in the integration of the methodology across 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 EERs, via co-design and implementation of the games. This dimension also includes expanding partners by diversifying the purpose of EERs, as in scientific EERs to be used as a lab 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 an interest in obtaining information about competencies such as leadership and communication, and finally aiming to inform students what gamification is and work on the development of specific competencies via EERs.

2.4. EER development and design

2.4.1. Development

Targeting 21st century skills, clearly defining Intended Learding 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 common 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); Soft skills, e.g. cooperation, creativity, teamwork, problem-solving skills & hard: e.g. digital skills, coding, encryption (Skills); Increase interest in STEM, SDGs, and enthusiasm for learning of the subject matter, increasing motivation for action (Attitude);

- **Educators:** New approaches to teaching, student-centred teaching (Knowledge); Skills and competencies for the use of innovative pedagogies (Skills); Increase enthusiasm, and awareness on topics e.g. academic and cultural student diversity (Attitude).

The interviewees pointed out the considerations related to working with diverse groups, and make sure proper **'framing'** is achieved. This is because some different micro- and macro-frameworks play into the interpretation of individual things and events, their contexts and meaning. In few cases, educators are observed to prepare pre-game surveys including IQ, and personality tests, e.g. Myers - Briggs indicator (MBTI), and cultural frameworks, e.g. Lewis Model to group students in teams accordingly and introduce certain cultural patterns of behaviour that would show up in the game, e.g. in the EERs Intercultural Management EERs, and The Lost Scientist.

Educators also reported the preparation of a number of **tools and materials** as part of their EERs, to increase the complexity and depth of student experience. Some of the mentioned materials are grouped as below:

- **Digital: Hardware:** Flat screen, led steering lights, microphone, baby camera, signal lights, computer screens, walkie-talkies, dictaphones (voice recorders), special wearable sensors, virtual reality devices, Software: sound system, Skype connection, Python script, QR codes
- **Physical: Puzzles:** wordplays, Sudoku, dice games, crossword; Materials: White board, wooden glass, padlocks, screws and nuts, books, math-problems, candles, tape, pens, toy gun, fake money, treasure chest, UV pencils, UV flashlights; Furniture: desk, bookcase, sofa, wardrobe, display cabinet

2.4.2. Design

There are **three major EER design elements emphasized**, being, (i) gamification, (ii) ILOs, and (iii) pedagogical elements. Accordingly, the country reports discuss gamification elements as rules hints, feedback, prizes, rewards, progression levels, time limit, ILOs as those targeting development of skills and repetition of already offered knowledge, and pedagogical elements embedding principles of problem-based learning (PBL), active teaching method, self-regulation, collaborative learning, inductive learning, and scaffolding theory of self-directed learning. Accordingly, students' active involvement in creation and participation in EERs is encouraged.

Interviewees have pointed out that before enacting students as designers, they have to be prepared better in the disciplinary content, to prevent them feeling unsure about achieving their learning outcomes. **Students as game designers and game participants have different learning outcomes.** Thus, this complex learning environment calls for 'differentiated instruction' (DI) as a teaching framework to understand and approach the learning situation.

2.4.3. EER design challenges

Most major EER design challenges reported by the interviewees as (i) lack of clear ILOs, (ii) identification of the right EER methodology to reach the IOs, and (iii) selection and integration of game design elements.

Educators are warned that if clear learning goals are missing, there is a risk of ambiguity, which confuses the students more than necessary. It is further pointed out that **(i) the context** can be a source of ambiguity when the game designer plays on the socio-cultural discourse into which an object or event is interpreted, **(ii) 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 **(iii) information** about an artifact can give rise to ambiguity.

This consideration about the concept of ambiguity was brought to attention in the EER case of Montpellier Business School, with reference to challenges of designing games for international groups, due to cultural differences in perceptions towards games, teamwork, and paths to task completion. In this particular case, the course instructor has had to change or even expand her cultural approach at times when selecting elements as part of hints and puzzles. For example, her decision on the selection of certain images slowed down some groups, since 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 cultural sensitivity of the game, it is important to get feedback or pilot test the game with multicultural teams prior to implementation with students.

