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Escape room as a teaching method

Introduction

It is essential to recognize how students can be better connected to the classroom and make the curriculum and learning more attractive. In order to attract and maintain students' attention, increase motivation and make learning easier, teachers are constantly experimenting with new strategies and teaching methods (Kurian & Ross, 2021).

The European Higher Education Area (EHEA)[1] supports the use of active learning teaching methods that complement traditional methods and respond to the new socio-educational context (Magro et al., 2019).

The active learning methodology is one of the most exciting approaches to facilitating the involvement of learners in their learning processes (Grande-de-Prado et al., 2021). According to Piaget and Vygotsky, the role of play in cognitive development is emphasized. The game allows strategies, norms, and values to be incorporated into the process of personality formation (DeVries, 2000). Among the advantages offered by games, it is worth highlighting their didactic potential, which ranges from adapting to different learning styles, allowing mistakes, providing instant feedback, and developing creativity to increase the motivation and socialization of students. Disadvantages include the risk of possible excessive competitiveness and inadequate time management, which should be considered along with other specific aspects of each game (Cadavid & Corcho, 2018). This approach, as opposed to traditional education, opens the door to new concepts such as integrating curriculum into the game-based frameworks.

The games are highly inspiring, use different methods to engage the individual, and offer opportunities for fun and competition (Dicheva et al., 2015). This innovative play method reduces the risk of dropout or low achievement (Ahmed, 2013). In addition, the application of play in the educational environment increases motivation and engagement and facilitates learning while developing collaborative and communication skills (Borrego et al., 2017; Cain, 2019; Clapson et al., 2020; Edwards et al., 2019).

Learning through play

In the 21st century, the concept of games has become very important due to the explosive development of technology, thanks to the digital revolution (Clarke et al., 2017). The use of games as a pedagogical method has gained momentum recently (Vlachopoulos & Makri, 2017). From an educational perspective, three important concepts are related to games: serious games, gamification, and game-based learning. True, the concepts are related to each other, but they still have different characteristics.

In fact, serious games are designed for development, not for playful purposes. The concept first appeared in 1970 thanks to American researcher Clark C. Abt. He calls serious games an approach or simulation based on a real situation that develops into a game with an educational purpose (Abt, 1970).

Gamification consists of using the elements and mechanics of the game in a non-game context (Bruder, 2014). Gamification became popular in education in the early 2010s (Kapp, 2012). It uses game-based mechanics, aesthetics, game and strategic thinking to engage participants, stimulate action, facilitate learning, and solve problems, implicitly focusing on its core strengths: engaging students, enhancing

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[1] The European Higher Education Area was launched in March 2010 as part of the Budapest-Vienna Ministerial Conference on the 10th anniversary of the Bologna Process. The European Higher Education Area is an association founded under the auspices of the Bologna Process, a European initiative whose members work together to renew higher education and facilitate the mobility of job-seekers and teachers in higher education. (European Higher Education Area and Bologna Process).

and improving learning, and motivating commitment (Makri et al., 2021). From an educational point of view, escape rooms are closely related to gamification methodology (Makri et al., 2021).

It is important to understand the differences between gamification and game-based learning. The main difference is that gamification adds a game component to the learning experience, while game-based learning involves the use of games in an educational context to achieve learning goals (Kapp, 2012; O'Brien & Pitera, 2019). Game-based learning aims to improve the quality of the learning process through interaction in a motivational environment (Cordova & Lepper, 1996).

By the way these methodologies, students are motivated to learn and master the curriculum while not even realizing they are learning. This approach makes learning playful, connects participants, and stimulates their curiosity in the educational environment (Looking at Learning Project, 2015). On the other hand, students can become key actors in their own learning process and interact with the available curriculum, because the presentation of new knowledge in the use of educational games differs from classical approaches.

The escape room is based on gamification and game-based learning. During this collaborative game, the task of the participants is to find different clues, solve puzzles, and complete various tasks within a limited time. The goal is usually to leave the room or find an object (Nicholson, 2015). Games developed for educational purposes are usually called educational escape room (game) or escape room (game) for educational purposes. The main theories of learning behind this method include active learning, which can be defined as "any instructional method that engages students in the learning process" (Prince, 2004: 1). One of the most representative characteristics of active learning is that students perform meaningful learning activities while thinking about the actions performed.

