

# Digital Educational Escape Rooms for Social Entrepreneurship: Identifying Design Choices for Educational Impact

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**Abstract:** Digital educational escape rooms (DEERs) can provide an engaging gamified learning experience for students that is easy to use and sustainable for teachers. Though well-established in the STEM fields, where escape rooms often call for students to apply procedural skills, escape rooms are also used across a range of subjects to impact durable skills and attitudes such as communication, collaboration, and critical thinking. This paper seeks to extend the application of DEERs into social entrepreneurship (SE) education by exploring the DEER design elements relevant to the SE field. This paper will focus on developing durable skills and attitudes associated with social entrepreneurship, an area of entrepreneurship that seeks to create businesses with positive social impact. To identify the relevant design elements in DEERs, we conducted a systematic literature review. The research question was "Which design elements of digital educational escape rooms are necessary to teach social entrepreneurship skills and competencies?" This current paper builds on this type of framework by highlighting the relationship between the components of a DEER and learning objectives, specifically those relevant to a social entrepreneur's educational context. For example, almost all papers reported successful collaboration in online groups. The authors also found that specific puzzle types were less important than the gamified context on impact on learning and skill development. Thus, the authors contribute to our understanding of how DEERs can relate to SE specific learning objectives, skills, and attitudes.

**Keywords:** Digital educational escape room, Social entrepreneurship, Teaching competencies, DEER design elements, Technology in education, Gamification

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## 1. Introduction

The use of escape rooms as a student-centered pedagogical tool has been increasing in higher education since their inception in 2007. Escape rooms are team-based games in which players solve various challenges within a time limit. Escape rooms become educational escape rooms when they incorporate content learning objectives into the challenges and other elements of the escape room, such as into the narrative, puzzles, and hints. A recent review of escape rooms in higher education by Veldkamp et al (2020) found that in relation to teaching and learning goals, the use of an escape room had a positive impact on implementing active learning, increasing motivation and/or engagement, increasing content knowledge, and developing teamwork and communication. As educational escape rooms grow in popularity, so too does the use of digital educational escape rooms (DEERs) as a cheaper and less time-intensive investment for teachers (Makri, Vlachopoulos, & Martina, 2021). Thus, DEERs can provide an engaging gamified learning experience for students that is easy to use and sustainable for teachers.

This research focuses on this digital subset of educational escape rooms and further zooms in on their use in the field of entrepreneurship education. Making social impact and responsibly addressing grand societal challenges is important in today's world and there is a growing movement in higher educational institutions to foster the growth of social entrepreneurial skills in students (Miller, Wesley, & Williams, 2012). Escape rooms have a positive impact on the learning goals and competencies that are necessary for developing the skills to create social impact. However, to date there has been little focus on escape rooms and digital escape rooms in entrepreneurship education. A few related studies have looked at EERs to teach value creation (Maaravi et al, 2020) and social entrepreneurship (Brinia et al, 2020). In addition, Martina & Göksen (2020) reported a positive impact of EERs on the development of soft skills in entrepreneurship students. However, there is not yet sufficient insight into the educational learning theories and game-based learning to push the future development of the sub-discipline. This paper addresses that gap by looking at the impact of digital educational escape rooms on skills, specifically social entrepreneurial (SE) skills. This review will focus on the following social entrepreneurial skills: ability to problem solve; interpersonal communication skills; innovativeness and creativity; confidence to succeed at challenging task; and empathy. These are in line with the 35 social entrepreneurship competencies listed by Miller, Wesley, & Williams (2012) and feature among the top ten competencies as rated by SE practitioners in the same report.

Research Question:

Given the gap in research on DEERs in social entrepreneurship education, we asked the question “Which design elements are necessary to teach social entrepreneurship skills and competencies through DEERs?”

We conducted a systematic literature review to link DEER design elements to social entrepreneurship skills and competencies. This research contributes to our understanding of game-based learning and DEER design elements and their impact on entrepreneurial skill development.

