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Design and Implementation of an Educational Escape Rooms Class

Jesus Alvaro C. PATO[ε], Gerick Jeremiah Niño N. GO[♞], Paolo Santino P. CAOILE, Gio Gabriel C. REYES, Joaquin Enrique B. SINJIAN, Jerold Luther P. AQUINO & Maria Mercedes T. RODRIGO

Ateneo de Manila University, Philippines

[ε]jpato@ateneo.edu; [♞]gjgo@ateneo.edu

Abstract: An escape room is a game in which a player or team of players is locked in a room or series of rooms. To exit the room successfully, they must solve puzzles or search for clues within a set amount of time. While commercial escape rooms are typically designed for entertainment, an escape room format can be used as an educational experience as well. A well-designed escape room can heighten engagement, provide immediate feedback, and help practice collaboration and cooperation. This paper describes the design and implementation of an educational escape rooms class at a major university in the Philippines. It describes the class's goals and objectives, and the major elements of an escape room's design. The class was offered during the second semester (January to May) of 2024 and the summer session (June to July) of 2024. The paper discusses two of the escape rooms that were designed by the members of the class, and some feedback from the games' alpha testers.

Keywords: Escape rooms, instructional materials design

1. Introduction to Educational Escape Rooms

An escape room is a game in which a player or team of players is locked in a room or series of rooms (Morris, 2020). The object of the game is to exit the room within a set amount of time. To do so, players must solve puzzles or search for clues that lead to keys or combinations that open locks. Although they are usually designed for entertainment, escape rooms can also serve an educational purpose. Educational escape room experiences can be unique, memorable, and fun. They can heighten student engagement, and they provide immediate feedback and validation. In the best of cases, an escape room puzzle can illustrate how a skill can be used in a real-life situation. Escape rooms lend themselves to practically any subject area domain but are best suited for factual knowledge or skills that students need to master as part of the course (Morris, 2020).

In academic years 2023-2024 and 2024-2025, a major private university in the Philippines offered a three-credit course on the design of educational escape rooms. In this paper, we share the process of designing educational escape rooms and the major components of an educational escape room. We also share two escape rooms designed for these classes. In the discussion of the design, we will show how the students complied with the design process and how their components mapped to the educational goals of the rooms.

2. Design Process

To design an educational escape room, two general methodologies are combined. The first is the design process for instructional materials. The second is a method for planning escape rooms specifically.

2.1 Instructional Design

The design process begins with the instructional design principles found in classic texts like Alessi and Trollip (2001) and Roblyer (2013). The steps in this process begin with an *analysis of the target audience*. The designers need to know characteristics of the learners that have an impact on design decisions. These characteristics may include age, educational level, experience level, cultural background, interests, and others.

The designers then must *define specific learning objectives*. What knowledge or skills are learners expected to gain or to practice while in the escape room? These need to be specific, measurable, achievable, and time bound. Each objective needs to specify content, e.g. math or history, and performance, e.g. compute, locate, spell.

Once the objectives have been stated, the designers must *create opportunities for the learners to demonstrate their knowledge or skills*. If the skill is to compute the sum of two single-digit numbers, the designers must present the learners with problems like 2+1, 4+5, and so on.

The next step is to *curate source materials and activities*. These may take the form of readings, references, multimedia materials, activities, and others.

From these source materials, the designers can *create the multimedia materials that are specific to the learning experience* they are designing. If the source material is a map that shows the seven continents and the goal is for the learner to identify the seven continents, the multimedia materials may be an interactive map that requires the learner to drag and drop labels on different map areas.

The designer must then *organize the materials into a course structure or flow*. The designer needs to know what the progression or flow of topics should be, so that the learners are able to relate one topic to the next.

The final stages have to do with *course delivery*, *evaluation*, and *revision*. Once the materials are created, they must be used by actual students. The designers then monitor how the materials are used, if they are used as intended, and if they produce the desired outcomes.

2.2 Escape Room Planning

When applied to escape room design, the instructional design process includes some steps that are specific to the format (Morris, 2020). First, the designers must *choose an overarching storyline*. A story contributes to immersion and sets the basic premise and motivation for the escape. The story answers questions such as: Why are the players locked in the room? How did they get there? What do they need to do to escape? What are the consequences if they fail? Why is there time pressure?

The designers then must *decide what type of escape room they want to construct*. Physical escape rooms, as the name suggests, are physical spaces with props that players can manipulate. Digital escape rooms are implemented wholly online. A mixed escape room combines both physical and digital elements. For the courses we offered, the students were required to have a mixed design.

Consistent with the instructional design process, the designers must *list what key concepts the learners must learn*. The designers must order these concepts logically and implement them using a variety of tasks.

The designers then *decide on the types of puzzles they want to create*. Lyman (2021) enumerates an assortment of puzzle types. These include codes and ciphers, mazes, crosswords, sequencing or arranging objects, crafting or building objects, different types of locks, and so on.

During this process, designers must adhere to principles for good puzzle design (Puzzle Design in Escape Rooms, n.d.). Puzzles need to be thematically coherent and consistent with the overarching story. The players need a fair chance of winning, so the puzzles may not be too difficult and winning should not be determined by random events. The puzzles need to provide clues that something is important, what the mechanics are for solving the puzzle, what form the answer should take, and where the player should go next. Puzzles should have one answer and enough clues to point to that answer. Clues and puzzles should

be clearly linked. Correlations with the real world need to be intuitive. If the players have to grind to solve a puzzle, then the grinding should not be a red herring. Grinding should provide a clear path to the solution. Puzzles should not have critical states that disappear. If a clue can be misplaced, the puzzle will be unsolvable. Puzzles should provide feedback so that learners know what state they are in. Designers need to keep an answer key for all these puzzles so that they can intervene if something goes wrong.

