Evaluation of the effectiveness of educational escape rooms within health professions education: A systematic review protocol

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Declarations of interest: None

Funding: This systematic review is being conducted as part of the ESCAPE4HEALTH Erasmus+ project, co-funded by the Erasmus+ Programme of the European Union. The co-funder has not been involved in the preparation of this protocol.

Registration: Protocol to be published in the International Journal of Education Research prior to the commencement of this systematic review.

Amendments: Amendments to the protocol, along with their justifications, will be recorded and outlined in any publications related to the completion of this systematic review.

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Abstract

Escape rooms are being increasingly employed as an educational approach within health professions education. Given the rapid increase in their application, investigators have adopted diverse evaluation methods, many of which utilise ad-hoc instruments. To inform future evaluation methods and the adoption of validated evaluation instruments, a systematic review is planned. This protocol outlines the steps of this review, which will collate and synthesise the evidence related to the evaluation and efficacy of educational escape rooms within health professions education. A search, applying terms for escape rooms, healthcare professionals and evaluation, will be conducted using multiple databases. Studies will be screened against eligibility criteria and all eligible studies will be quality assessed using a validated tool. Data will be narratively synthesised.

Key words

Escape Rooms; Evaluation; Systematic Review; Study Protocol

1. Background

Escape rooms are defined by Nicholson (2015) as *'live-action, team-based games where players discover clues, solve puzzles, and accomplish tasks in one or more rooms in order to accomplish a specific goal in a limited amount of time'*. Inspired by video games, the first escape room was introduced to the entertainment industry in 2007 by Takao Kato (Corkill, 2009). Since then, the concept has become immensely popular and escape rooms can now be played worldwide. Parallel to their growing popularity as a form of entertainment, the potential for learning through an escape room experience is increasingly being recognised by educators and escape rooms are increasingly being employed as an educational approach (Veldkamp et al., 2020). This is particularly true for health professions education, which represents a leading field within which educational escape rooms are being employed (Veldkamp et al., 2020).

Educational escape rooms represent a form of game-based learning, whereby learning objectives are primarily fulfilled through the application of a game (Wiggins, 2016). Game-based learning evolved as an educational approach due to decreased levels of engagement and motivation observed across learners (Lee & Hammer, 2011; Villagrasa et al., 2014). The emotions that arise within gameplay, such as enjoyment, competition, focus and accomplishment, have been shown to increase players' engagement, motivation and productivity levels (Buckley & Doyle, 2016; Diaz, 2017; Sailer et al., 2017). Thus, the aim of game-based learning is to harness these emotions and transfer them to learning, whereby learners' engagement, motivation and productivity within an educational context are enhanced. The current evidence appears to support this notion, with a recent systematic review on the use of all forms of gamified learning in higher education, identifying several benefits of the educational approach (Subhash & Cudney, 2018). These included enhanced learner engagement, motivation, confidence, attitude, perceived learning and performance (Subhash & Cudney, 2018). As a result, the implementation of game-based learning, including educational escape rooms, can be expected to increase further over the coming years.

Educational escape rooms have been implemented across various healthcare-related disciplines, including medicine, nursing, pharmacy, occupational therapy and physiotherapy (Dugnol-Menéndez et al., 2021; Faysal et al., 2022; Kavanaugh et al., 2020; Molina-Torres et al., 2021; Morrell & Eukel, 2021) . Their use spans undergraduate, postgraduate and continuing education (Cole & Ruble, 2021; Jambhekar et al., 2020; Molina-Torres et al., 2022). Diverse learning goals have been trained through the application of escape rooms, covering both 'technical' and 'non-technical' knowledge and skills. Examples of technical learning goals include anatomy education, consolidating teaching of dermatology concepts and training the recognition and management of a patient with sepsis (Gabriel et al., 2021; Guckian et al., 2020; Molina-Torres et al., 2022). Examples of non-technical learning goals include training teamwork, communication and critical thinking (Rosenkrantz et al., 2019; Smith & Paul, 2021; Valdes et al., 2021). However, broader concepts such as patient safety, student orientation and recruitment have also been explored (Backhouse & Malik, 2019; Connelly et al., 2018; Nybo et al., 2020).