2. Methods

To create the framework, we conducted a systematic literature review using the following databases: ERIC, Web of Science, and Scopus. These databases provide extensive access to journals in the social science fields, and in particular, the field of education. Search terms included the following terms digital, online, and virtual escape rooms, escape games, breakout boxes, puzzle rooms, exit games, gaming rooms, adventure rooms + education. Publications were then screened to exclude physical escape rooms, systematic literature reviews that only partly dealt with digital educational escape rooms, and contexts other than higher education. Publications that only designed as opposed to carrying out digital escape rooms were also cut. Publications were limited to English language peer-reviewed journal articles published between January 2019 and February 2023.

The authors then analysed the theoretical underpinning, design elements, and learning objectives of 38 papers on digital educational escape rooms.

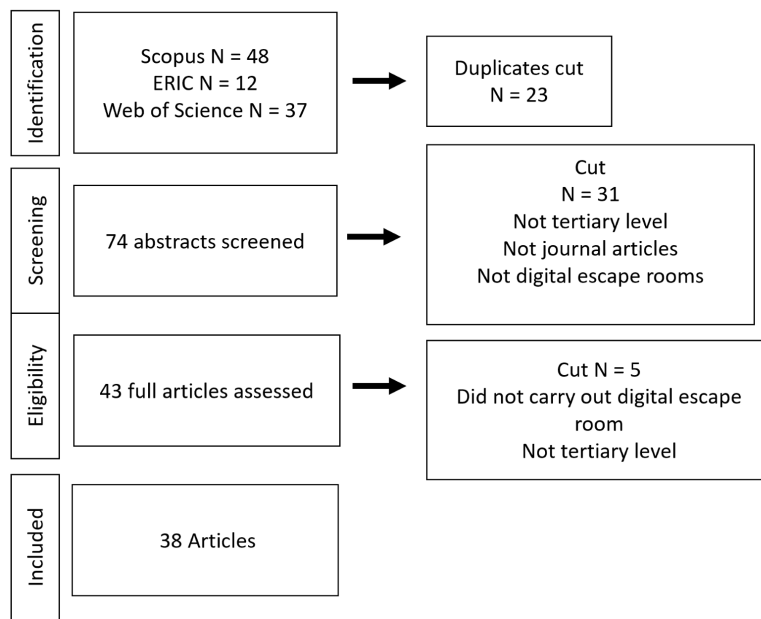


Figure 1: Article Selection Process

3. Data Analysis

The articles that were reviewed reported a mix of qualitative and quantitative data and reflected a variety of focal points. We used in vivo coding to categorize the data and find trends. The coding procedure is based on Miles & Huberman (2014) and the categories are below in Table 1.

Table 1: Coding Categories

| Descriptive Analysis |                                      |
|----------------------|--------------------------------------|
| Subject area         | Content area or field                |
| Region               | Global region for context            |
| Study Type           | Qualitative, quantitative, or mixed  |
| Impact               | Skill, Knowledge, Behavior, Attitude |

| Thematic Analysis  |  |
|--------------------|--|
| Learning Theories  | What theories of learning were reported as a foundation for decisions around the use of DEERs?   |
| Design Theories    | Which theories informed the design choices in the creating of the DEER?                          |
| Skills             | What skills were educators trying to impact?   |
| Impact measured    | What skills and learning objectives were measured?   |
| Impact reported    | What skills and learning objectives were reported as impacted by the DEER learning experience?   |
| Research questions | What topics and themes are important to the DEER community?                                      |
| Design elements    | What elements of the DEER were reported? Which design choices are important for effective DEERs? |

## 4. Results

### 4.1 Descriptive Analysis

Digital educational escape rooms offer a versatile and less-resource intense gamified learning experience than physical educational escape rooms. DEERs are re-usable and once created, are quick to set up and carry out (Hursman et al, 2022; Smith & Davis, 2021). In addition, there are fewer space obligations as students can participate via online mobile devices. The various Covid-related lockdowns in 2020-2021 have played an important role in familiarizing teachers and students with the online environment, also leading to teachers experimenting with DEERs as a way to engage students not physically present in the classroom (Vestal, Matthias, & Thompson, 2021; Cates et al, 2020). 26% of the articles reviewed were published in 2019 and 2020. Twenty-seven (71%) of the articles reviewed were published in 2021 and 2022. 47% of the articles were from US institutions, 45% were from European institutions, and the remaining 8% were from institutions in Asia and the Middle East. See Tables 2 and 3 below.

