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A review on use of escape rooms in education – touching the void

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ABSTRACT

This review article focuses on use of an escape room as a didactic tool in teaching and learning, as identified in empirical studies that have examined the use of escape rooms in educational contexts. The review studied the methods used to study escape rooms, what the focus of attention was, what the reported use was, and implications this has for the use of escape rooms for teaching and learning. Our analysis showed that most studies are concerned with the implementation and use of an escape room in relation to four fields of attention; scenario, curriculum, 21st-century skills, and motivation. Overall, the reviewed articles indicate that more studies are needed on the use of escape rooms for educational purposes. It seems that research on this topic has reached a new phase, and there is a need for structured research and transparency in the research design and methods for data collection and analysis. We see opportunities for the use of escape rooms as a didactic tool in primary and secondary education, and in teacher education.

Introduction

One of the most school-related words around is *classroom*. Now we see that another "room word" has entered the vocabulary of schools worldwide: *escape room*. We do not suggest that the classroom should be perceived as an escape room in the proper sense, but we see that teachers within various fields of expertise and at various levels in the education system are implementing the idea of escape rooms as a didactic tool, especially within some higher education programmes (e.g. Adams, Burger, Crawford, & Setter, 2018; Aubeaux et al., 2020; Healy, 2019; López-Pernas, Gordillo, Barra, & Quemada, 2019).

The *escape room* phenomenon has a quite short history. The first well-documented activity of a *Real Escape Game Event* started in Kyoto, Japan, in 2007, as a single room game for teams of 5–6 players (Nicholson, 2015). The inspiration for the escape room phenomenon comes from a variety of genres, such as live-action role-playing, point-and -click adventure games, puzzle hunt, interactive theatre, and haunted houses. The interest for this phenomenon grew rapidly from about 2012–2013, expanding first in Asia, and then spread to Europe, Australia and North America (Nicholson, 2015).

Today it is recognised as a global, common and popular leisure feature, which appeals to both adults, youngsters and children. According to Miller (2015) escape games had been popular in the computer and video gaming community for years, before it was developed into live versions as well. In general, use of an escape room may take different approaches, but the main idea is to create a context where players must solve different tasks as a group within a given time. In this article, we use Nicholson's definition of an escape room as a "live-action team-based game where players discover clues, solve puzzles, and accomplish 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, p. 1).

Game-based learning is not new to the educational environment, and it is well known that game-based learning offers opportunities related to active learning, creativity, problem solving, self-regulation, fun and social interaction (Bober, 2010). Such opportunities and benefits from game-based learning are reported also by Veach (2019), who in addition highlights that game-based approaches in teaching and learning can appeal to students' various learning styles. In fact, features of several theories of learning may be identified in an escape room activity. Zhang et al. (2018) and Ouariachi and Wim (2020) argue that elements of both constructivism and behaviourism may be recognised to some extent. Constructivism because the participants construct their own knowledge based on real-time experiences with tasks in the escape room (Franco & DeLuca, 2019; Ouariachi & Wim, 2020), and behaviourism because positive behaviour is reinforced through the escape room (Zhang et al., 2018). However, due to its nature of being a "live-action team-based game", an escape room activity is primarily recognised to be a didactic tool that coincides with many of the features associated with a socio-cultural approach to learning (Ouariachi & Wim, 2020; Zhang et al., 2018). Socio-cultural learning theory emphasises the influence of social settings that frame the participants' actions, and these actions must be seen in relation to the activity the participants are involved in, mediating artefacts that are used and communication between the participants. In other words, an escape room activity used for educational purposes is an example of how educators can facilitate for students to cooperate, communicate, and be critical and active learners.

