Escape Rooms as Tools for Learning Through Failure

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Abstract: The increasingly neoliberal course of Higher Education is linked to rises in student anxiety around assessment and increased fear of the consequences of failure. Making mistakes is an inevitable part of any learning process (and of life generally) and managing failure in a productive and positive way is crucial for success and wellbeing beyond university. In this article, we argue that academia does not adequately prepare learners for managing mistake-making progressively and that escape rooms can provide a way to facilitate learning through failure. We first present an original model of failure-based learning that explores why being able to make mistakes safely is important for students and why the use of escape rooms in Higher Education presents an excellent opportunity for the application of this model. We then show the relevance of this model by using it to analyse two case studies that explore different ways in which educational escape rooms can be used in Higher Education: either designed to facilitate learning by *playing* a game; or supporting learning through *designing* a game. Our model of failure-based learning has three stages, emphasising the importance of *preparation*, an iterative *play* cycle of testing, failing, reflecting, and revising, and finishing with a *presentation* phase. The article concludes by considering the limitations of educational escape rooms in this context and highlighting some practical considerations for the use of these approaches.

Key words: Failure, Escape rooms, Play, Games, Playful learning

1. Introduction

Escape rooms, in which small groups work together to solve puzzles within time constraints, have seen phenomenal growth as a recreational phenomenon over the past ten years (Lama and Martín, 2021). Their potential for supporting learning and engagement was quickly recognised by the educational community and the use of educational escape games in Higher Education has also grown quickly, with a wide variety of uses including student recruitment, induction, information literacy, design skills, domain-specific skills and knowledge, and generic skills (Veldkamp, et al., 2020b).

While research on educational escape rooms typically recognises their potential for providing motivational team-based challenges, there is less exploration of the theoretical underpinnings of the approach from a pedagogic perspective. Escape rooms are active learning environments that support authentic (Brookes and Moseley, 2012), problem-based (Savery and Duffy, 1995), and collaborative (McConnell, 2006) learning. Using the theoretical framing of the magic circle (Huizinga, 1955; Salen and Zimmerman, 2004), escape rooms can be viewed pedagogically as playgrounds in which the players suspend disbelief in a narrative separate from the real world, in which it is safe (if not inevitable) for participants to make mistakes and learn from them as they attempt to escape.

Games, by their very nature as intrinsically motivated activities, have evolved to keep players engaged in the game as their experience is balanced between the appropriate levels of challenge and competence (Schell, 2008); too easy and they become boring, too hard and they become frustrating. Failing, and learning from failure, is fundamental to game design, entirely in opposition to the way that failure is villainised and feared in Higher Education (Choi, 2021). Failure in games has two features that make it progressive: first, a game failure seldom has a serious consequence, it might lead to restarting a level or losing resources or a life, but it is unlikely to require starting again from the beginning; second, the failure provides feedback that leads to new knowledge, enabling players to learn from the failure, and avoid it in subsequent plays. Compare this to our education system: failure is seldom seen as positive part of the learning process and high stakes single-shot assessments, such as end-of-year examinations, offer serious consequences with little in the way of useful and timely feedback. The use of high-pressure assessments increases student fear of failure and anxiety, and in consequence decreases risk-taking and innovation. Too often the consequences of failure are too great, and the feedback too little. It is little wonder that students fear failure.

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In this article, we explore the theorisation of escape rooms as failure-based learning environments. First, we provide background on escape rooms and the different approaches to their use in education, before exploring the role of failure in learning. We then present a model of failure-based learning and apply this model to two case studies of escape rooms in education: one where students learn from *playing* escape rooms, and one where they learn from *building* escape rooms and having others play them. Finally, we conclude by reflecting on some of the lessons learned through our use of the model and highlight some future directions for research.

