



Designing educational escape rooms

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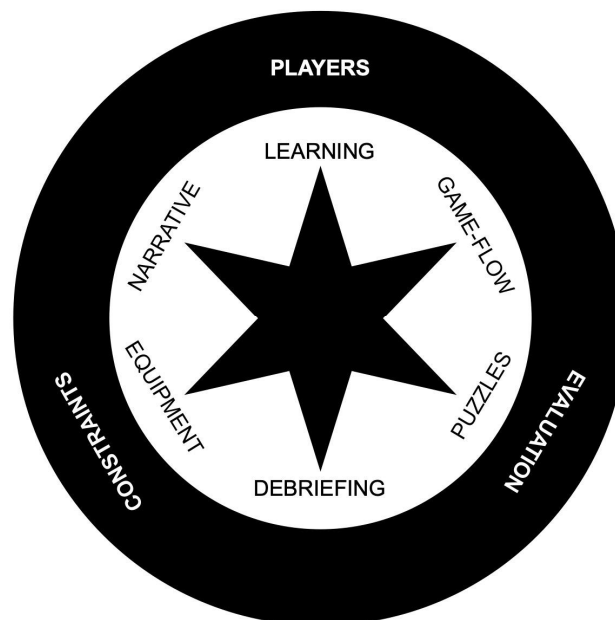


1. Introduction

This guide will work through the process of designing an educational escape room from scratch. It follows on from the first guide - using escape rooms in teaching and aims to provide a reference for teachers who do not want to use educational escape rooms off the shelf. In some cases finding and adapting one can be as time-consuming as developing oneself, and is less fun. It's relatively straightforward to design your own escape game, but some specialist knowledge is required, which this manual aims to provide.

Designing an escape room: an overview map

How can we describe an educational escape room in terms of design? What are the elements that we should think of, develop and match with one another in order to generate an effective and engaging game-based learning experience? This model is presented as a further development of the EscapED model (Clarke, Peel, Arnab, Morini, Keegan & Wood, 2017).



From a design point of view, an educational escape room is a game device composed of six key elements, represented as the points of the star in the model. Four of them are also found in leisure escape rooms:

1. The **NARRATIVE** is the story heartbeat that pulses life into the escape room. The narrative provides an overarching theme that – if respected – can support the consistency of the experience and promote immersion and engagement.
 - a. The narrative suggests the mode or type of the escape room: escaping a prison, solving a mystery, liberating hostages, etc.
 - b. The narrative can be stand-alone (like a full movie) or be framed as an episode in a series.

2. The **GAME-FLOW** describes the structure of the game experience for the players. Typically, an escape room has different phases (an introduction into the escape room 'world' and narrative; an exploration, solving different puzzles to get a code, unlocking a big challenge, etc.).
 - a. Activities within an escape room can be sequential or parallel or follow more complex patterns.
 - b. While commercial escape rooms are usually designed for a few people, educational escape rooms are often designed to host classes of up to 20+ students. Groupings are part of the game-flow design.
 - c. When multiple players or groups play an escape room, they can be competitive and/or collaborative.
3. Solving an escape room means solving a set of **PUZZLES**, that can be of many different kinds, involving both cognitive and physical abilities: finding objects in a room, breaking a code, translating sentences, doing math, building objects from components, programming, etc. Matching puzzles to learning goals is often the hardest challenge in educational escape room design. Also, puzzles should be clear, i.e., they should look like items that require a solution, and provide a clear feedback when solutions (correct or incorrect) are tested. The provision of specific hints and or hint rules (when should a hint be given? How?) is also part of the development of puzzles.
4. An escape room materializes into a set of coordinated **EQUIPMENT**, physical and/or digital. This includes:
 - a. The room itself
 - b. The elements to be manipulated in order to solve the puzzles (crosswords, riddles, sudokus, hidden clues, etc.)
 - c. Technological elements (a projector, lights, loudspeakers, etc.)
 - d. Lockers or other blocking elements (padlocks, chains, passwords, etc.)
 - e. Often, a stopwatch is required.
 - f. Narrative elements (video, audio, printed documents, etc.)
 - g. Props that embody the theme or setting
 - h. In some cases, actors (or a game master) are necessary to play an escape room