**Table 2: Year of Publication**

| Year | Number of Articles | Percentage of Articles |
|------|--------------------|------------------------|
| 2019 | 1                  | 2%                     |
| 2020 | 9                  | 24%                    |
| 2021 | 7                  | 18%                    |
| 2022 | 20                 | 53%                    |
| 2023 | 1                  | 2%                     |

**Table 3: Region of Publication**

| Region        | Number of Articles | Percentage of Articles |
|---------------|--------------------|------------------------|
| North America | 18                 | 47%                    |
| Europe        | 17                 | 45%                    |
| Asia          | 2                  | 5%                     |
| Middle East   | 1                  | 2%                     |

### 4.2 Thematic Analysis

#### 4.2.1 State of the field

The literature in the current review reveals that there is a wide range of DEER-related topics being addressed by higher educational institutions. The varied list of topics and their key themes highlight the diversity of questions that remain in the field. For example, five (13%) studies directly measured and reported gains in subject-specific learning outcomes, such as copyright and media law (Buchner, Ruter, & Keres, 2022), tobacco cessation treatment (Barrickman et al, 2022), balancing chemical formulas (Cai, 2022), calculus (Magrenan et al, 2022), and infectious disease (Dimeo et al, 2022). Eight (21%) studies sought to observe the impact of

DEERs on motivation, engagement, or interest, such as Bellés-Calvera & Martínez-Hernández (2022) who found that language students participating were motivated to communicate in the target language and Sanchez-Ruiz et al (2022) who showed that motivation was one of the most prevalent positive emotions reported by students playing a DEER. One article (2%) focused on specific design elements. Neumann, Alvarado-Albertorio, and Ramírez-Salgado (2020), found that asynchronous DEERs were comparable to physical EERs. Table 4 below provides an overview of the different focus points of the articles.

**Table 4: Topics from Research Questions**

| <b>Relevant Topics from Research Questions</b>                                     |                                      |  |
|--|--------------------------------------|--|
| Question   | Number of Articles if greater than 1 | Percentage of Articles if greater than 1 |
| <b>Design</b>  |                                      |  |
| What are necessary design elements?  | 2                                    | 5%                                       |
| Does digital format work for escape rooms?   |                                      |  |
| Are asynchronous DEERs effective?  |                                      |  |
| Is instruction first necessary for an effective DEER experience?                   |                                      |  |
| Is there a difference in perception of DEERs based on gender?                      |                                      |  |
| <b>Impact on Behavior or Attitude</b>  |                                      |  |
| What is the effect on students' emotions such as stress or motivation or interest? | 8                                    | 21%                                      |
| Is a DEER a generally positive learning experience?                                | 10                                   | 26%                                      |
| <b>Learning Theory</b>   |                                      |  |
| Does productive failure play a role impact the efficacy of DEERs?                  |                                      |  |

4.2.2 *Subject matter and learning objectives*

In 2020, Hajar et al found in a state-of-the-art review that the majority of literature in the field of educational escape rooms came from the healthcare field. According to the current review, the use of DEERs in healthcare field is in line with those trends, with fifteen (39%) of the articles based on games within healthcare-related courses. Science and engineering were represented with nine (24%) articles, teacher training programs with four articles (10%), and language, history, and law with one article each (5%). Three (8%) studies failed to mention the content area. In addition to this range of content areas and content-area objectives, the majority (92%) of articles also reported behavioral or skill-related objectives such as increased motivation, collaboration skills, or critical thinking skills. For example, Barrickman et al. (2022) and Hursman (2022) reported a positive impact on communication in the context of interprofessional teamwork in clinical settings where healthcare professionals from different disciplines collaborate. For a full list of reported objective types, see Table 5 below.