Various stakeholders have called for changes to what goes on in schools and classrooms. This includes political and socioeconomic stakeholders, as well as school research that points to the lack of coherence between societal development and priorities and experienced priorities in schools (Organisation for Economic Co-operation and Development [OECD], 2010; Sawyer, 2012; Thomson, 2012). In policy documents we now see that the aim of schooling is focused on the future requirements for coming generations, as operationalised through the identification of key competences for the future (European Commission, 2018a) and 21st-century skills such as those needed for lifelong learning, innovation, career, life, and digital literacy (Partnership for 21st century skills, 2014). This new direction calls for further development and changes in curricula and didactic approach for younger and older students, and for students in teacher education. It is expected that schools and teachers will make changes in accordance with the revised direction of curricula to provide effective education that produces 21st-century students who are creative and socially proactive and who are adept at problem-solving and critical thinking. The rapid increase in publications related to use of escape room for educational purposes

shows that many teachers and researchers are curious about the use of escape room as a didactic tool in this respect, "adapting the concept to fit the needs of their students in classrooms" (Ouariachi & Wim, 2020, p. 1195).

Despite the enthusiasm for and promising reports about use of escape room (e.g. Berthod et al., 2019; Cain, 2019; Eukel, Frenzel, & Cernusca, 2017; Garwood, 2020), not enough is known about the use of escape rooms in education. Examining the use of escape rooms in empirical research into teaching and learning will be helpful for identifying the future implications of escape rooms for educational purposes. However, we have found no comprehensive review of research on the use of escape rooms in education.

This review article focuses on the research interests of empirical projects that have studied the use of escape rooms for educational purposes. We include projects that have taken a mixed-methods approach (Ferreiro-González et al., 2019; Veldkamp et al., 2020; Zhang et al., 2018), case studies where the priority of the escape room content was to connect professional realism to the teaching (Berthod et al., 2019; Clauson et al., 2019; Eukel et al., 2017), and studies that have focused more on the 21st-century skills gained in the escape room setting than on the school subjects involved (Duncan, 2020; Kutzin, 2019). In this review, we aim to address the emerging and, at present, unstructured body of research on the use of escape rooms in education by bringing together and synthesising the research, with an emphasis on the implications of the use of escape rooms for teaching and learning. We also aim to identify areas that need to be addressed in future research on the use of escape rooms for educational purposes. Within these parameters, we focus on the following four key questions:

(1) *What methods have been used to examine the use of escape rooms for educational purposes?*
(2) *How is the escape room used for educational purposes?*
(3) *What is the focus of attention in research on the use of escape rooms in education?*
(4) *What are the implications of the use of escape rooms for teaching and learning?*

Materials and methods

Review parameters

The selection process for this review comprised three phases. In the first phase, we searched for the term "escape room" using search engines such as Oria and Google to obtain an overall impression of the relevant synonyms for this concept and keywords related to the use of an escape room for educational purposes. Through this inductive, preliminary phase, we found that an escape room is a concept that seems to be clearly defined (Nicholson, 2015). We also found that some authors use the term "breakout room" as a synonym for escape room and narrower terms such as "escape game," "serious escape room," and "breakout box." We decided to use the keywords "escape room" and "breakout room" in our search for articles because our search using these two terms included all search results that used the other terms mentioned above.

In the second phase, we entered a rigid and deductive stage when we searched the ERIC, Scopus, Science Direct, and ISI Web of Science databases (first in September 2019, and then a new search in August 2020), using the keywords that we found in the preliminary phase. These four databases have broad influence in education research. The searches were limited to peer-reviewed articles written in English and published after 2007, because this was the year that the first nonvirtual escape room was introduced to the public (Nicholson, 2015).

In the third phase, still with a rigid and deductive approach, we removed duplicate articles and those that did not include empirical studies, did not focus on educational purposes, or were not published in peer-reviewed journals. The resulting 70 articles form the basis of this review (see Appendix 1). All articles were published within the past four years (2017–2020): four in 2017, eight in 2018, 32 in 2019, and 26 in 2020. This publication trend indicates that there is a rapidly increasing interest in the use of escape rooms for educational purposes.