These four elements describe a generic leisure escape room. When an escape room is designed as an educational activity, two additional elements come into play, namely:

5. The envisaged **LEARNING** process, which is actually the reason of existence of an educational escape room. This entails
 - a. The targeted learning outcomes in terms of (extra-) curricular content, (inter- or multi-) disciplinary competences, and soft skills.
 - b. The expected learning process, i.e., how the learning should take place. Is the content to be learned part of the background story? Are specific competencies developed through puzzle solving? Etc.
6. The **DEBRIEFING**, which is a key (but often overlooked) after-game phase in which the learning cycle is completed (Betrus & Botturi, 2011):
 - a. Players are made aware of the learning that occurred during the gameplay.
 - b. Players are helped to connect it to prior learning and to the broader learning process in which the escape room is included.

As with any game, all elements should be *consistent* with each other: this makes the escape room interesting, engaging and effective. During the design process, the six elements should connect to each other to form a seamless experience. For example, the puzzles in an escape room should be consistent with the storyline, and their solution should carry it meaningfully forward; also, puzzle and narrative should support learning; etc.

Nonetheless, they are also *independent*, i.e., each of them can be (at least partly) changed without necessarily requiring to change the others. For example, a designer might decide to change a single puzzle (e.g., after a revision): the new puzzle should of course match the narrative and the props, but in principle that would not necessarily require changes to the background narrative or the props; or, to adapt the game-flow to multiple group play without changing the narrative and learning elements.

For those familiar with game design, these elements correspond to traditional game design elements (Salen, Tekinbaş & Zimmermann, 2004): The narrative/theme corresponds directly, the game-flow corresponds to the game design, the puzzles correspond to the game mechanics, and the equipment corresponds to the game interface. The elements and their interrelations can be understood as design layers in the terms of Gibbons (2013).

As well as the key ingredients (or design layers) of an educational escape room, the design of an escape room should be informed by its context. The star model defines three relevant dimensions that should be analysed *before* starting the design process and that influence all the above-mentioned design elements.

1. The **PLAYERS**, who are often students, and who have specific characteristics (demographics, attitude towards the subject matter or content, attitude towards playing for learning, etc.), and that can be of a specific number (e.g., classes of 15 or 20 or 25 students). Understanding your players corresponds to the regular “learner analysis” included in most Instructional Design models (Morrison, Ross, Morrison & Kalman, 2019).
2. Possible time and space **CONSTRAINTS**, e.g. available space (the room might be small; or there might be multiple rooms available), or time (e.g. if the escape room must be played within a specific school period), or the availability of specific equipment, etc. The learning outcomes themselves also constrain the content of the escape room, such as matching to the curriculum. This can be intended as a context analysis.
3. How designers intend to conduct the **EVALUATION** of the escape room (see, for example, the guides and questionnaires produced as part of this project). This is different – even if complementary – to the evaluation of the learning that took place in the escape room. Arnab & Clarke (2017) understand evaluation as a main component in GBL development: designers should identify specific moments to observe, or specific artefacts to collect and analyse afterwards, or specific questions or feedback to be collected from players after the game.

2. A process for educational escape room design

Designing an escape room is not an easy task: a room has many components and their interrelatedness might seem to be a formidable challenge for novices. In this section we will outline the main steps that the design should follow. While a generic reasonable and effective design process can be devised (and should be tentatively followed), any design activity will inevitably

move back and forth from one element to the other, striving to follow inspiration and ideas (which may come from any point and at any time), and at the same time keep the overall design consistent.