**Table 5: Objective Type**

| <b>Objective</b>                           | <b>Number of Articles</b> | <b>Percentage of Articles</b> |
|--|---------------------------|-------------------------------|
| <b>Skill-related Objective</b>             |                           |                               |
| Critical Thinking and Analysis             | 9                         | 23%                           |
| Collaboration and collaborative teamwork   | 10                        | 26%                           |
| Communication*                             | 8                         | 21%                           |
| Problem solving and group problem solving* | 6                         |                               |

| Objective                              | Number of Articles | Percentage of Articles |
|--|--------------------|------------------------|
| Teamwork                               | 5                  | 13%                    |
| Creativity and Innovation*             | 2                  | 5%                     |
| Decision making and clinical judgement | 4                  | 10%                    |
| Behavior-related Objective             |                    |                        |
| Motivation and Engagement              | 7                  | 18%                    |
| Confidence*                            | 4                  | 10%                    |
| Autonomy                               | 1                  | 2%                     |

\*Objectives identified in SE education

#### 4.2.3 Theories for game design

Fifteen (39%) articles did not report the application of a game-design theory to inform choices around game design. Within the context of designing puzzles or the DEER, nine (24%) articles mentioned the idea of gamification writ-large referring to the need make sure the DEER creates a game-like learning experience. However, no specific DEER design elements were connected to gamification. In one exception, Rodriguez-Ferrer et al (2022) applies the Mechanics, Dynamics, and Aesthetics model for game design to link content and skills with the mechanics and dynamics of the puzzles and to link aesthetics with narrative and immersion. Rodriguez-Ferrer et al concludes that each of these three components must have a connection to the learning objectives to be impactful. Six (16%) studies mentioned specific theories that informed the process of designing DEERs, such as the EscapEd framework for physical ERs (Clarke et al, 2017), Jenkins’ (2004) Narrative Architecture, and the design cycle of Frederik and Sonneveld (2007).

#### 4.2.4 Pedagogical theory

Fifteen (39%) articles did not include references to pedagogical theory to inform choices around including a DEER as a learning activity. Nine (24%) articles referred to gamification as a justification for the use of a digital escape room in an educational context and as a model for increased learning. These papers generally referred to the impact of gamification on knowledge retention and engagement. Other papers present gamification as a subset of active learning which is defined by Prince (2004) as learning that happens while students are engaged in activities. For example, Sanchez-Ruiz et al (2022) explicitly states that DEERs are a form of gamification and active learning that effectively creates a positive learning experience with increased learning. In addition to gamification as an approach to teaching and learning, Vestal et al (2021) highlighted constructivist theory and adult-learning theory as a framework for the application of a DEER. Constructivist theory emphasizes that learning happens when individuals create meaning through thinking and doing, for example through problem-solving (Bada & Olusegun, 2015). Adult-learning theory focuses on motivation for learning when individuals are engaged in problem-centered relevant activities (Merriam, 2008). Closely related to this is problem-based learning, applied by Gomez (2020) in which student teachers played and then created a DEER to meet learning objectives around problem-based and student-centered learning. Similarly, Heim, Duke & Holt (2022) referred to design-based learning in their report of engaging students in an ecology course in the creation of their own DEERs as a way of meeting content learning objectives. A last example is Ross and Hall (2021), who used DEERs as a stand in for simulation-based learning when face-to-face learning was not possible. In lieu of students practicing clinical work in a lab with mannequins, DEERs were found to meet the same application goals and to build student confidence.

In addition to pedagogical models and approaches, some specific theories of learning were also found. Dimeo et al (2022) applied self-determination theory to justify the DEER’s impact on motivation. Rodriguez-Ferrer et al (2022) links the immersiveness of the DEER to its impact on learning via the flow theory. This theory refers to a state of flow, or intense focus, attained during gameplay in which information processing, and thus learning, is taking place. Finally, building on ideas around productive failure versus the limits of the cognitive load, Buchner, Ruter, & Kerres (2022) asked whether DEERs were more effective before or after explicit instruction. Productive failure is closely tied to problem-based learning and learning by doing and posits that deeper learning takes place through exploring a problem and potential solutions. The cognitive load theory, on the other hand, takes into account the limitations of working memory, with the implication for instructional design being that the working memory limits attention and what students are asked to do in an escape room

should take this limit into account. For example, instructions and game play should be clear enough that they do not impede the student’s cognitive load and that their attention and working memory is focused on content-related questions so that they can process new information effectively. Buchner, Ruter, & Kerres (2022) concludes that instruction first leads to higher levels of knowledge acquisition and retention.