Based on the description of the three phases that constitutes the selection process for the body of articles for this review, the search should be easy to reproduce. Furthermore, this is a review article that focuses on the research interests of empirical projects that have studied the use of escape rooms for educational purposes. The demand for articles to be based on empirical studies, to focus on educational purposes, and to be published in peer-review journals, secure that the body of articles for this review represents what the research front on escape room has published with attention to educational purposes.

Analysis

We started the process of analysis by dividing the articles equally between all five authors, for a first round of reading. We used a summary table for each article, in which we outlined the focus of attention in the article, setting (type of school or profession, and number of participants), method and data sources, and implications of the use of escape rooms for teaching and learning. The first author then combined these details into a single table (Appendix 1) and checked for inconsistencies or missing information. In order to strengthen the reliability and validity of the analysis of articles, the work on the appendix went through two more stages. The four other authors read through the appendix in order to check that the presented information reflected the content of each article. In a second round of reading, each article was read by another author than in the first round, and the article summary in the appendix from round one was adjusted if the new reader's summary differed from the summary from round one.

The four research questions very much defined the criteria for analysis, and this is reflected in the structure of the presentation of results in this article. What research methods that have been used to examine the use of escape rooms for educational purposes, and how and by whom escape rooms have been used in education, were identified for each article and summarised. The explicit focus of attention in the articles varies of course, and a review article gives us the opportunity to reach a more general level. Through a constant comparison approach (Silverman, 2013; Strauss & Corbin, 1998), a criterion for analysis therefore was to identify the main question(s) asked by the researchers and identify what main fields of attention the current research may be

grouped in. Finally, on some level each article presents implications of presented results, discussion and conclusions. A criterion for analysis was, therefore, again through a constant comparison approach (Silverman, 2013; Strauss & Corbin, 1998), to identify what the current research reports as experienced opportunities and challenges related to use of escape rooms for educational purposes, and through this analysis get an overall impression of where the research on use of escape room for educational purposes currently is.

Results

Methods used to examine the use of escape rooms for educational purposes

The articles included in this review show that the research on the use of escape rooms in education is dominated by a lack of emphasis on research structure. The articles covered in our review exhibited large variation in the methodological fundamentals. An overview of the types of methods used in this research is provided in Table 1.

Most of the articles report on the experiences from creating and using an escape room and included some sort of quantitative or qualitative instrument to collect feedback from the participants after they had finished using the escape room (e.g. Friedrich, Teaford, Taubenheim, Boland, & Sick, 2019; Ma, Chaung, & Lin, 2018). Some articles based their conclusions only on informal feedback (e.g. Pun, 2017; Wise, Lowe, Hill, Barnett, & Barton, 2018). Several articles added informal observational impressions to this body of feedback (e.g. Adams et al., 2018; Berthod et al., 2019), whereas others relied solely on informal observations by the authors themselves (Brown, Darby, & Coronel, 2019; Kinio, Dufresne, Brandys, & Jetty, 2018). This is valuable information, especially in the phase where one is curious about what an escape room is and how such a didactic tool is received by the students. However, the value of the research community in education is limited.

Some articles emphasised the methodical approach more strongly. Some were strictly quantitative studies that relied on post-participation questionnaires (e.g. Novak, Lozos, & Spear, 2019; Sánches-Martín, Corrales-Serrano, Luque-Sendra, & Zamora-Polo, 2020). Other articles included pre- and post-participation surveys of subject matter knowledge and motivation (e.g. Aubeaux et al., 2020; Eukel et al., 2017; Guckian,

Table 1. Types of methods.

Type of method	Number of articles
Feedback (written or oral)	5
Debrief	1
Interview	2
Observation	1
Questionnaire/survey	20
Assessment	1
Questionnaire/survey and assessment	9
Mixed methods*	28
Case study	3
Total	70

*Mixed methods includes a combination of two or more of the following methods: feedback, debrief, interview, observation, questionnaire/survey and assessment.