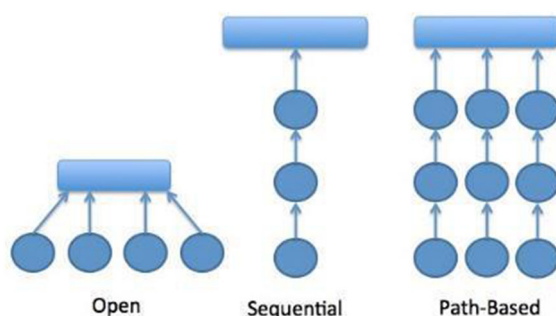
1. Define learning outcomes (→ **LEARNING**)
2. Identify constraints (time, space, people) (→ **CONSTRAINTS/PLAYERS**)
3. Determine type of escape room, breakout box, or escape-inspired activity
4. Find core theme/narrative (→ **NARRATIVE**)
5. Create overview map of puzzle flow (→ **GAMEFLOW**)
6. Design individual puzzles (and playtest) (→ **PUZZLE**)
7. Bring puzzles together into complete room (and playtest)
8. Design physical space and scene-setting (→ **EQUIPMENT**)
9. Achieve game balance
10. Review against learning outcomes (→ **DEBRIEFING/EVALUATION**)

Designing an escape room also includes thinking about the ease of resetting the room to play again (i.e. playing it over again with different players/groups/classes). During the design it is therefore important also to consider the practicalities of the escape room management.

It is impossible to overstate the importance of play-testing in this process; players never behave as you expect them to and it is only by having your game played over and over that you will be able to create a robust educational escape room. It is also important to consider how many people will be involved in the design process. While it is quite possible for a single person to design a room, the ongoing process of critique and refinement that takes place when working as a team can be invaluable.

The game-flow

It's relatively easy for teachers to define good teaching targets and to find a narrative scenario. Designing a game-flow instead is less common: in an escape room it is a matter of designing the puzzle sequence that players would have to solve to get out of the room. Escape rooms could have a predefined sequence (sequential game) or a more flexible one (open puzzle sequence), or even hybrid solutions with more paths (Nicholson, 2016).



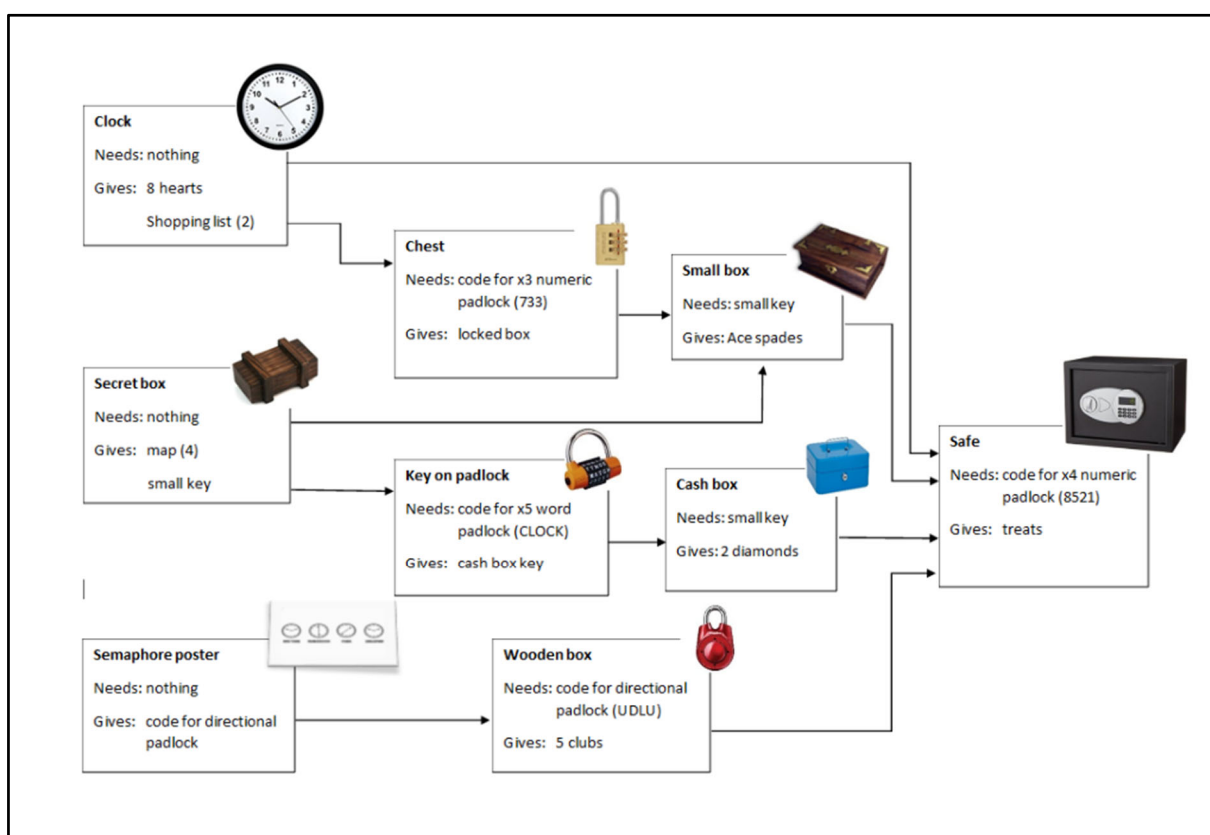
From Nicholson, Scott. (2016). The State of Escape: Escape Room Design and Facilities. Paper presented at Meaningful Play 2016. Lansing, Michigan. Available online at <http://scottnicholson.com/pubs/stateofescape.pdf>