Educational escape room

In recent years, commercial escape rooms have inspired teachers worldwide to use this fun activity for educational purposes (Veldkamp et al., 2020a). Escape room games are problem-based, limited playing time, and require active and cooperative participants. The first generation of escape rooms focused on tricky logical puzzles, which have now evolved into attractive environments with high-quality props and effects (Wiemker et al., 2015).

The escape rooms appeared in the educational area in 2017 and drew the attention of educators (López-Pernas et al., 2021). Since then, escape rooms have been used in various educational settings, and the game has emerged at all levels of education. In addition, the possibility of providing learning activities has attracted the attention of many researchers, as evidenced by the exponential growth in the number of studies in recent years (Fotaris & Mastoras, 2019). Although rooms have been developed for educational purposes as a relatively new concept, their educational potential has been explored by several authors (Adams et al., 2018; Ang et al., 2020; Borrego et al., 2017; Clarke et al., 2017; Duggins, 2019).

Unlike commercial escape rooms puzzles in educational rooms need to be aligned with the curriculum, and students need subject knowledge and a range of soft skills to achieve planned learning goals (Cain, 2019; López-Pernas et al., 2019b). Therefore, the primary criteria for designing escape rooms for educational purposes include reconciling learning objectives and puzzles.

The educational escape room is a new game-based learning approach that combines team-based problem solving with a narrative and mysterious clues. In the game, all problem situations and challenges are called puzzles that ensure the activity of the participants (Nicholson, 2012). There are different categories of puzzles: (1) cognitive, (2) physical, and (3) meta-puzzles. Predominantly present logical, analytical and mathematical games in rooms requiring problem-solving and logical thinking. (Wiemker et al., 2015).

This game has proven to be an innovative pedagogical tool that increases learning efficiency. Educational escape rooms are perfect examples of active learning because students have to interact

with various elements and figure out how to solve different puzzles. The game's appeal lies in stimulating the players' minds and the variety of puzzles (Zaug et al., 2021). Escape rooms can transform any curriculum into an attractive learning environment (Neumann et al., 2020). One of its main advantages is to increase student engagement and motivation (Berthod et al., 2020; Grande-de-Prado et al., 2021; Kinio et al., 2019; Walsh & Spence, 2018). The puzzles test students' knowledge of the curriculum and actively develop their skills. In particular, by participating in the educational escape room, students strengthen their problem-solving skills by observing, identifying relationships and logical contexts while solving problems creatively (Huang et al., 2020).

Competences that can be developed through the game include developing problem-solving skills, encouraging collaborative work, learning to think, motivating and learning to learn, improving learning, developing imagination, fostering social interaction and communication, critical and lateral thinking, developing leadership behavior, etc. (e.g., Cruz, 2019; Friedrich et al., 2019; Karageorgiou et al., 2019). Furthermore, compared to other teaching and learning methods, the fact that students work together can be emphasized, making it possible to strengthen group cohesion. In addition, it provides an opportunity to simulate different lifelike situations (Brooks-Buza et al., 2011).

The majority of studies on educational escape rooms focus on teaching educational topics (Adams et al., 2018; Dietrich, 2018; Glavaš & Staščik, 2017; Jambhekar et al., 2020; López-Pernas et al., 2019a). However, it is possible to develop technical (complex) and social (soft) skills simultaneously. For example, some games focus on developing soft skills, such as team building and group leadership (Gordon et al., 2019a; Wu et al., 2018). However, it is impossible to draw a clear line between a game created solely for developing interpersonal skills and a game that serves to teach subject knowledge. In summary, escape room games are suitable for the development of both: cognitive and social competencies.

Game methodology and design

Before developing a game, several aspects need to be considered: the target group, the length of time spent on the game, the equipment required, and the educational and competency development goals of the game (Clarke et al., 2017).

Designing escape games requires a thoughtful, well-defined process. There is very scarce literature about the methodological implementation of the game. Teachers must be helped with guidelines to apply a thoughtful, methodical, iterative process to ensure quality, educational capacity, and a positive learning experience (Eukel & Morrell, 2021). The game is designed through an iterative process. This process is through different approaches conducted by designers, researchers, and educators. There are theoretical frameworks for design and construction in the literature, some of which are specifically designed to meet educational goals: escapED (Clarke et al., 2017); SERF (Snyder, 2018); SEGAM (Guigon et al., 2018); StarModel (Botturi & Babazadeh, 2020). Each model contains steps for planning, experimenting, evaluating, redesigning, re-evaluating, and repeating the steps listed.

When designing escape rooms, teachers should consider educational goals, available resources, and the aims of the game. All puzzles must be carefully designed to meet the needs of education, teachers, and students.