4.2.5 Emotions

Prieto et al (2021) explored the impact on the affective domain with pre- and post-tests before and after playing a DEER. Both positive emotions, such as satisfaction and happiness, and negative emotions, such as worry and frustration, were stimulated in players. However, there is no link to the specific game elements or impact on learning.

4.2.6 Puzzle types

The puzzle types shown in Table 6 is not exhaustive but highlights the wide variety of puzzle types applicable in digital educational escape rooms. Puzzle types were inconsistently listed throughout the literature and were never the focus of research questions. Therefore, the relation of specific puzzle types to impact on behavior or knowledge remains an area for further research. The fact that no papers specifically examined specific puzzle type in relation to behavior or knowledge suggests that the general consensus that DEERs can positively impact behavior or learning is not the result of the puzzle or question type, but a product of the gamified learning environment.

**Table 6: Puzzle Type**

| Puzzle Type  | Content Area        | Conclusion   |
|--|---------------------|--|
| Single- or multiple-choice, drag-and-drop tasks                                  | Copyright media law | Increased knowledge  |
| Crossword, decode letter/numbers   | Chemistry           | Increased participation and motivation   |
| Math questions, jigsaw puzzles   | Nursing             | Collaborative teamwork, critical thinking, knowledge-based retentions, self-confidence |
| Hidden object puzzles, code-breaking puzzles, logic puzzles                      | Engineering         | Critical thinking, problem-solving, collaboration, teamwork, increased knowledge       |
| Crossword puzzles, unscramble words, decipher codes                              | Nursing             | Increased knowledge, engagement, confidence, critical thinking, decision-making        |
| geographical maze; anagrams, fill-in-the-blank, multiple-choice, or short answer | Nursing             | Engagement, increased knowledge  |
| MS and short answer questions, find hidden code                                  | Nursing             | Collaboration, engagement  |
| Sorting, ordering, math, cipher, fill in blank                                   | Nursing             | Communication, teamwork  |

**4.3 Towards a Framework for DEERs in SE**

This paper sought to find DEER elements that focus on developing skills and competencies associated with social entrepreneurship, an area of entrepreneurship that seeks to create businesses with positive social impact. In line with research reporting on physical educational escape rooms (Tercanli et al, 2021; Veldkamp et al, 2020), reports in the field of digital educational escape rooms from 2019 – 2022 show the positive impact of DEERs on behavior and learning. However, research in this literature review fails to highlight specific elements of DEERs that play a role in developing targeted behaviors or skills. Furthermore, studies often reported similar impact on knowledge and skills despite varied choices in puzzle type, layout, and interaction capabilities. For example, Pozo-Sanchez, Lampropoulos & López-Belmonte (2022) measured the impact of physical and digital education escape rooms on different factors, finding that both positively impacted learning and engagement, while DEERs had slightly more impact on student’s feelings of autonomy, creativity, and exploration. This suggests that the general gamified environment has more impact on learning than particular puzzle types or other game elements. Dittman et al (2021) compared team-based DEERs carried out with individual collaborating remotely or with the individuals together in the same room and found that each construct led to positive learning experiences and fostered collaboration.

#### 4.3.1 *Gamification, teamwork, developing skills*

This literature review found no overwhelming evidence that decisions around the following DEER elements directly relates to the development of ability to problem solve; interpersonal communication skills; innovativeness and creativity; confidence to succeed at challenging task; and empathy: team size, play time, number of questions, puzzle type, or narrative type.

Turning our attention to the gamified environment and the role of social and active learning, research suggests that DEER design choices that optimize teamwork and collaboration may have the most impact on social entrepreneurship skill development. Anton-Solanas et al (2022) found positive impact on enjoyment and creative thinking and that teamwork, certain skills, and critical thinking were attained through participation in a DEER. They also found that participants with previous experience with commercial escape rooms rated the usefulness, impact on learning, and enjoyment significantly higher than those with no similar escape rooms experience. Lyman (2022) found increase satisfaction, self-confidence, and enjoyment in DEER participants and practitioners observed high rates of communication and collaboration. However, while all DEERs presented in the literature review except for one were team-based, the literature did not identify any other specific design choices for teamwork and collaboration.