You also need to consider whether there is something for everyone to be doing during game play. This will depend on the degree to which the puzzles are open or sequential.

A game that is entirely open may lack narrative flow, while a fully sequential one may leave some players on the sidelines. A balanced combination of different parallel paths provides a solution, but need careful playtesting to ensure that some paths are not more difficult than others.

Designing an escape room

There are various different approaches you can take to designing a room; but it is important to have a system that let you record (and play with) the game-flow of the room, the puzzles and the order they can be completed in, and the key objects that the players need to interact with. A simple way to do this is by creating a room map - this details each individual puzzle and provides a memory aid to where it is located in the room, and visibly shows the flow of the room in terms of the order in which the puzzles must be completed.



A room map is useful for checking for consistency in the room design, sharing the design with others in the design team, and acting as a key to re-setting the room once it has been played. It also provides an overview of the room and enables you to holistically consider the game balance:

- Have you included a range of different types of puzzles (see section 3 on puzzle design)?
- Have you included a range of different difficulties of puzzles?
- Have you used a variety of different types of lock, such as physical (padlocks, keys), mechanical (magnets, weights, gears), and electronic (computer passwords)?
- Are there lots of different things for people to do (e.g. searching for objects, solving puzzles, opening boxes)?

Integrating the narrative

It is also important at the start to consider how the narrative will be integrated into the game - will it be the key to solving the puzzles or simply add to the ambience of the game. You need to think creatively about how to bring the narrative into the game from initial briefing through to the end game. For example, if your game is set in a science lab you could ask participants to wear lab coats and name badges, which would be used in a puzzle. You also need to think early on about the finish of the game - what is the object from the players' perspectives and how can you make it as satisfying as possible if they achieve it? It might be to escape a room, but could involve defusing a bomb, or solving a mystery. Again, tying this together in a coherent narrative can significantly add to the players' enjoyment of the game.

3. Designing puzzles

Once you have an overview of the structure of the game, you can get down to thinking about the individual puzzles. In order to cater to a wide variety of players it is good to have as many different types of puzzles as possible.

There are lots of possible types of puzzle, for example:

- **Finding things.** Such as objects hidden within the room, either in objects with secret compartments, in pockets of clothing, or even in plain sight, sometimes hidden clues need something else before they can be discovered, such as messages that need an ultra violet torch to be read.
- **Spatial puzzles.** Such as using maps to determine directions, coordinates to identify locations, or overlays show initially hidden information spatially.
- **Physical puzzles.** Such as solving a jigsaw to reveal a message, working out how to access secret boxes, or using tools to reach inaccessible objects.
- **Codes.** Encrypted information using a variety of codes such as Morse, semaphore, substitution cyphers, binary, radio code words, periodic table elements. Codes are often hidden so that the player has to first recognise that there is a code to be solved, for example a flashing light may have Morse code embedded in its sequence. If you use codes you cannot assume that the player will know the code so you have to make it available in the room (e.g. in a book or poster).
- **Graphical puzzles:** Puzzles involve pictures or other graphical elements such as spot-the-difference or counting objects in paintings.
- **Traditional puzzles:** Such as riddles, logic puzzles, word or arithmetic puzzles are often embedded in escape rooms, but it is important to be careful that they fit in with the theme of the game and do not distract from the flow.
- **General knowledge:** Puzzles that rely on external knowledge, such as identifying flags; as in the case for codes you cannot assume that the player has the knowledge so much make it available in the room.
- **Sequences and patterns:** these puzzles are common for end-game puzzles as they bring several elements together; they involve identifying a series of elements and using an external 'key' to put them into the correct order. For example, a series of portraits in a room might show a person looking in different directions - giving the code for a directional lock - but to find out what order to put the directions in you have to realise that the clothes the person is wearing match the colours of the rainbow, which provides the key to other order.

This provides an overview of the most common different types of escape room puzzles, but there are many more possibilities, including ones that haven't been created yet! Puzzles can be combined, and mixed-up; a puzzle of one type can be made to look like a different type - uncovering the puzzle is as much a part of the fun as solving it. Think creatively about how to use puzzles that engage all of our senses, making the most of the physical environment - puzzles that use light and sound are common, but ones that use taste and smell are also used on occasion.

As with all aspects of the game it is important to test each puzzle individually with as many people as possible. Consider:

- Is it clear? Does the player understand what they have to do? Are there other possible interpretations of the instructions?
- Does your puzzle assume some prior knowledge? Can you make this available in some form?
- Is it fair? Is it obvious that it is a puzzle that needs to be solved? Is there a way that they can become unsolvable (e.g. if your puzzle relies on a code embedded in a chess set-up, what happens if someone moves the pieces)?
- Is there only one solution, and is it obvious when the correct solution has been found? This is a very important point: nothing is more frustrating than finding out a puzzle has been solved first try without even realizing!

You might also consider using strategic red herrings, but use these with caution as players may see this a frustrating waste of time. We suggest using red herrings only when they take small amounts of time and add something to the game through, for example, as a short humorous aside, or to include some important learning content.

4. Bringing the game together

Once you have a plan and the core individual puzzles that form the game, you can bring them all together. Playtesting at this stage will enable you to discover whether you have the right balance of playability and learning, and give you the opportunity to refine existing puzzles or add new ones if you think the game needs it. It's also the time to start thinking about the additional elements that you can add - the secrets and surprises that add an extra level to the game.

Now is the time to think about the equipment you will need to make the puzzles work and to set the scene. If you can make the puzzles integrate seamlessly into the environment and staging then it will add an additional layer of immersion to the game. Consider:

- **Staging and props.** What will you add to the room so that it fits in with your theme? For an educational escape room you are unlikely to have a permanent room but there will still be pieces of furniture, pictures, equipment, etc. that you can use to create the look and feel of the room. Is there anything in the room anyway that you can use?
- **Lighting and sound.** If you have control over the light, how will you set it? Will there be music playing?
- **Backstory.** Are there additional elements that you can have in the room that fit in with the narrative and provide colour through a backstory? For example, in a hospital-themed room you could include Get Well Soon cards with a code embedded in their messages.

You will also need to consider how the players will communicate with the gamesmaster (person running the game). There will usually be one gamesmaster per game but in classroom situations it is feasible that many duplicate games are running simultaneously, and you will have to take this into account. If you can build in communication in a way that is in-keeping with the setting and the narrative then it will keep the players immersed in the game environment. For example clues might be delivered digitally through a monitor or messaging on a tablet, they could be given through a telephone or walkie-talkie, or even in-person, say by a 'security guard' in the room.

Another aspect is the challenge management; for an escape game to be the most fun players need to feel it is achievable but not impossible; they need to be given time to struggle with puzzles so that they experience the pleasure of solving them, but not get totally stuck. A game that is too hard will be frustrating, but one that is too easy will be boring. Ideally, if you manage the challenge well, they will complete the room with seconds to spare. One strategy is to make the challenges difficult, but provide hints and clues if necessary to reduce the difficulty. Consider how you will provide hints, whether players will be given on request or when you think they're needed. Will the number of clues be limited, and will you give straight clues or cryptic clues that form puzzles in themselves. Will you plan the hints in advance and work from a script or make them up ad-hoc?