Given the novelty of escape rooms as an educational activity, there are few validated instruments available for the evaluation of such activities. As such, ad-hoc instruments are frequently implemented, often measuring different outcomes in varying levels of detail (Molina-Torres et al., 2021; Nybo et al., 2020; Valdes et al., 2021). This presents a challenge for educators aspiring to evaluate their educational escape rooms, as they are required to either develop and validate their own instrument or identify a suitable instrument from the array available within the literature. The authors are not aware of any existing

systematic review collating and appraising the methods adopted for the evaluation of educational escape rooms.

To support educators in overcoming this challenge, a systematic review is planned. This systematic review will collate and synthesise the evidence related to the evaluation and efficacy of educational escape rooms within health professions education. The findings of this review are anticipated to support educators in adopting evidence-based evaluation methods, which will contribute to enhancing our understanding of the application of educational escape rooms within health professions education.

1.1 Research questions

The systematic review will address the following primary and secondary research questions:

Primary research questions

1. Which methods are applied to the evaluation of the effectiveness of educational escape rooms within health professions education?
2. How valid and reliable are the identified evaluation methods?

Secondary research question

1. What is the evidence regarding the effectiveness of educational escape rooms with health professions education?

2. Methods

2.1 Study design

In selecting the most appropriate review design to answer the research questions underpinning this study, the various typologies of reviews were considered (Grant & Booth, 2009). As this study aims to collate, appraise and synthesise the entirety of the current available literature regarding the evaluation of educational escape rooms within healthcare education, a systematic review design was selected. This systematic review will adhere to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 checklist, whilst this protocol has been prepared in accordance with the PRISMA 2015 checklist for systematic review protocols (Moher et al., 2015; Page et al., 2021).

2.2 Eligibility criteria

The eligibility of studies to be included in this systematic review will be determined by screening all articles against a list of predefined eligibility criteria. The eligibility criteria specify the study characteristics of studies to be included. If one, or more, criteria are not fulfilled, the study will be excluded. The eligibility criteria are as follows:

Population: the population of eligible studies will comprise students, trainees or fully qualified healthcare professions, or combinations of these. All healthcare professions will be eligible for inclusion.

Intervention: the intervention of eligible studies will be an escape room activity, as defined by the authors of the published article, which has been developed and implemented to educate participants in any healthcare related topic. Both technical (i.e., cardiopulmonary resuscitation) and non-technical (i.e., teamwork and communication) topics are eligible.

Comparison: no comparison group is required for studies to be eligible for inclusion. Studies including no comparison group, a pre-test/post-test comparison and a comparison of an educational escape room to an alternative educational escape room or educational approach will all be eligible.

Outcome: the outcome of eligible studies will be an evaluation of the educational escape room using any evaluation method and any evaluation tool. Both validated and non-validated evaluation tools will be eligible for inclusion.

Study design: only interventional study designs generating empirical data will be eligible for inclusion.

Setting: all settings for an escape room will be eligible for inclusion. This includes physical, augmented, mixed and virtual escape rooms in either a clinical or non-clinical setting, in any country.

Timeframe: only studies published after 2007 will be eligible for inclusion.

Language: only studies published in the English language will be eligible for inclusion.

Publication: only published, peer-reviewed studies will be eligible for inclusion.

2.3 Information sources

The search strategy will be run in the following electronic databases: Medline (OVID interface Embase (OVID interface), Web of Science (Clarivate interface), CINAHL (EBSCOhost interface), ERIC (EBSCOhost interface) and PsycInfo (OVID interface). Searches will be run in August 2022. Additionally, the reference lists of all included articles will be manually searched for eligible articles.

2.4 Search strategy

The search strategy has been informed by a preliminary literature search with input from individuals experienced in undertaking systematic reviews. The strategy comprises variations and synonyms for the terms: escape rooms, healthcare professionals and evaluation. Both Medical Subject Headings (MeSH) and keyword search functions will be applied, as well as Boolean logic and wildcards, in accordance with the requirements of the individual databases. The search strategy for Medline is shown in table 1.