Sridhar, & Meggitt, 2019), whereas others combined questionnaires with qualitative feedback debriefing after the participants had completed the escape room activity (Béguin et al., 2019; Moore & Campbell, 2019). We also found examples of strictly qualitative approaches that relied on oral debriefing and observations by nonparticipants (Kutzin, 2019) for triangulation of ratings of video recordings of the use of an escape room, and data from a qualitative questionnaire answered by participants after they had completed the escape room activity (Rosenkrantz et al., 2019).

Use of escape rooms in education

The concept of escape rooms has been used more frequently in the past 10 years, and their use has gone from pure entertainment to teaching and learning methods (Nicholson, 2015). The material reviewed for this article showed some common traits in the use of escape rooms in education. For example, in a typical escape room, the experience starts with an introduction, during which a game master, written message, or video introduces the participants to the room and explains the rules of the game (Jambhekar, Pahls, & Deloney, 2019; Watermeier & Salzameda, 2019). During the introduction, the participants are also referred to as "teams" that need to work together to succeed. Another common feature is that the participants are told they must solve problems within a limited timeframe to "break out" and complete the escape room challenge (Clarke et al., 2017; Healy, 2019), although escape rooms can differ in the challenges given to the teams and in design. This understanding of escape rooms is encapsulated within Nicholson's (2015) definition. However, the articles we reviewed reported on many variants within this overarching concept.

The articles describe the use of escape rooms in various educational contexts. In Table 2, these studies are categorised according to the educational or professional level of the informants or the type of education the informants are associated with (e.g. faculty members).

Most of the studies included in this article concerned the implementation of educational escape rooms in higher education at the undergraduate, graduate, or postgraduate levels. 55 of the 71 studies included focused wholly or partly on students in college or university. Some also targeted residential programmes and courses for professional practitioners in a field or a mix of these (e.g. Adams et al., 2018; Zhang, Diemer, Lee,

Table 2. Educational contexts.

Type of educational setting	Number of studies
Primary education	2
Secondary education	5
Higher education (undergraduate, graduate, and postgraduate programmes)	52
Residential programmes	3
Professionals	1
Mix*	6
N/A**	1
Total	70

*The informants were from different levels of education or a mix of students and professionals within a field.

**Not applicable. The studies do not refer to a specific group of informants, school type, or educational level.

Jaffe, & Papanagnou, 2019). Only two of the studies described an escape room used solely in primary school (Duncan, 2020; Huang, Kuo, & Chen, 2020).

The articles were also categorised according to the relevant subject areas (Table 3).

Most of the articles were concerned with health care professions or science, technology, engineering, and mathematics (STEM) subjects. The area of health care included eleven studies aimed at pharmacy, twelve studies aimed at nursing, and six at medicine. Only a few other professions were represented in our material, and these were single occurrences (e.g. Aubeaux et al., 2020; Borrego, Fernández, Blanes, & Robles, 2017; LaPaglia, 2020; Liu et al., 2020). These differences between areas may reflect the focus on the development and use of serious games in certain professional educational programmes, especially within pharmacy, as reported by Caldas, Eukel, Matulewicz, Fernández, and Donohoe (2019). In addition, the professions often combine theoretical knowledge and practical skills, and it is central to be able to work as a team and under pressure in these professions (Gómez-Urquiza et al., 2019; Gordon, Trovinger, & DeLillis, 2019).

Many of the studies concerning STEM subjects were directed towards a single discipline such as chemistry or biology. Of the seven studies aimed at primary and secondary education, six of them are concerned with STEM subjects. Of the five studies of the use of an escape room within the field of chemistry, two were in secondary school (Peleg, Yayon, Katchevich, Moria-Shipony, & Blonder, 2019; Watermeier & Salzameda, 2019). The escape room used in the field of entomology described by Healy (2019) was developed at a university for students in secondary education. We note that the only two studies whose informants were teacher education students were also within STEM subjects (Queiruga-Dios, Sánchez, Dios, Martínez, & Encinas, 2020; Sánches-Martín et al., 2020).