As with all aspects of the game it is important that you test your communication systems and hints and clues. This is your opportunity to interact with the players and influence the game as it takes place so it is crucial that you get it right.

5. Playtesting

Playtesting of your game at all stages is absolutely crucial in order to develop a game that is both educational and fun to play. It is important to test at each stage:

1. *Puzzles* - testing each puzzle individually outside of the complete game.
2. *Paper prototyping* - testing the full game using prototype elements, such as envelopes and cards, before investing in the final kit and padlocks, in order to test the flow and balance of puzzles.
3. *Full game* - testing the complete game with final kit and artefacts.

Just watching people play your game and solve your puzzles will open your eyes to any problems in the game design. It will also allow you to test and refine your hint design system. In an ideal world, each stage above will be tested at least three times (more if possible) in order to ensure that the game is playable and fun.

As well as testing for playability, you need to consider the degree to which your game is achieving its intended learning outcomes. This may be more difficult to measure as a pre-post test model may not work in many real teaching situations, but self-evaluation against the learning outcomes is a useful exercise. This checklist provides a useful tool for self-evaluation of an escape room before testing, and can also be used to guide testing.

What do you have to consider when designing an educational escape room

Checklist

Escape Rooms can be designed, depending on its focus, as either:

- **Theme-driven** (Escape rooms revolve around a theme constructed by the decorations, props, audio tracks and audio-visual materials that are used to match with the theme. However, narrative is not a priority)
- **Narrative-driven** (Escape rooms have a strong narrative and the players are placed into a role inside the narrative through some type of a pre-game video or a story presented by the game master and the goal may tie into this narrative)

		Check	Comments
Theme-driven escape rooms	The theme is clear		
	The theme is motivating for the students		
	The vocabulary and terminology related to the theme are used		
	The decorations, video presentations, audio tracks and props in the room match up with the theme		
Narrative-driven escape rooms	The narrative is present throughout all the experience and it is integrated into the different challenges of the game		
	The narrative presents well-defined characters and/or participants have characters that fit into the narrative		
	Elements in the narrative are consistent with each other		
	Narrative is engaging (motivating)		
Definition of the Educational Goal	The escape room as a whole includes a clear purpose, which fosters critical thought: Example: What you want them to explore/understand or learn are clear		

Puzzles and riddles	The escape room includes a rich and a diverse variety of puzzles and riddles		
	Each puzzle and riddle has a purpose and allows the players to advance in order to reach the goal		
	The difficulty level of the escape room is adequate for the students		
Rewards and/or badges	The rewards, if there are any, add to a high level of motivation		
Transfer of Knowledge	The escape room offers interesting starting points for discussion in class related to educational objectives		
Soft skills	The escape room includes the use of critical, resilient and creative thinking skills and/or knowledge and skills salient for the subject field.		
	The escape room fosters the development of problem-solving skills		
	The escape room provides opportunities to develop social skills (which includes collaboration and communication skills)		
Implementation of the escape rooms	The escape room can be easily adapted (to different environments)		
	The escape room is scalable (to different numbers of participants)		
	The escape room set-up time is reasonable (time needed for first set-up of the experience)		
	The Escape Room reset time is reasonable (time for getting the experience ready again for another group)		

There are also a number of practical considerations to think about when testing your game:

- Is it accessible to as wide a range of people as possible? Particularly thinking about people with disabilities, allergies, or phobias. Think about anything that might potentially be a problem (e.g. flashing lights) and warn participants in advance.
- Is the game safe? Are there any potential things that players could do to injure themselves (don't assume that they won't try silly things!)?
- How are you going to brief the players at the start of the game regarding safety considerations and the rules of the game? For example, games often use stickers to delineate the elements of a room that are not part of the game, or tell players that nothing above head-height is part of the game or that they will not need to move heavy objects.

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