2. Educational Escape Rooms

Worldwide, recreational escape rooms have been growing exponentially in popularity since their inception, with an estimated global market growth from $7.9 billion in 2022 to $31.0 billion in 2032 (Allied Market Research, 2023). They are now a cornerstone of popular culture, increasingly becoming a significant and profitable part of the leisure market with increasing interest in their pedagogic use (Stone, 2016) as they can in many cases be easily aligned with curriculum goals and active learning practices, as well as provide motivating and authentic opportunities for collaboration.

Escape rooms are immersive themed environments in which a player or team of players solve puzzles, discover clues and accomplish tasks to achieve a specific goal, usually within a limited amount of time (Nicholson, 2015; O'Brien and Farrow, 2020). They evolved from single-player digital point-and-click escape-the-room games to being developed as real-world spaces and subsequently being developed to use in classroom environments. In the first iterations of these games, the mission was usually to 'escape' from a room in a limited time, however the educational adaptation of such activities sees the intention change according to the context in which they are used, to align with learning objectives (Veldkamp, et al., 2020a).

From an educational perspective, escape rooms (as well as escape boxes and escape games) align well with active, experiential learning opportunities that enable students to be immersed in their learning. Recent years have seen educators adopt escape rooms (both physical and virtual) into their curricula in a variety of contexts including skill development such as critical thinking, communication and problem solving (Wilby and Kremer, 2020; Avargil, Shwartz and Zemel, 2021), as well as domain knowledge and skills in subjects including medicine and allied areas (Gómez-Urquiza, et al., 2019; Wilby and Kremer, 2020; Rodríguez-Ferrer, et al., 2022), pharmacology (Hermanns, et al., 2017), genetics (Brady and Andersen, 2021), and software engineering (Gordillo, et al., 2020).

In understanding the pedagogic basis for escape rooms, it is important to recognise that their interdisciplinary nature and their origins as a commercial entertainment form means that the language used to describe their educational potential is not always consistent. It does, however, predominantly draw on discourses of learning that is active, gamified, and game-based. Escape rooms are learner-centred active learning opportunities (Adams, et al., 2018) that develop communication and teamworking skills (Veldkamp, et al., 2020a). They can also be considered as gamified systems, which add game mechanics to non-game activities through rewards and points (Deterding, et al., 2011) to increase motivation, add structure and rewards to learning activities (López-Belmonte, et al., 2020), and improve learning outcomes. Although the use of gamification has mixed results and is not without its critics, Brady and Andresen (2021) argue that proper implementation can result in effective escape rooms that increase engagement and motivation for learning.

In addition, escape room pedagogy draws on the literature of game-based learning, which learning seeks to use educational games, either digital or traditional, to teach curriculum content, skills, attitudes, behaviours as well as engage or motivate learners. Promoting learning opportunities by incorporating games into the curriculum has the potential to increase participation of learners who may not have previously engaged (de Freitas, 2006), increase motivation (Deterding, et al., 2011), support experiential learning (Whitton, 2007; Strickland and Kaylor, 2016), and build player agency and well-being (Barr and Copeland-Stewart, 2022). Game designers such as McGonical (2011), Koster (2005), and Schell (2008) reflect on the enjoyment of games as deriving from the process of learning, which is also reflective of the work of Gee (2003; 2007) who considers games as transformative teaching opportunities that provide ways of motivating learners in ways that traditional education does not. However, digital game-based learning has been critiqued for prohibitive costs, complex authoring, long development timelines, and implementation challenges (Begg, 2008; Whitton, 2012; Dichev and Dicheva, 2017) and escape rooms offer a cost-effective approach that overcomes these issues to some extent.

Reflecting on whether games are effective learning tools, de Freitas (2018) argues that research findings point toward significant improvements learning in games over traditional methods, and these are further enhanced by blended approaches that use game and face-to-face approaches. However, establishing efficacy of learning

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is a complex task that must be contextualised within a wider understanding of how learning happens. Using games does not guarantee a student will be more engaged, motivated, or produced improved learning outcomes.

As well as drawing on the literatures of game-based pedagogy, escape rooms can also be theorised as playful learning environments in which players are intrinsically motivated to collaborate safely, imagine possibilities, take risks, step out of their comfort zones, and – crucially – learn by making mistakes and reflecting on them to move forward. This model of failure-based learning through play is explored in detail in the sections that follow.