We found examples of escape rooms being used in some subjects in higher education in addition to health care professions and STEM subjects. These include strategic communication (Craig, Ngondo, Devling, & Scharlach, 2019), creative design (Ma et al., 2018) and English (Santamaría & Alcade, 2019). Escape rooms have also been used for wider groups of students and not aimed at professional or discipline-specific skills or knowledge, such as information literacy (e.g. Davis, 2019; Pun, 2017). Some of the studies aimed to explore the value of educational escape rooms generally and did not focus on a specific subject (e.g. Clarke et al., 2017; López-Belmonte, Segura-Robles, Fuentes-Cabrera, & Parra-Conzález, 2020; Whitton, 2018).

Table 3. Subject areas.

Subject area	Number of studies
Health care*	37
STEM subjects**	18
Miscellaneous higher education***	7
N/A****	8
Total	70

*Includes nursing, medicine, dentistry, radiology, psychology and pharmacy, and technical skills, subject matter knowledge, 21st-century skills, and leadership within health care professions.
**Science, technology, engineering, and mathematics.
***Includes both specialised topics (strategic communication, creative design, English) and topics for larger student groups (earthquake preparedness, information literacy).
**** Not applicable. Articles examined the use of escape rooms as a method for teaching and learning in general.

Focus of research attention on the use of escape rooms in education

The unstated but overarching questions asked by many articles studied in this review are, "Does this work?", or more precisely, "How can we use escape rooms to strengthen participant learning?" These questions have been approached from different perspectives, both in terms of the aims of the authors of the articles reviewed, and the educational level they studied. Through our constant comparison approach, we identified four fields of such attention: scenario, curriculum, 21st-century skills, and motivation.

First, we found that escape rooms are used to expose students to scenarios where they can experience a situation in which they need to trust their own and their colleagues' competence, work together as a team, and handle both time constraints and the consequences of not working fast enough. This is a highly relevant issue in some professions, such as health care. In our research for this review, we found that such escape room situations have been used to offer real-life scenarios and thereby to bring greater authenticity to courses for students. Responding to a natural disaster (Moore & Campbell, 2019), protecting oneself from computer attacks (Béguin et al., 2019), and patient care (Adams et al., 2018; Diemer, Jaffe, Papanagnou, Zhang, & Zavodnick, 2019) are typical scenarios where it is necessary to work quickly, precisely, and competently as a team to avoid the ultimate crisis.

Second, several studies have tried to create a real-life atmosphere in their use of an escape room, even though they did not have the same access to authentic scenarios (Ferreiro-González et al., 2019; Healy, 2019). However, use of quasi-realistic scenarios does not seem to limit the motivation for the creation of escape rooms or participation in escape rooms. Gaining and using knowledge and skills from the subject areas seems to surpass the actual relevance of the scenarios used. Some articles have reported that escape rooms provide a way for students to apply the knowledge and skills they have learned in a more complex context (de la Flor, Calles, Espada, & Rodríguez, 2020; López-Pernas et al., 2019; Watermeier & Salzameda, 2019). Escape rooms also give students the opportunity to apply curriculum content towards the end of the semester. Vergne, Simmons, and Bowen (2019) observed that the escape room used in their higher education introductory course in chemistry generated both additional attention to the curriculum content and discussions between students and teachers about their perceptions of the relevance of specific aspects of the curriculum content. Hence, the question of direct relevance of the escape room context may seem to be subordinate to the attention to curriculum content, and instead the escape room becomes a setting for students to apply their understanding of the subject area in a quasi-realistic scene without direct relevance to a profession.