In addition to teaching the curriculum, outcomes should also be considered, including developing a range of social skills. Systematic, flexible, and cyclical design can help make learning more effective, as the game is subject to constant change.

Four categories have been identified for the resources required to design and implement an escape room for Educational purposes: physical resources, equipment, time, and money (Tercanli et al., 2021).

As our research has shown, a lack of physical resources can lead to several problems. Most educational escape room games consist of two separate rooms. While one room is set up as an actual educational escape room for players, game designers, moderators, and observers to watch participants from a

separate control room, which is mainly done via live video through a video camera (Berthod et al., 2020; Clarke et al., 2017). In addition, they can use microphones and speakers or computer chat windows to remotely give tips to participants if they encounter difficulties during the game (Clare, 2015). Most educational escape rooms are self-funded by educators, so the games contain simple puzzles and decorations.

In many cases, existing educational materials are used to design the rooms (Eukel et al., 2020; Nicholson, 2018). There are many templates on the World Wide Web, such as the BreakoutEDU sets. The time required for development depends on the complexity of the game. It can be a time interval from one day to several weeks, and sometimes it takes several months (Clare, 2015).

**Theoretical framework – SmarTeacheRoom**

Several theoretical frameworks for designing escape rooms for educational purposes have been published that include step-by-step procedures for building a game (Clarke et al., 2017; Guigon et al., 2018; Snider, 2018). Frameworks provide guidelines for the design of physical rooms. However, some teachers prefer to develop more cost-effective, affordable, and accessible digital escape rooms, as several available digital tools can be used to create educational games in a hybrid or online environment (Kroski, 2020).

Based on theoretical frameworks describing the structure of existing escape rooms, we have developed our integrated model combining and complementing the different approaches.

We needed to create a model showing that problem-solving activities cannot always be accomplished without using social skills. Some activities move the group forward in the collaborative problem-solving process, which does not require the cognitive skills to solve them. In the model, the emphasis is on the directly observable activities since our observations are always related to the elements of behavior. Therefore, we can only assume the abilities and processes behind the activities.

The framework helps to find a way to structure and evaluate escape rooms for educational purposes, as well as direct observation of problem-solving groups to find out how individuals solve problems and how they work with their group peers. Incorporating elements such as objectives, participants, context, and evaluation allows for solving tasks as a game in an educational environment.

Figure 1: Theoretical framework (SmarTeacheRoom - STR)
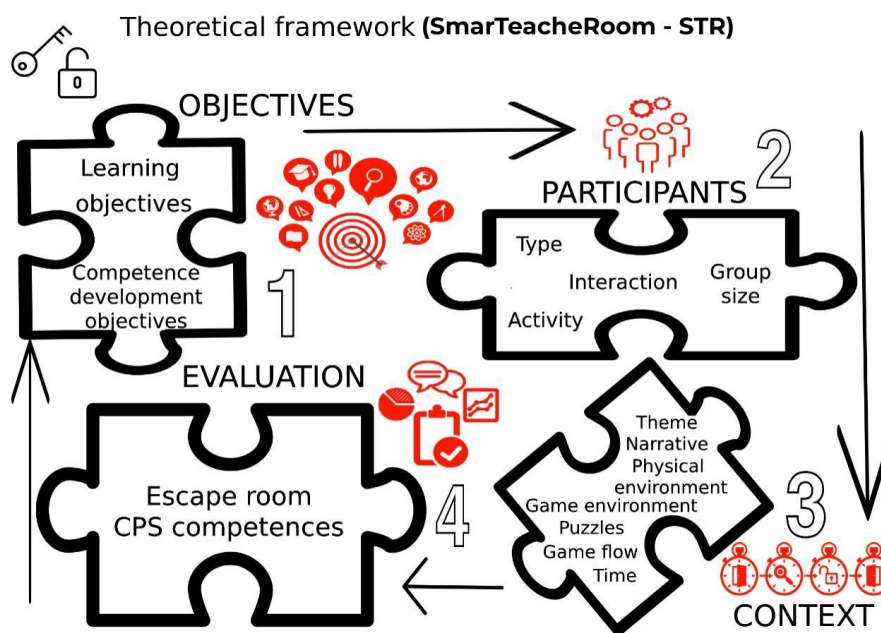
(source: Own elaboration)

Learning and competence development objectives are needed to create a meaningful educational game. Based on the model, it is advisable to start designing an escape room for educational purposes by defining aims. Developing goals at an early stage of the planning process ensures that the gaming experience is purposefully planned. Aligning other items with objectives is much easier than embedding objectives in an already planned game. The objectives of the game designer help to select the right participants, as well as to understand the structure and construction process. This step provides a basis on which the direction of development becomes clear and facilitates the subsequent development of the evaluation strategy (Snider, 2018).