3. Failure-Based Learning Through Play

Failure is an inevitable part of life and yet at our schools and universities failure is primarily constructed as something that should be avoided rather than an experience that can be learned from productively. As a result, many students come to university never having experienced significant failure and not having the resources and resilience to deal with it when it does happen. Moreover, the emphasis placed on one-shot, high-stakes assessment leads to an understandable fear of failure among many students. Fear of failure in education can manifest itself in a variety of ways, including avoidance of tasks that might potentially be failed, feelings of shame and personal embarrassment, self-handicapping through activities that remove responsibility for failure such as getting too little sleep or using harmful substances, and learned helplessness, where students perceive that they have little control over their personal situations (Choi, 2021).

Learning how to fail well is a crucial life skill. Self-awareness relating to managing failure is likely to result in a confident individual who is more open to risk taking, and it is only through measured risk-taking that creativity and innovation happens. Failure-based learning is an approach that aims to support students in learning through their failures, supporting both the learning process and building resilience to manage failure itself. Darabi and colleagues (2018) identify five theoretical perspectives that underpin failure-based learning: cognitive disequilibrium where learners strive to update their mental models as a result of failure (Piaget, 1952); impasse-driven learning where failure encourages learners to overcome the impasse causing them to try again by seeking help (VanLehn, 1988); productive failure where students are supported in attempting to provide multiple solutions to difficult tasks (Kapur and Rummel, 2012); failure-driven memory where learners deliberately explain and understand how failure occurred to learn through deliberate practice (Ericsson, Krampe and Tesch-Römer, 1993); and the theory of negative knowledge where non-viable knowledge is seen as beneficial because it leads learners to a more comprehensive understanding of a topic (Gartmeier, et al., 2008).

While there are few studies that investigate failure as a learning strategy, a meta-analysis on learning with both children and adults by Darabi and colleagues (2018) showed moderately positive effects from the approach. Other researchers have found negative effects, such as Eskreis-Winkler and Fishbach (2019) who found in five studies that students learned less with failure, which they argue is because failure is ego-threatening; there is also evidence that failure can lead to decreased confidence (Jackson, et al., 2022). This serves to highlight the importance of the development of safe and collaborative communities of learning in which failure is seen as positive and does not negatively impact on confidence or wellbeing; supporting the development of the magic circle that underpins the value of playful learning.

The use of playful learning approaches is growing in Higher Education (James, 2022). These approaches encompass a suite of playful tools such as games and toys, techniques such as role play or quest-based learning, and tactics such as storytelling or surprise (Whitton, 2018). In addition, playful learning adopts a philosophical position that is exemplified in its signature pedagogy as learning that is open and democratic, accepting of risk and failure, in which learners are intrinsically motivated to enter into the spirit of play (Nørgård, Toft-Nielsen and Whitton, 2017).

The theoretical framing of the magic circle (Huizinga, 1955; Salen and Zimmerman, 2004; Remmele and Whitton, 2014) is useful for understanding the theoretical relationship between play and failure. The magic circle is a mutually constructed space, in which a game is played, which may be signified by objects (e.g., a chess set or a football pitch), may be implicitly constructed by the players (e.g., games of house, banter), or set out as immovable rules of play (e.g., in a video game). By playing a game, players voluntarily agree to abide by the rules of the magic circle and in so doing this means that there are limited consequences of the game in the real world, although it would be impossible to remove these entirely. Magic circles provide spaces for players to imagine possibilities and explore other worlds from within the alternative possibility space of the game. Games are not designed to be easy, but to engage players by keeping them in a state of flow where increasing challenges meet increasing skills (Schell, 2008) and therefore failure within the magic circle is a natural and expected part of game

play. As such, playful learning encompasses learning from failure as an intrinsic part of its design and escape rooms, when considered as a form of playful learning, present ideal opportunities to learn from failure.