### 5. Discussion

The top competencies in social entrepreneurship that this paper is interested in are the ability to problem solve; interpersonal communication skills; innovativeness and creativity; confidence to succeed at challenging task; and empathy. A growing number of research reports positive impacts on the ability to problem solve, communication skills, innovativeness and creativity, and confidence (see Table 4 above). Furthermore, it is clear that practitioners are increasingly using DEERs to impact these competencies.

In terms of which design elements result in the development of these competencies, the common thread is the gamified learning environment in which there is team-based collaboration. This is in line with constructivist theory and forms of problem-based or active learning. The literature does not yet show that specific narrative types, puzzle types, or other design elements specifically impact these competencies. In fact, positive results were found across DEERs with varying play design (synchronous vs asynchronous), narrative structure (imaginary vs real-life), play length, and types of puzzles (see Table 5 above).

### 6. Future Research and Limitations

There is a lack of a common reporting schema, resulting in a fragmented view of DEERs in practice. For example, in the literature reviewed not all authors report learning and design theories and not all authors report all elements of DEERs such as puzzle type, team size, or play time. Furthermore, not all competencies and skills are defined, leading to possible overlap of terms or fracturing of categories. For example, this paper combined critical thinking and analysis as one category, though some authors only reported on one and not the other. In addition, not all studies included pre- and post-tests and some results were based on small sample sizes and/or observation. Future research areas include the extent to which DEERs can build certain competencies, design elements with specific impact on learning outcomes, as well as understanding how to optimize collaboration in DEERs to best achieve goals around competencies. Exploration into neighbouring fields such as online learning and gaming may also provide insight into design elements for specific purposes.

### 7. Conclusions

In the past three years, there has been a significant uptick in the number of works published on DEERs. This literature review has provided an overview of the state of the field and the current important questions for the use of DEERs in higher education. DEERs are overwhelmingly found to have a positive impact on learning and on the learning environment, however, insight into specific and structured DEER design elements that is linked to impact remains limited. Research shows that DEERs are being used to impact skills and competencies that overlap with social entrepreneurial competencies, such as ability to problem solve, communication, and increased confidence. As such, there is a lot of potential for DEERs in social entrepreneurship education, though the need for a more nuanced understanding of the relationship between DEER design elements, a gamified environment, and the development of these skills remains.

### References

Ang, J. W. J., Ng, Y. N. A., and Liew, R. S. (2020) "Physical and digital educational escape room for teaching chemical bonding", *Journal of Chemical Education*, Vol 97, No. 9, pp 2849-2856.