As a second step, the designer should consider the participants and analyze who the target audience is. The target audience for the gaming experience must be selected before other content can be developed. Participants, often students, have different characteristics (demographic aspects, subject, and content aspects, attitudes towards play and learning, etc.).

The third step is for the designers to consider the general theme of the escape room. The context itself can increase the participants' motivation, and the game's narrative and content can provide an engaging gaming experience for the participants. The context gives meaning to the activity. Escape rooms usually have solid themes and narratives. Popular topics include investigation, escape from prison, hostage rescue, spyware games, and more. To increase the gaming experience's authenticity, designers use various decorations. A wide range of these props includes lighting, music, puzzles, riddles, and clues that follow the theme of the room. Finally, the designer should consider the space and equipment he will use to support the gaming experience. If e.g., the game design should be supported by technology, this step can help consider how participants will interact with technology and the steps to be taken if technology does not work as planned. The context is divided into seven areas the designer must consider during the design process.

The last point in the theoretical framework is evaluation. The designer must consider how to evaluate the gaming experience and the acquired knowledge, which is closely related to the first step of design: objectives. Here, methods for assessing desired goals and results come to the fore. Evaluation is a critical element of development. The overall efficiency of knowledge transfer in the escape room will be assessed, and the data collected by the evaluation may be helpful to improve the gaming experience further. It is possible to assess whether the escape room meets the objectives, which aspects contribute to or degrade the gaming experience, and how confusing elements could be corrected. In this step, we separate the evaluation of the escape room itself and the competencies we want to assess.

The role of the teacher

In most educational escape rooms, teachers take over the roles of game designers, moderators, and observers (Berthod et al., 2020; Cain, 2019; Eukel et al., 2020). It is a great advantage if the teacher has previous experience in game development. A great advantage is the knowledge of design methods, creativity and entrepreneurial mindset, good time management, and flexibility. In addition, writing skills and knowledge of subject knowledge are essential. The teacher spends most of his time designing and planning the game.

Creating an educational escape room online platform to share and disseminate the tool and methodologies is critical. Such a platform could include blueprints, design schemes, and reproducible educational escape room modules. In addition, manuals and tutorials are needed to guide the teacher on how to modify and integrate this method into their courses. Such a platform could bring together teachers and escape room fans as a network node, creating new synergies and collaborations (Tercanli et al., 2021).

Learning outcomes

In recent years, escape rooms for educational purposes have become an increasingly popular educational tool, with the ultimate goal of engaging students in the learning environment, encouraging collaboration, and practicing and developing 21st-century soft skills (Kinio et al., 2019). By using these tools for educational purposes, students move from passive knowledge recipients to active participants in the learning process. In an educational context, a problem-solving game that can simulate the real world provides an opportunity to practice different situations. Therefore, the criterion for a well-structured game is to ensure active participation.

The characteristics of many learning theories can be discovered during certain activities of the escape room game. Elements of constructionism and behaviorism are also recognizable (Ouariachi & Wim, 2020). Social constructivism is manifested in cooperation and constructive knowledge based on real-time experience (Zhang et al., 2018). This theory emphasizes the influence of those social circumstances that frame the social interactions between participants. Behaviorism is evident in the elements that reward positive behavior (Ouariachi & Wim, 2020; Zhang et al., 2018).

The student learning cycle follows specific characteristics during the activity (see Figure 2).

Figure 2: Student learning cycle in the escape room
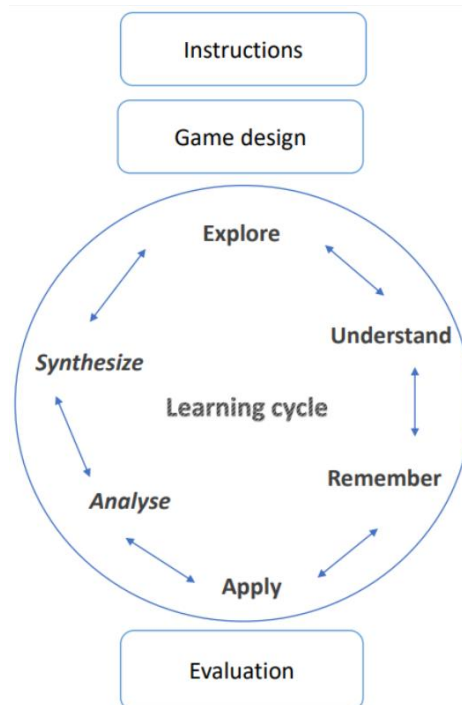
Source: Reuter et al. (2020)