Approaches exist for failure-based learning in lectures (Lee, Do-Yeop, Yoon, Cheol-Hwan and Park, Chan-Sik, 2011), within case-based learning (Rong and Choi, 2019), and using failure for learning within the context of art and design (Sawyer, 2019). Tawfik and colleagues (2015) present a unified design approach to failure-based learning that highlights four principles that can be used to design learning environments that support learning from failure: 1) allow learners to identify and redefine conditions for success and failure; 2) design the learning environment to intentionally cause students to encounter failure; 3) support reflection on failure; and 4) support solution generation to resolve failures. However, we could find no model published that explicitly links failure-based learning and playful learning, and this is what we present here.

3.1 A Model of Failure-Based Learning

This original model of failure-based learning was a developed during the first two years of a project that explored how the creation of escape rooms could be used to support experiential and collaborative learning for high school students (described in Whitton, 2018). The *EduScapes* project, which ran from 2016-18 supported groups of senior high school students (aged 17-18 years) to iteratively develop escape rooms as a school enrichment project. These rooms were subsequently played live for delegates at a national education conference. In the first two years of the project, twelve students took part each year with three escape rooms developed during a two- or one-week block after the school exam period. In the final year of the project, we expanded the programme with forty students taking part over a six-month period to develop eight different escape rooms.

Ethical approval was granted through Manchester Metropolitan University to undertake focus groups with each of the student groups, and interviews with teaching staff, which were carried out by an independent researcher. Group interviews were transcribed and analysed using thematic analysis (Braun and Clarke, 2006) to better understand the students experience of involvement in the project and explore how to scaffold failure during the game development process so that students saw it as productive rather than negative. The model of failure-based learning presented here emerged from the data analysed during the first year of project and was refined and tested in the second year. The expanded version of the programme is used as one of two case studies in the following section that demonstrate how this model for failure-based learning might be applied to both playing and building educational escape rooms.

Bringing together the student and staff experience data with the reflections of the project team and the literature on designing productive failure in education, we developed and refined an original model for designing failure-based learning (see Figure 1). This model describes iterative cycle of play through testing, failing, reflecting and revising preceded by a preparation activity and followed by a presentation activity. While it was derived from an escape room design project and we apply the model to escape rooms in this article, we also hypothesise that it could be more widely applicable to the design of any failure-based learning experience.

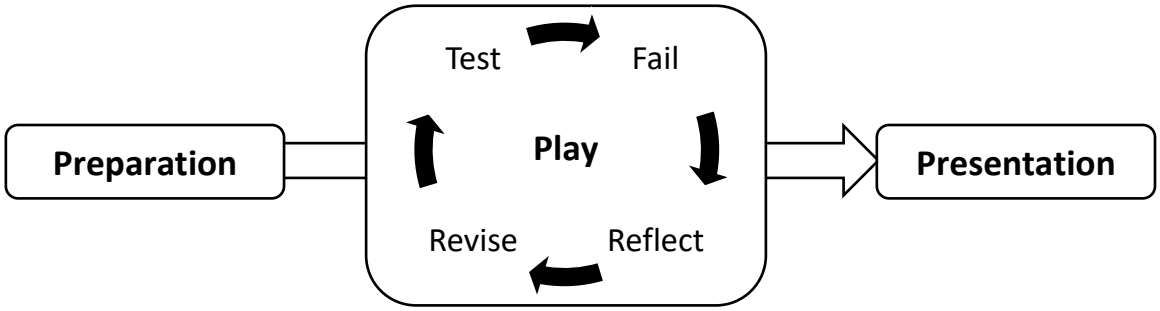

Figure 1: Model for failure-based learning

The model consists of three phases: preparation, play, and presentation. In the **preparation** phase, students are introduced to the idea of games and their benefits for learning. In the case of escape rooms, this can involve learning what escape rooms are and how they work, playing an actual escape room, undertaking puzzles, or other initiation activities that both introduce the idea of an escape room and support students to work in teams and trust one another. This phase is important as it signifies an initial movement into the magic circle and development of the trust and group bonding that makes failure safer.