Ovid MEDLINE(R) ALL <1946 to July 28, 2022>
1 (escape room or escape game* or escape box* or mystery room* or puzzle room*)*
2 exp Medicine/ or exp Surgeons/ or exp Physicians/ or exp Nurses/ or exp Nursing/ or exp Pharmacists/ or exp Pharmacy/ or exp Physical Therapists/ or exp Occupational Therapists/ or exp Occupational Therapy/ or exp Midwifery/ or exp Allied Health Personnel/ or exp Health Personnel/ or exp Dentists/ or exp Dentistry/ or exp Physician Assistants/ or exp Radiography/ or exp Psychology/ or exp Nursing Assistants/
3 (medic or surge* or physician* or doctor* or clinician* or practition* or nurs* or pharma* or physio* or physical therap* or occupational therap* or midwife* or health?care assistant* or health* profession* or dentist* or dieti?ian or speech and language therap* or physician assistant* or paramedic* or medical assistant* or radiograph* or psycholog* or physician associate* or nursing assistant*)*

4	*2 or 3*
5	*exp Evaluation Studies as Topic/ or exp "Surveys and Questionnaires"/ or exp Interview/ or exp Focus Groups/*
6	*(evaluat* or assess* or apprais* or analys* or measure* or outcome* or effect* or perception* or impact* or rank* or mark* or score* or rat* or question* or interview* or focus group* or survey* or summative or formative)*
7	*5 or 6*
8	*1 and 4 and 7*
9	*limit 8 to (english language and yr="2007 -Current")*

Table 1. Medline search strategy

2.5 Data management

The search results will be exported into Rayyan © 2022 and duplicates removed electronically. The screening process will be completed using the Rayyan © 2022 software. Data extraction will be completed using a Microsoft Excel © (v 2102) spreadsheet.

2.6 Selection process

The title and abstract of all articles will be independently screened by two reviewers against the eligibility criteria. If there is agreement between reviewers, the article will either progress to full-text screening or be excluded, depending on the reviewers' decision. If there is disagreement between reviewers, this will be resolved through discussion, with the involvement of a third reviewer if consensus cannot be reached. Following the title and abstract screening, all retained articles will be independently screened by two reviewers against the eligibility criteria. If there is agreement between reviewers, the article will either be included in the systematic review or be excluded from the study. If there is disagreement between reviewers, this will be resolved through discussion, with the involvement of a third reviewer if consensus cannot be reached.

2.7 Data collection process

The data extraction will be conducted by one reviewer and validated by a second reviewer. The first reviewer will read the full-text article and extract the necessary information, as determined by the data items. The second reviewer will read the full-text article and the extracted information and confirm that all relevant data has been extracted. If there is disagreement between reviewers, this will be resolved through discussion, with the involvement of a reviewer if consensus cannot be reached.

2.8 Data items

The following data items will be extracted from eligible studies, as determined by the outcomes of this review:

- Title
- Authorship (first and second authors if two authors or first author et al. if more than two authors)
- Year of publication

- Country of research project
- Study design
- Setting (university, hospital, outpatient clinic, distance-learning, etc.)
- Population
- Number of participants recruited
- Type of escape room (physical, augmented, mixed, virtual, etc.)
- Summary of escape room design
- Topic(s) taught through escape room
- Methods of evaluation (interviews, questionnaire, knowledge test, OSCE, etc.)
- Psychometrics of evaluation method (validity and reliability of evaluation methods)
- Axis evaluated (perceptions, educational efficacy, technical)
- Results of evaluation: perceptions
- Results of evaluation: educational efficacy
- Results of evaluation: technical

The data extraction items will be piloted, with each reviewer extracting information from two included studies. The results of the pilot will be discussed amongst the reviewing team to identify and agree any necessary adjustments to the data extraction items. However, data extraction will be an iterative process, whereby data extraction items can be added, adjusted or removed throughout the process, as agreed by all members of the reviewing team.