- Antón-Solanas, I., Rodríguez-Roca, B., Urcola-Pardo, F., Anguas-Gracia, A., Satústegui-Dordá, P.J., Echániz-Serrano, E., and Subirón-Valera, A.B. (2022) "An evaluation of undergraduate student nurses' gameful experience, whilst playing a digital escape room as part of a FIRST year module: A cross-sectional study", *Nurse Education Today*, Vol 118, pp 1-8.
- Bada, S.O. and Olusegun, S. (2015) "Constructivism learning theory: A paradigm for teaching and learning", *Journal of Research & Method in Education*, Vol 5, No. 6 pp 66-70.
- Badr, A. F. (2022) "The Geriatric Virtual Escape Room in Pharmacy Education: Female Students Escape Significantly Faster than Male Students" *Pharmacy*, Vol 10, No. 2, p 36.
- Barrickman, A., Baugh, G., Purnell, K., Wiener, R.C., Funk, A., Whetsel, T., Momen, J., Summers, A.S., Morgan, S. and DeBiase, C. (2022) "Development and implementation of a virtual interprofessional escape room to reinforce tobacco cessation concepts", *Journal of Interprofessional Education & Practice*, Vol 27, p 100511.
- Bellés-Calvera, L. and Martínez-Hernández, A.I. (2022) "Slave away or get away: Escape rooms as a motivational tool for the CLIL history classroom in higher education", *Latin American Journal of Content & Language Integrated Learning*, Vol 15, No. 1, e1511.
- Brinia, V., Economou, G., Gialos, G., Panagiotopoulou, A.R., Spanidi, M. and Beloyianni, M. (2020) "An innovative approach to entrepreneurship in higher and secondary education: cultural routes and economy of experience-a case study", *International Journal of Education Economics and Development*, Vol 11, No. 3, pp 277-291.
- Buchner, J., Ruter, M., and Kerres, M. (2022) "Learning with a digital escape room game: before or after instruction?", *Research in Practice in Technology Enhanced Learning*, Vol 17, No. 1, p 10.
- Cai, S. (2022) "Harry Potter Themed Digital Escape Room for Addressing Misconceptions in Stoichiometry", *Journal of Chemical Education*, Vol 99, No. 7, pp 2747-2753.
- Cates, A. L., Krueger, J., Simpson, S., and Stobart-Gallagher, M. (2020) "Comparing the Effectiveness of a Virtual Toxicology Escape Room at Two Emergency Medicine Residencies", *Cureus*, Vol 12, No. 10.
- Clarke, S., Peel, D., Arnab, S., Morini, L. and Wood, O. (2017) "EscapED: A framework for creating educational escape rooms and interactive games to for higher/further education" *International Journal of Serious Games*, Vol 4, No. 3, pp 73-86.
- Dimeo, S.P., Astemborski, C., Smart, J. and Jones, E.L. (2022) "A virtual escape room versus lecture on infectious disease content: Effect on resident knowledge and motivation", *Western Journal of Emergency Medicine*, Vol 23, No. 1, p 9.
- Dittman, J.M., Maiden, K., Matulewicz, A.T., Beaird, G., Lockeman, K. and Dow, A. (2021) "A flexible customizable virtual escape room approach for interprofessional learners", *Journal of Interprofessional Education & Practice*, Vol 24, p 100455.
- Frederik, J.E. and Sonneveld, W. (2007) "Mysteries for sale: Stimulating activities to start teaching design skills", *Analyzing best practices in technology education*, pp 83-92.
- Gerber, A. and Fischetti, B. 2022, "The Impact of Escape Room Gamification Using a Teleconferencing Platform on Pharmacy Student Learning", *Medical Science Educator*, Vol 32, No. 5, pp 1159-1164.
- Gomez, M. (2020). "A COVID-19 Intervention: Using Digital Escape Rooms to Provide Professional Development to Alternative Certification Educators", *Journal of Technology and Teacher Education*, Vol 28, No. 2, pp 425-432.
- Heim, A.B., Duke, J., and Holt, E.A. (2022) "Design, discover, and decipher: student-developed escape rooms in the virtual ecology classroom", *Journal of Microbiology & Biology Education*, Vol 23, No. 1, pp e00015-22.
- Hursman, A., Richter, L.M., Frenzel, J., Nice, J., and Monson, E. (2022) "An online escape room used to support the growth of teamwork in health professions students", *Journal of Interprofessional Education & Practice*, Vol 29, No. 100545.
- Jenkins, H. (2004) "Game design as narrative architecture", *Computer*, Vol 11, No. 3, pp 118-130.
- Lyman, K. (2022) "Implementation of a virtual escape room mock code to comply with social distancing", *Nurse Education Today*, Vol 110, pp 1-5.
- Maaravi, Y., Heller, B., Amar, S. and Stav, H. (2020) "Training techniques for entrepreneurial value creation", *Entrepreneurship Education*, Vol 3, pp 215-238.
- Makri, A., Vlachopoulos, D. and Martina, R.A. (2021) "Digital escape rooms as innovative pedagogical tools in education: A systematic literature review," *Sustainability*, Vol 13, No. 8, p 4587.
- Magreñán, Á. A., Jiménez, C., Orcos, L., and Roca, S. (2022) "Teaching calculus in the first year of an engineering degree using a Digital Escape Room in an online scenario", *Computer Applications in Engineering Education*, Special Edition, pp 1-20.
- Martina, R.A. and Göksen, S. (2022) "Developing educational escape rooms for experiential entrepreneurship education", *Entrepreneurship Education and Pedagogy*, Vol 5, No. 3, pp 449-471.
- Merriam, S.B. (2008) "Adult learning theory for the twenty-first century", *New directions for adult and continuing education*, Vol 119, pp 93-98.
- Miles, H. and Huberman, A.M., 2020. Saldana. (2014) *Qualitative data analysis: A methods sourcebook*. New York: Sage Publications, Inc.
- Miller, T.L., Wesley, C.L. and Williams, D.E. (2012) "Educating the minds of caring hearts: Comparing the views of practitioners and educators on the importance of social entrepreneurship competencies", *Academy of Management Learning & Education*, Vol 11, No. 3, pp 349-370.
- Mudure-Iacob, I. (2021) "Hide and Seek in Gamified Learning: Formative Assessment of ESP in Digital Escape Rooms", *Transilvanian Association for the Literature and Culture of Romanian People*, pp 209-217.
- Neumann, K.L., Alvarado-Albertorio, F. and Ramírez-Salgado, A. (2020) "Online Approaches for Implementing a Digital Escape Room with Preservice Teachers", *Journal of Technology and Teacher Education*, Vol 28, No. 2, pp 415-424.