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The **play** phase is the longest in this model, and it is in this phase that ideas are generated and tested, through an iterative cycle of developing and testing propositions, inevitable failure at times, reflecting on those failures, revising ideas, and then testing again. In this phase game mechanics such as scaffolding, gradual increases in difficulty, or hints and clues can be used as learners grow used to learning from failure.

The final phase of the model is the **presentation** phase in which the outcomes of play, learning, or development are presented and reflected upon. The final reflection is crucial to learning from failure because it presents the experience as a positive one for learning, even if the outcomes of play are not in themselves successes.

What is important to consider in this model is the way in which the Preparation and Presentation phases provide entry and exit points to the magic circle of play, similar to the briefing and debriefing that is key to game-based learning (Crookall, 2010). Often, when playful learning or game-based learning is used, too little attention is given to how to remove the initial barriers to play at entry point or how to enhance learning and reflection at the exit point through thoughtful conversation initiation and closure activities. These phases are important for mitigating any impacts of the game play subsequently in the real world, maintaining the sanctity of the magic circle as a separate space.

4. Failure-Based Learning in Educational Escape Rooms

We assume reality is a social construct and understandings of the world cannot be truly objective, but that meaning is continually constructed individually, and shared understandings can be reached through discussion with others to understand their personal interactions with their environment (Coe, et al., 2017). From this, we understand it is the role of the researchers to make sense of these multiple perspectives through interpretive analysis. To remain consistent with the outlined epistemological position, case studies were used to address the following research question: how can the model for failure-based learning in educational escape rooms be applied in a learning context?

In this section, we present two case studies showing different ways in which escape rooms have been used in education and show how the model presented can be applied to support learners to fail progressively and learn through failure in each case. Using a case-based approach enabled us to generate an in-depth, multi-faceted understanding of how this model worked in different educational contexts with two specific and distinct groups (Crowe, et al., 2011).

The first case study explores an example of using escape rooms to teach curriculum content, in this case learning about the potential of escape rooms for learning by playing escape rooms. The second takes a different approach by exploring the potential of learning through failure in escape rooms but facilitating students making the rooms themselves and the game design process that underpins it.

4.1 Case Study 1: Learning by *Playing* Escape Rooms

This case study explores a 'puzzle design in the classroom' workshop that follows the model for failure-based learning with escape rooms by demonstrating escape rooms as frameworks for productive failure. This workshop ran three times between 2021-2023. Participants were teaching staff from Durham University. The first workshop had 14 participants, the second iteration had 12 participants and the third iteration had 25 participants. Ethical approval for study of this workshop was granted by Durham University and participants consented to artefacts they produced being used as part of this case study.

The puzzle workshop was delivered synchronously online over two hours and took the following format:

- Pre-work (preparation phase);
- 20 minutes introduction to literature and briefing (preparation phase);
- 60 minutes escape room (play phase);
- 40 minutes debriefing (play moving into presentation phase);
- Post-workshop reflective activity (presentation phase).

Preparation: This course teaches *about* escape rooms, *using* escape rooms. Engaging participants in the preparation phase lays the groundwork for groups to build trust and prepare to work together, which is an important first step in reducing barriers to enter the magic circle. The escape room is used as an object to think with and deconstruct in relation to failure, which can be helpful to support participants in moving between conceptual areas of difficulty. They also provide a mutual language to understand and communicate decision making, problem solving and failure, both within the game and broadening out to a learning context. This is the 'so what?' stage.