In the beginning, participants explore the tools available for the activity. Then they discover some clues and begin to understand the course of the game and the steps needed to solve the puzzle. Students need to remember certain contents and apply them in the game through attempts until they find a solution. In this process, participants need the ability to collaborate, communicate, and think critically to respond to challenges (Wiemker et al., 2015). Escape rooms are team-based activities and are great for active learning due to the pressure of the time frame and the number of puzzles that require a variety of mindsets (Menon, 2019).

Participants should have a range of skills to help them face challenges, such as good observation of details, clues to solving puzzles, logical thinking, memorizing a series of numbers or symbols, and good math skills, including solving anagrams and cryptograms. Successful teams work together, communicate and delegate challenges well, and analyze and synthesize possible solutions (Giang et al., 2020). A great feature of escape rooms is that they are suitable for all ages and are gender-

independent - in fact, teams composed of players with different backgrounds, abilities, and knowledge are the most successful (Gordon et al., 2019).

Creating an optimal flow is essential during the game. When experiencing the flow, participants are fully involved in the task and focus exclusively on it. If the challenge is too difficult, players become anxious and may become unmotivated to continue playing, while a too easy challenge leads to boredom (Wiemker et al., 2015). So, if the escape room is well designed, follows every step of the organization and creation accurately, and takes into account the needs of the students, the activity is more likely to get the students to the desired state of flow and the planned level of knowledge.

Research

Our educational escape room game is designed to observe and measure collaborative problem-solving competencies. The game covers a wide range of escape room puzzles. Our target group was students of pedagogical practice. The sample consisted of students from:
- J. Selye University (Faculty of Education), Komarno, Slovakia;
- the Faculty of Economic and Social Sciences (BME), (Department of Technical Pedagogy), Budapest, Hungary;
- And UNS - University of Novi Sad Hungarian Language Teacher Training Faculty (Faculty of Teacher Education), Subotica, Serbia.

The sample consists of 101 students who participated in the research. The groups consisted of 3 to 5 participants. The progress of the game was monitored using a camera. The game was followed by focus group interviews and the completion of four questionnaires and a test:
- Scrambled Adaptive Matrices (SAM) (Fodor et al., 2018);
- Big Five (Caprara et al., 1993);
- Teamwork Skills Questionnaire (Marshall et al., 2005);
- Tóth-féle Kreativitás Becslő Skála (TKBS) (Tóth & Király, 2006);
- and background questionnaire.

Data collection began in September 2021 and ended in mid-December. The final results of the research are expected by the summer of 2022.

Conclusion

Escape rooms have become one of the most significant leisure activities in the last few years (Lama, 2018). The advantages discovered in various studies of escape rooms are collaborative work, social competence, problem-solving, and motivation. In addition, existing experience and research results also support that the escape room for educational purposes can be a tool for any teaching area, as it is easy to apply, student-centered, and promotes research thinking, logical and critical thinking (Aubeux et al., 2020; Eukel et al., 2020).

Educational play provides a challenging activity for education that, in a well-designed way, can be very appealing to both students and teachers, promoting active and meaningful learning. With the right expertise and experience, teachers can cope with the challenges of escape rooms that maintain the flow between challenges and required skills, incorporating this activity into the curriculum and adapting it to organizational issues such as spaces, resources, schedules, and groups. True, there are several limitations that a teacher may face, such as limited resources. However, on the other hand, the benefits can enrich educational activities by facilitating the development of social relations and students' active involvement in the curriculum. Platforms like Breakout EDU or Genially can be very helpful in designing, as well as providing a variety of digital templates. Planning can be supported by one of the frameworks mentioned in the study, which can be a handy guide in different learning/teaching contexts.

In game-based learning, play is at the heart of the learning process. The acquisition of new knowledge and the realization of learning goals takes place in a playful environment, which provides additional motivation for students through the possibility of fun and competition. Moving beyond commercial use to education, the escape room is gaining importance in traditional and digital forms as a game-based learning tool.

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