- Pozo-Sánchez, S., Lampropoulos, G. and López-Belmonte, J. (2022) "Comparing Gamification Models in Higher Education Using Face-to-Face and Virtual Escape Rooms", *Journal of New Approaches in Educational Research*, Vol 11, No. 2, pp 307-322.
- Prince, M. (2004) "Does active learning work? A review of the research," *Journal of engineering education*, Vol 93, No. 3, pp 223-231.
- Rodríguez-Ferrer, J.M., Manzano-León, A., Cangas, A.J., Aguilar-Parra, J.M., Fernández-Jiménez, C., Fernández-Campoy, J.M., Luque de la Rosa, A. and Martínez-Martínez, A.M. (2022) "Acquisition of Learning and Empathy Towards Patients in nursing students through online escape room: an exploratory qualitative study", *Psychology Research and Behavior Management*, pp 103-110.
- Ross, R. and Hall, R. (2021) "Towards Teaching Digital Electronics Using Escape Rooms", *Advances in Engineering Education*, Vol 9, No. 2, p n2.
- Sánchez-Ruiz, L., López-Alfonso, S., Moll-López, S., Moraño-Fernández, J. and Vega-Fleitas, E. (2022) "Educational Digital Escape Rooms Footprint on Students' Feelings: A Case Study within Aerospace Engineering", *Information*, Vol 13, No. 10, pp 3-18.
- Smith, M.M. and Davis, R.G. (2021) "Can you escape? The pharmacology review virtual escape room," *Simulation & Gaming*, Vol 52, No. 1, pp 79-87.
- Tercanli, H., Martina, R., Ferreira Dias, M., Reuter, J., Amorim, M., Madaleno, M., Magueta, D., Vieira, E., Veloso C., Figueiredo, C., Vitória, A., Wakkee, I., Gomes, I., Meireles, G., Daubariene, A., Daunoriene, A., Mortensen, A., Zinovyeva, A., Rivera-Trigueros, I., LópezAlcarria, A., Rodríguez-Díaz, P., Olvera-Lobo, M.D., Ruiz-Padillo, D.P. And Gutiérrez-Pérez, J. (2021) *Educational escape rooms in practice: Research, experiences and recommendations*. UA Editora.
- Veldkamp, A., van de Grint, L., Knippels, M.C.P. and van Joolingen, W.R. (2020) "Escape education: A systematic review on escape rooms in education", *Educational Research Review*, Vol 31, p 100364.
- Veldkamp, A., Daemen, J., Teekens, S., Koelewijn, S., Knippels, M.-C.P.J. and van Joolingen, W.R. (2020) "Escape boxes: Bringing escape room experience into the classroom" *British Journal of Educational Technology*, Vol 51, pp 1220-1239.
- Vestal, M. E., Matthias, A. D., and Thompson, C. E. (2021) "Engaging students with patient safety in an online escape room", *Journal of Nursing Education*, Vol 60, No. 8, pp 466-469.