The pre-work involves participants reading a paper that positions the session within literature and introduces the theoretical concept of the magic circle (Huizinga, 1955; Salen and Zimmerman, 2003). Participants are asked to suspend their disbelief and immerse themselves in the spirit of play, or adopt a 'lusory attitude' (Suits, 1978) for the duration of the workshop. The groupwork starts as soon as participants join the synchronous workshop where they are assigned to an exploration group. Through guided discussion and planned activities, groups get to know each other before starting activities. To alleviate pressure on play and recognise peoples' different levels of comfort and preference relating to playing and participation (Whitton, 2010), participants choose their level of involvement and their own adventure. They are encouraged to work collaboratively to choose or devise 'roles' (e.g. playing with pre-prepared escape rooms, designing puzzles, exploring literature, and observing and reflecting on practice). Easing pressure on 'playing' makes the preparation phase more inclusive, enabling groups to enter the magic circle and feel more comfortable with failure.

Enabling participants to find their own paths and explore personal curiosities has been key to encouraging productive failure as we have found that participants are more likely to try and fail if they perceive they are in a safe space to do so. We also found evidence that this supports participants in determining which approach works best for their practice and connecting the two (Brady and Andersen, 2021). For example, one participant reflected that:

> *"This magic circle made a safe space and increased motivation for team working in our group. After experiencing this myself, I overcame the fear of stepping outside of my comfort zone and decided to let my students manage an important part of their module. My students were extremely engaged and excited to be involved."*

Play: An effective way of working through difficult real-world concepts is by experiencing them, with opportunities to reflect on, discuss and contextualise experiences. Using this approach to introduce escape rooms and failure encourages active involvement in, design of and playing with ideas. To allow and support this, one third of the session is dedicated to guided debriefing.

During this phase, participants attempted a pre-planned escape room with a brief that introduces the narrative of the escape room and positions it as an activity without a solution. Their task is then to figure out which puzzle is unsolvable and correctly identifying the puzzle results participants progressing. Participants worked in online breakout rooms so that they could navigate the online activity and have access to workshop facilitators. They were advised to call on facilitators for clues or hints.

Participants then had sixty minutes to work through an online escape room in their groups. The escape room was made up of different types of puzzles, starting with a puzzle to relate the content to literature (e.g., this puzzle used a playful learning article, participants solved clues which led them to the word 'lusory', which unlocked the next activity). Such activities encouraged group cohesion and confidence using the online system and moving through a range of textual, hidden object, and logic puzzles that contained the information needed to meet the workshop learning outcomes. There are prompts throughout for groups to discuss different approaches to problem solving, and failure, exiting and entering the magic circle as they progress and their confidence in failure progresses.

Solving puzzles unlocks information relating to escape room design and the final capstone puzzle challenged participants to put into practice what they have experienced during the game, developing their own puzzle (with extra points for involving failure). Participants highlighted the impact of learning to fail on their own classroom practices, for example:

> *"Since experiencing failure through an escape room I've felt confident to try similar [ones] in the classroom. Students said the discussion was the most valuable part of the module and ask to repeat it."*

Presentation: The final third of the synchronous workshop was used for the presentation phase, where participants shared the outcomes of play, learning and development. The first part of the discussion was scaffolded around failure and positively framed this experience within the activity. The second part was for sharing the results of the puzzle design, again positioning within failure-based-learning and exploring the participants' experiences of the activity.

During the workshop, participants initially struggled to get to the point of revising puzzles, instead using their time to discuss failure and future practice. So, to better support this part of the model we implemented a follow up meeting for playtesting puzzles and getting peer feedback. We discovered that workshop participants

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sometimes take time to appreciate the value of testing and refinement, but eventually see the value for themselves and for their own participants, for example:

> *"After playtesting my idea with colleagues, I used a social psychology crossword puzzle with my students. The students fed back that they liked that the activity made them feel capable."*

The use of failure-based learning with escape rooms has enabled us to frame discussions around failure in a positive and productive way, while situating it in personal experience and encouraging participants to actively reflect immediately afterwards. For the most part, participants reported this as a valuable opportunity to think about their practice and how this might be useful in other contexts, as well as reporting feeling more confident. Even those participants who remain sceptical leave the workshop having experienced failure in a safe way, and we hope that at the very least we have opened their minds to the possibility of progressive failure as part of the learning process. In the words of one participant:

> *"I'm interested in puzzles and failure but felt very ill equipped to implement anything like it. I struggled to see how it would work in my field. Having spent time reading, attending the workshop, and trying things out, I've come to realise these concepts can be applied to anything. It's about thinking creatively."*

4.2 Case Study 2: Learning by Designing Escape Rooms

Many examples of the use of escape rooms in the literature provide evidence of the efficacy for teaching students in the context of game play (e.g. Alonso and Schroder, 2020; Moore and Campbell, 2021; Wilby and Kremmer, 2020) but there is also a compelling literature that game-making is a valuable approach (Earp, 2015). Perhaps unsurprisingly, it is an approach most commonly used in computing (Wu, et al., 2009; Xinogalos, 2018; e.g. Santana-Mancilla, et al., 2019) and has also been used in non-digital disciplines, for example to facilitate idea generation and creativity (Triantafyllakos, Palaigeorgiou and Tsoukalas, 2011), teaching information literacy (Frydenberg, 2015), sustainable behaviours (Mercer, et al., 2017), and social class and inequality (Sandoz, 2016).

During the final year of the *EduScapes* project outlined earlier, forty students volunteered for the project during which the developed model of failure-based learning was tested over a six-month period during which eight escape rooms were developed and run in a public space.

Preparation: Many students who took part did not know each other before the project started, so the preparation phase had three aims: first, to introduce students to the concept of escape rooms and build understanding on designing them; second, to act as an induction for students to meet and better get to know each other before they started working together; and third, to demonstrate some playful techniques that would help students learn and collaborate throughout the project.

There were four stages to the preparation activities, taking place over two days, which are described in greater detail by Woolley (2019). This extensive preparation process was important both for scene setting and team cohesion. These stages were:

1. Developing understanding of puzzle typology in a collaborative quiz and workshop.
2. Experiencing an *EduScapes* room from a previous student cohort, showing what can be achieved over a relatively short period of time on a small budget.
3. Understanding critical paths for escape rooms using examples to unpick and explore, particularly focusing on what worked and what could be improved.
4. Experiencing a commercial escape room in final teams, supporting both the application of knowledge already gained and further teambuilding.

This stage of the process was appreciated by students for building trust and allowing them to feel comfortable with the task and each other in an environment where mistakes were inevitable.

Play: After the preparation phase, students independently began the process of designing and creating their escape rooms through an extended process of design, test, fail, reflect, and refine as described in Figure 1. Broadly speaking, students were encouraged to carry out their developments in three stages once they had agreed upon the overall theme and the critical path for puzzles. First, they were expected to prototype individual puzzles on each other and outside of the group. Second, they were asked to combine all the puzzles into a 'paper prototype' version of the complete room, for playtesting with other groups and peers. At this stage, escape room experts from the university also tested and gave feedback on the rooms. Finally, the groups could use their small budget to purchase and assemble the final kit required such as locked boxes, padlocks, and theme props, and the completed rooms were given a final test by peers, teachers, and parents. In total, students were expected

to have their rooms tested a minimum of ten times over the development period, with each test leading to further refinements.

The focus group data highlighted a range of skills that students believed they had learned from involvement in the project. These included expected areas such as teamwork, time management, planning, organisation, problem-solving, creativity, initiative, flexibility, and independent learning. There was also evidence that the students valued the iterative design process of learning through failure:

> *"… you've kind of just got to get stuck in, make something, test it, and if it doesn't work, change it."*
>
> *"… it kind of gives you the skills of when something doesn't work, not just giving up but trying to find a solution."*
>
> *"… to keep refining something and improving it because there were a lot of flaws, a lot of things that could be made better. There are always things that can be done better with it and by doing the Escape Room and having other people test it, then you can really make it better."*

Another unexpected area was highlighted by several students. They described the importance of learning about different ways people engaged with puzzles and played while in the room, which they identified as a key learning outcome. For example, students said:

> *"You think people are going to think one way, but you can't really predict what everyone's going to think or do. What you think they're going to do may not be right because people think differently."*
>
> *"I learnt that not everyone will think the same way, some people will think of things you didn't think anyone could actually think of and you have to adjust for that when making it."*

Related to this was the joy that students found in watching others – particularly teachers – struggle with puzzles that they had created.