Third, a more general focus of attention is the use of escape rooms in educational surroundings as a setting for learning to apply 21st-century skills. Several articles emphasise the importance of critical thinking, creativity, group dynamics, initiative, and problem-solving in an escape room setting (López-Pernas et al., 2019; Peleg et al., 2019; Zhang et al., 2019). Given that research and political and socioeconomic sources have noted the need to combine curriculum content with the development of key competencies and 21st-century skills, it is surprising that only a few articles have focused on the use of escape rooms in primary and secondary school (Duncan, 2020; Huang et al., 2020) and teacher education (Sánches-Martín et al., 2020).

Fourth, in some articles examined in this review, the focus of attention was on using an escape room setting to make the experience of a subject fun and to generate enthusiasm and curiosity among students (Borrego et al., 2017; Vergne et al., 2019). Escape rooms have been introduced as a didactic tool with a motivational purpose (Gómez-Urquiza et al., 2019; Kinio et al., 2018). Several articles have reported that participation in an escape room generated much discussion among those who had finished about the tasks and puzzles encountered during the session, and discussions with teachers about the subject matter and the puzzles created for the escape room (e.g. Friedrich et al., 2019; Jambhekar et al., 2019).

These four fields of attention are all related to validation of the use of escape rooms for educational purposes. Some of the articles included in this review were concerned specifically with the issue of validation of the didactic tool they developed and used (e.g. Rosenkrantz et al., 2019). Several articles were concerned with the participants' evaluation of the experience, which is tied to aspects of both engagement and motivation, and the participants' perceived learning outcomes from either the curriculum content or the development of 21st-century skills (e.g. Gómez-Urquiza et al., 2019; Peleg et al., 2019). A few articles used student assessment to validate the tool and, through this approach, to answer the question, "Does this work?" (Caldas et al., 2019; Clauson et al., 2019).

Implications for the use of escape rooms in teaching and learning

In our analysis, we also considered the implications of the use of escape rooms for educational purposes. Some of these considerations relate to the design and development of an escape room (Clarke et al., 2017) and the time needed for both planning and designing one (Baker, Crabtree & Anderson, 2020; Cain, 2019; Edwards, Boothby, & Succheralli, 2019). These considerations involve attention to both participants and creators. Several articles noted the importance of both briefing the participants before they enter the escape room and debriefing them after they complete the escape room experience (Franco & DeLuca, 2019; Vergne et al., 2019). Some articles also discussed how general constraints can influence the escape room experience; for example, the question of time. In some escape room scenarios, time is extremely important; for example, when the escape room experience involves saving lives (Moore & Campbell, 2019; Novak et al., 2019). In other scenarios, time is not that important; for instance, collecting samples from a crime scene and taking them to the laboratory (Ferreiro-González et al., 2019; Healy, 2019). Researchers seem to anticipate that the choices about the design of the escape room (for instance group size, heterogeneous or homogeneous groups, context, time, game master influence, and rules) can affect the learning experience offered by participating in an escape room activity (e.g. Peleg et al., 2019).

The use of escape rooms for educational purposes has content-related constraints. All students should experience a learning process through the use of escape room in education, and several articles emphasise the need for including curriculum content from students' subjects. Our review shows that researchers and educators have started to look for frameworks for designing escape rooms for educational purposes and for evaluating both 21st-century skills and subject matter competence on an individual level. It should be possible to assess the learners' subject matter competence before, during, and after an escape room session, and to explore their behaviour and how it

changes as the learning process proceeds. There are pitfalls, however. One article warned that including too many clues about finding and solving puzzles left too little time to focus on curriculum content (Jambhekar et al., 2019).