Connecting the tasks of the game with each other to create a coherent pattern between the individual puzzles, in order to reach the ILOs have proven to be a challenge. It is reported that often the connections between the tasks feel constructed and not intuitive. This difficulty further challenges the efforts for creating new environments with a different combination of puzzles, especially if educators are wishing to integrate EER activities on a continuously basis in their course programs.

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. Thus, 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. This dichotomy between content/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.

Another challenge was stated as **adjusting the level of complexity** 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 adds an extra layer since 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 evaluation process and not necessarily in an explorative learning process.

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. Furthermore, there are different players and learning types within groups, that hinder making a fair assessment. Among the EER cases investigated, formative assessment is found to be common. It takes place through reflections during debriefing, reflects on oneself and others. The assessment also relies on self-reporting questionnaires, pre and post tests conducted by the educators, and notes, pictures, and videos recorded.

2.5. Supporting and inhibiting factors in the HEI adoption of EERs

2.5.1. Supporting factors

UNLOCK research revealed a number of supporting factors that contribute to the successful development and implementation of EERs in educational contexts. Educators are on different levels of experience concerning EERs. Some consult introductory videos, guidebooks, and attend trainings organized by their institutions, while others already have experience with EERs due to the diverse experience at universities and companies before. In addition, interviewed educators are observed not only being 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 ERs, knowledge of EERs and their design methodologies, creativity and entrepreneurial mindset, timing skills, flexibility, writing skills, technical competencies and design abilities

Institutional factors: Institutions introducing CPD courses & learning labs, availability of relevant workshops, institutional recognition, available institutional, and regional funding, courses in which the EERs can be embedded

Methodological factors: Involving students in the game design, integrating different stakeholders, both inside and outside educational institutions, in order to succeed 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 resources for the educators to invest explore/ innovate/create/implement an EER. Accordingly, the support provided by the regional governments and HEIs, as captured in the case studies include:

- Teacher Development Fund provided by the Ministry of Education (NL)
- HE Internal funds, i.e., Stimulation Fund for Educational Innovation, with accessed grants amounting to 20,000 Euros, Grassroots funding scheme that provides funding for up to 1000 euros for small, accessible, and ICT-related projects that can be readily implemented in an educational setting, and departmental funding for the design and daily implementation of the games (NL), Funding from the Learning Infrastructure program, advised by the Quality Improvement Commission (QVK), in the amount of 49,400 euros (DE).

In the case of EERs funded by the European Commission, in one of the cases, the teams resumed their activities by embedding the EER approach in their existing initiatives. The sustainability of EERs as an integral part of teaching is also ensured by exploring options for further funding, through collaborations with public and private organisations who would be interested in knowledge exchange generated by the experiences.

Grants, training, coaching, online resources, all matter, but it is the attitude and approach of educators, to pull these resources together, and creatively design their own game towards their own purpose. Educators can draw back on the facilities and equipment of their faculties, which reduces the overall costs of the EER implementation.

2.5.2. Inhibiting factors

Inhibiting factors reported by the interviewees included factors related to educators' own competencies, institutional barriers, students` preparedness, and lacking resources. One of the highlighted inhibiting factors experienced included resistance from management, due to concerns regarding content over form.

- **Educators' knowledge skills, and attitudes:** Adopting a new methodology, creating a successful string of puzzles, setting up a digital EER, adjusting the difficulty level, managing cultural & personality combination in teams, lack of technical competencies, and storytelling skills
- **Institutional factors:** Bureaucracy in the arrangement of the space the game is planned to be played; conflicting approaches to education, meeting safety regulations
- **Students:** Unfamiliarity with the concept of EERs games; lack of inspiration/interest/creativity
- **Resources:** Lacking time and finances developing and maintaining an EER; unsustainable use of props; time invested in supervision of the games; technical problems with electronic devices

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 ERs 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 (for ER 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 experience, 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.

2.8. Recommendations
FOR EER RESEARCH AND PRACTICE

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 EER 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.

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