> *"When you watch people do it and you know all the answers, it's, kind of, the frustration and the humour side of it. We were laughing at them. It's the frustrating side of you knowing they are looking for the right thing and then they go off on the wrong track. It's trying to lead them back on the track with the hints and stuff. That was probably my favourite part of it."*

The process of creating rooms that other people could not solve easily increased students' confidence, and seeing teachers fail in their rooms changed the way that several thought about the dynamic between teacher and student.

Presentation: In the final stage of the model, each student team was asked to run their escape rooms for a live audience of conference delegates at the Playful Learning Conference in Manchester. The delegates were a friendly group with a high awareness of escape rooms, which reduced the pressure on students, but they were still expected to deliver a professional product.

At the end of the day, students were asked to reflect in their groups on what they had learned during focus groups. Sharing their finished products with the 'public' proved to be one of the most important aspects of the project for many:

> *"When it all comes together and you see someone do the room and it actually fully works, I think that is really satisfying."*
>
> *"You see everything that you've conceptualised and discussed and tested finally come together and they are enjoying it and having a good time, which is the most important thing."*

By providing a real-world opportunity for students to present their creations we were, in a way, providing a type of authentic formative assessment, but without the pressure of high stakes grading or one-shot outcome.

5. Conclusions

Students often come to university without experience of failure or the resilience to deal with failure when it happens. Learning how to fail and manage failure is a crucial skill that supports risk-taking, problem-solving and leads to innovation. We can learn from the way failure is handled in games and use this to better support productive failure in educational contexts. Escape rooms as a form of play can provide a framework for learning about failure through tools, techniques, and tactics such as: clear goals and narrative, a requirement for problem-solving and lateral thinking and surprise.

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However, using escape rooms in learning is not without challenges. For example, playing, and failing, is not something that appeals to everybody. For those who choose to play, they may not enter the magic circle as intended but instead focus on cheating or be overly competitive and winning. Using games in education can be a difficult balancing act between incorporating game elements and fun, while also retaining the purpose of the educational context. The wrong balance could misalign or skew the activity, shifting the emphasis away from learning.

Inadequate briefing or debriefing around failure could potentially result in low-confidence, ego-driven engagement, or frustration from players. To counter challenges, we believe it is important to take time during the preparation phase to develop a safe collaborative community of learning from the outset of activities, in which failure is framed as a positive outcome, and does not negatively impact on confidence and wellbeing. This may be achieved by following the preparation, play, presentation model outlined in Figure 1 and retaining the importance of briefing and debriefing in such activities. As demonstrated in both case studies, different applications result in different challenges and outcomes, however both lead to opportunities to problem solve resulting in authentic learning without the pressure of high stakes grading.

The model we propose has power in its simplicity. It centres on the importance of the magic circle, a mutually constructed safe space that mediates the relationship between play, and failure in a supported space. It constructs the escape room as a framework for learning from play as well as a safe space to learn from failure. The three stages of preparation, play, and presentation open gateways in to and out of the magic circle of play, removing initial barriers to play at entry points, opening different options and ways in which learners can engage, and enhancing learning and reflection at exit points through thoughtful conversation and closure activities.

This model can potentially provide a pedagogic framework for educators using escape rooms as part of their practice, as well as those who want to think more broadly about supporting learning through failure by explicitly considering how to provide opportunities to make mistakes productively. While this model has been developed in the context of escape rooms, a future direction for research would be the applicability of this framework more generally to other forms of pedagogy, embedding the benefits of failure-based learning more widely into curricula and supporting students to fail, take risks, innovate – and have fun while they do.

Ethics statement

All participants gave their informed consent for inclusion before their information was included in the case studies described.

Case study 1: Durham University DCAD-2023-06-15T16_09_02-kfqn12

Case study 2: Manchester Metropolitan University ED-1718-17

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