The articles included in this review offer no clear and immediate answers to complex questions about using escape room for educational purposes. What we do see in this review is a beginning of answering some of these complex questions; for example, whether participation in an escape room helps people develop a more strategic approach in such a setting (Caldas et al., 2019), which in turn provides an indication whether such activity helps to develop 21st-century skills. Some studies have reflected on the role of the game master and the involvement in the assessment of learning attached to this position (Jambhekar et al., 2019). Finally, some studies have underscored that an escape room activity used for educational purposes is an activity that emphasises student activity and how students may be encouraged and challenged to create an escape room for other students (Rosenkrantz et al., 2019; Veldkamp et al., 2020). The latter example shows that it is possible to use an escape room to integrate work with curriculum content and facilitation for active work with the content in a way that may prove valuable to others (Haara & Jenssen, 2019). This will help to pave the way for learning from two perspectives: the creator's perspective and the participant's perspective.

Discussion

Although our search for articles for this review included the early days of nonvirtual escape rooms in 2007 (Nicholson, 2015), we had to settle for articles published after 2016. All 70 articles studied in this review were from 2017 to 2020, and only 12 of these were published before 2019. This trend shows the increasing curiosity concerning escape rooms in the education research environment. It also shows that, given the parallel publication process, those who are publishing articles about the use of escape rooms for educational purposes may not be fully aware of other publications. This suggests that research within this field is in a preliminary phase. The emphasis so far seems to have been on exploring what an escape room is and how it can be applied to educational purposes. Therefore, we found many articles that reported experiences in the context of these two questions, and which prioritised the development of an escape room, trying it with students or other participants, and collecting feedback and responses from the participants. We have found little attention to the research design or methods used in the data collection and analysis in studies of escape rooms. This is understandable given the early phase of the use of escape rooms in education and the experimental approach to use of escape room as a didactic tool at present.

The reported experiences with escape room for educational purposes are generally positive. The reasons for this are manifold but concentrate mainly on outcomes. Only one article reported a slight decline in students' results after use of an escape room (Clauson et al., 2019). A few others report little effect on students' results but point to increased motivation and enjoyment as a positive outcome (e.g. Duncan, 2020; Huang et al., 2020). Researchers have reported on the opportunities to apply curriculum content, create practical situations closely related to the profession, and emphasise and enhance the development and applications of 21st-century skills such as creativity, critical thinking, problem-solving, and cooperation. The cooperative search for clues,

the distribution of responsibility and the solving of puzzles secure the attention to 21st-century skills. Researchers have also focused on motivation, with an emphasis on affective concepts such as fun, enthusiasm, and eagerness. No one has reported criticism, derision, or lack of seriousness associated with participation in an escape room session. This one-dimensional impression of the use of escape rooms in educational research is natural and probably relates to the novelty of research in this field. However, we have started to see glimpses of rigid research related to the use of escape rooms for educational purposes (e.g. Morell, Eukel, & Santurri, 2020; Rosenkrantz et al., 2019). In addition, several articles in the material point to the need for further studies on the effects of escape rooms in education (e.g. Baker et al., 2020; Liu et al., 2020). Overall, the results from this review show that the future of research within this area requires the application of complex research designs, related to use and outcomes of escape rooms. In other words, it seems that the research on the use of escape rooms for educational purposes has reached a new phase, which requires greater structure and transparency in research design and methods for data collection and analysis.

In order to move the research into this next phase, a more systematised use of research designs that go beyond the present creation and try-out objective is required. This includes longitudinal studies that follow students who use escape rooms as a didactic tool over the long term, intervention studies that explore student outcomes and assessment, and studies that focus on teachers' or teacher education students' experiences with or beliefs about the use of escape rooms as a didactic tool for 21st-century education.

In addition, small-scale studies on the use of escape rooms for educational purposes are also needed. Some studies in this review present a framework developed for creating and using an escape room and have invited others to test it and to relate their research to both the framework and elements (Clarke et al., 2017; Rosenkrantz et al., 2019). This review also shows that the use of escape rooms for educational purposes is established in some areas of health care and to some extent in STEM subject but is less common in other subject areas in both compulsory and higher education. It is therefore also necessary to continue cross-sectional or small-scale research studies on the use of escape rooms for educational purposes. One can relate the research focus to the tool itself, those who create and modify it, participants, content, outcomes of participation, outcomes of creating and modifying an escape room, or relevance for professionals and for primary and secondary education. The possibilities for the research field in this phase seem endless.