2.9 Outcomes

The primary outcomes of this systematic review are:

1. To identify the methods of evaluation applied for the evaluation of educational escape rooms within health professions education
2. To outline the validity and reliability of the identified evaluation methods

The secondary outcomes of this systematic review are:

1. To critically appraise the efficacy of educational escape rooms within health professions education

2.10 Quality assessment

All eligible studies will be quality assessed using the Mixed Methods Appraisal Tool (v18) (Hong et al., 2019). Quality assessments will be completed by two independent reviewers. If there is disagreement between reviewers, this will be resolved through discussion, with the involvement of a reviewer if consensus cannot be reached. Studies will not be excluded on the basis of the quality assessments, though the quality of eligible studies, and the impact of this on the strength of the findings, will be considered and outlined.

2.11 Data synthesis

It is anticipated that there will be a significant degree of heterogeneity amongst eligible studies. Therefore, data will be narratively synthesised. The characteristics of eligible studies will be descriptively outlined, supported by a summary table of study characteristics. The quality of eligible studies will be summarised and its impact on the findings will be described. Data related to the outcomes of this systematic review will be thematically analysed, using an inductive analysis approach which means that the themes and subthemes will be determined by the data itself. If numerous studies employ an identical evaluation instrument, the feasibility of a subgroup meta-analysis will be explored with a statistician experienced in

conducting meta-analyses. However, only results related to the validity and reliability of identified evaluation methods described in eligible studies will be incorporated into the synthesis. The authors will not retrospectively assess the validity and reliability, instead this missing information will be outlined as a finding of the systematic review. Depending upon the findings and the quality of the evidence, data will be collated to produce a set of recommendations to inform the implementation and evaluation of educational escape rooms within health professions education.

2.12 Ethics

Given that this study is a systematic review, and therefore will be working with data freely available in the public domain and will not be directly involve human or animal subjects, formal ethical approve is not deemed necessary.

2.13 Dissemination plan

Upon completion of this systematic review, various dissemination activities are planned. A publication will be prepared and submitted for publication in a peer-reviewed journal and an abstract will be submitted for presentation at both national and international conferences. Local dissemination activities, such as internal presentations at the reviewing teams' individual organisations, are also planned.

2.14 Timeline and author contribution

This systematic review will be completed within eight months. Dr Lucy Bray will be the project leader. Table 2 outlines the planned timeline, tasks and author involvement for this systematic review.

Month	**Step**	**Author Contributions**
June	Kick-off meeting and planning of activities	XX
July	Write protocol	XX
	Submit protocol for publication	XX
November	Amendments to protocol and resubmission	XX
	Run searches	XX
	Export and deduplicate search results	XX
	Commence screening	XX
December	Complete screening	XX
	Commence data extraction	XX
January	Complete data extraction	XX
	Undertake quality assessments	XX
February	Undertake data analysis	XX
	Prepare first draft of manuscript	XX
March	Prepare first draft of manuscript Amendments to manuscript	XX
April	Amendments to manuscript	XX
	Submit manuscript	XX

Table 2. Tasks, timeline of completion and contributions of individual authors

3. Discussion

This protocol outlines the steps of a systematic review that will collate and synthesise the evidence related to the evaluation and efficacy of educational escape rooms within health professions education. The findings of this review are intended to ensure the increasing application of educational escape rooms is underpinned by evidence of their efficacy and that future escape rooms can be evaluated by valid and reliable evaluation methods, enhancing our understanding of this novel educational approach further.

3.1 Strengths and limitations

There are numerous strengths to this planned systematic review:

- Addresses a topical and important issue with the potential to achieve a real impact on the evaluation of educational escape rooms
- Adheres to the standard practice of conducting systematic reviews
- Adopts a two-reviewer approach through the selection process, data extraction and quality assessments minimising the risk of error

However, there are some limitations to this planned systematic review:

- Eligible studies are restricted to studies published in peer-reviewed journals in the English language introducing the risk of publication and language bias into the findings
- Eligible studies will not be excluded on the basis of quality which will potentially impair the strength of the findings

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