Curriculum reform initiatives recommend that school subjects, key competencies, and skills for the 21st century should be emphasised by teachers and developed by the students from the start of their education (European Commission, 2018b; OECD, 2012). This is a frontier that challenges the traditional horizon of task-related beliefs about the purpose of schooling and may prove to be challenging for many schools and teachers (Thomson, 2012). Students must be educated for the future, and this education starts when they enter the school system. The outcomes of the preliminary phase of research on the use of escape rooms for educational purposes suggest that the use of escape rooms may be one of several didactic tools that teachers may use in their teaching to fulfil the threefold aim of the curriculum reform initiatives, given the role of escape room activities in the application of school subjects, key competences, and 21st-century skills. The connection between escape room and socio-cultural learning-related approaches, such as problem-based learning

(Boud & Feletti, 1997) and pedagogical entrepreneurship (Haara & Jenssen, 2019) seems close, and use of escape room activity seems to be a promising approach for emphasis on students' development of self-regulation. Self-regulated learning takes place in an interactive process between individuals and the environment they are in. According to Zimmerman (2000) it is important that students have the opportunity to practice self-regulating skills through working with tasks relevant for their competence. In other words, the learning context plays an important part for self-regulated learning and use of escape room as a didactic tool may in our opinion just be such an arena for both social modelling and application of theoretical and practical knowledge and skills.

Longitudinal or intervention studies that follow the development and use of escape rooms in primary and secondary schools may have effects on the emphasis on 21st-century skills, evaluation of such skills and learning within school subjects, and teachers' development of competence. Furthermore, teacher education students are future agents of change who can bring new ideas and new possibilities to the schools where they complete their teaching practice as students and to the schools where they eventually work as teachers. The teacher education institutions have the opportunity to try out the use of escape rooms with these students, which may provide informants for research projects or participants in action research projects on the use of escape rooms in education.

Limitations

This review of research on use of escape rooms for educational purposes has shown that this field of research is in a preliminary phase, and that the time for entering a more rigid phase in research is ripe. Our rigid approach to the selection of articles may have made it possible that we have missed some articles that could have been part of such a review. This is for instance PhD-theses, books, peer-reviewed articles in other languages than English, or articles that are not published in peer-review journals. By omitting theses and books, we are aware that we may have overlooked some empirical and peer-reviewed projects on use of escape rooms for educational purposes. However, most PhD-theses today are based on published articles in peer-review journals, and books are to our knowledge rarely chosen when new, empirical research is offered to other researchers. We may also mention that we did not come across any PhD-theses or books that we found to jeopardise the choices we made in the three phases described in the paragraph "Review Parameters".

Furthermore, we are also aware that interpretation processes will challenge both the trustworthiness and consistency of qualitative work. We have, however, in every part of our work on this article, strived for objectivity in our selections, interpretations and decisions, in order to secure trustworthiness and consistency.

Conclusions

The future of the methodological approaches to understanding the combination of subjects and 21st-century skills to be used in escape rooms in educational settings is unknown. Many teachers are touching the void in their search for new approaches and methods to meet new priorities in revised curriculums and expand the understanding of the use of escape rooms in education. We urge the educational research community to progress research on escape rooms into a phase that provides schools and teachers with rigorous

research about the "if, how, why, and when" regarding the use of escape rooms as a didactic tool that can be relevant to both primary and secondary education, as well as higher education. Based on these realities, we believe that structured studies using these approaches to use of escape rooms with teacher education students as informants may be a promising start in the process of providing important information about whether and how escape rooms should be used in primary and secondary school teaching.

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