Once the puzzles have been designed, the puzzles must be implemented (Morris, 2020). If they are physical puzzles, then the physical components must be created. If they are digital puzzles, they must be programmed.

Finally, the puzzles must be play tested multiple times to ensure correctness as well as fun. Ideally, the play test should be a structured activity with a test plan (Albert & Tullis, 2023). This plan starts with a description of the target audience. The plan should include a brief description of the escape room, its educational goals, the overarching narrative, the puzzles, and their answers. The testing goals should also be stated–how will the designers measure what the learners learned, how hard the puzzles were, and whether the experience was positive?

The test plan should include a script that dictates how the test will flow, from the time the volunteers are recruited to the time they are introduced to the overarching storyline to the clues that the designers should provide and finally to how the win or lose state is announced.

3. Mixed Physical and Digital Components in Escape Rooms

Abrahamson, et al. (2005) argues that a single medium has its limitations, thus mixing teaching media would relax these constraints in the learning experience of participants. A mixed media learning environment allows for multiple entries to facilitate learning, increasing the opportunity for learning development.

3.1 Physical and Digital Escape Rooms

Escape rooms that are purely physical and purely digital have their own strengths and weaknesses.

The physical escape room places the player/s in a real room or series of rooms that they must escape within a specific time limit; usually 50 minutes to an hour. The rooms usually have set dressing corresponding to the theme or narrative of the escape room. All the locks and keys must work mechanically. In some cases, locks can be unlocked by an outside observer/game master when certain conditions are met. These conditions allow for the player/s to be fully immersed in the escape room. However, due to the physical requirements, this kind of escape room can be expensive to make, difficult to maintain, and can limit the access to many players as only one group can play the room at a time.

The digital escape room can come in many different forms such as text-based games, point-and-click video games, virtual reality games, etc. Most of the physical restraints are absent in a digital escape room. Room size is no issue, locks and keys don't have to physically make sense, and puzzle design can be more open. Players can also play, so long as they have a device with access to the digital escape room. However, the digital format can make it difficult to fully immerse the player in the escape room.

3.2 Mixed Escape Rooms

The mixed escape room format incorporates aspects from both the physical and digital escape room formats. In the students' implementation, the player/s are placed in a real room with physical locks and keys like the physical escape room. In addition to that, a digital component which can come in the form of a digital interface, or a game is included. This allows for the open puzzle design present in the digital escape room format. These elements in the game are designed in such a way that they aren't isolated from one another. The physical component

is required to progress through the digital component, and vice versa. Hints in the room can lead to further access to the contents of the digital component, and output from the digital component can then be used to open some of the locks present in the room. Having this mix of physical and digital components allows the player to be fully immersed within a physical space, while allowing for more open puzzle design with the digital interface.

4. Escape Room 1: Deadline Dilemma

4.1 Design Process

This escape room is designed to educate players about the visa application process, time zones and country codes. It is designed for the demographic targeting young Filipino adults with an expectation in their competence in spatial, logical, and cognitive reasoning skills and a fluency of the English language.

A storyline for the escape room was developed, with possible puzzles that would suit the narrative. The narrative that was settled on had players of the escape room take on the character James Antiporda, who has planned a trip to Japan, however due to unforeseen circumstances has lost all memories about who they are. The escape room would now have the players' task to deduce who exactly James Antiporda was, to correctly fill out their visa application form and submit said form to escape the room.

4.1.1 Puzzle Design

The escape room is designed to challenge the players to find the information needed to process a Japanese visa. To design the physical puzzles, how the information needed for the application would be stored was considered.

For the first puzzle, James' identity is kept in the safe which contains passports, documents, and a journal. To open the safe, a diegetic hint was located nearby, which indicated that the combination for the safe is an additive combination of two numbers found in pictures inside the room. To pick the correct passports, the players had to read the journal that points towards the correct person.

The second puzzle, the players need to log in to a locked laptop where the credentials are mentioned in the journal. Afterward, players would need to navigate a standard email environment to deduce the travel dates and times.

Through the emails, the players are also introduced to several characters that have interacted with James, which are clues for the other puzzles. The information gained here would be the travel dates and time. This time zone conversion would use clocks set to different time zones present in the room.

The last puzzle asks the players to deduce who to place down on the application as a reference. The laptop accessed earlier had a list of contacts that could be called and using that list and reading the emails would lead the players to the correct answer. This puzzle was designed to teach the players about the concept of a reference in application forms, and the concept of country codes for telephone numbers.

4.2 Limitations, Implementation and Feedback

During the escape room design process, challenges arose in integrating digital and physical puzzles seamlessly, leading to the use of manual solutions. For instance, the intended custom program for the email puzzle was replaced with an existing email service. Monitoring players involved a screen-sharing program monitored by a game master. Despite these technical limitations, they did not significantly affect the overall experience.

The escape room went into three rounds of testing. In the first playtest round, two main issues were identified: unclear puzzle instructions due to low-quality props, and weak logical connections between the puzzles and the narrative.

In the second round, after improving from the feedback, two groups tested the room, completing it in about 30 minutes with positive feedback. The puzzles were generally effective, though the safe puzzle lacked challenge.

The third round involved four groups. Feedback by the players was positive, though some puzzles were found challenging by a few players. However, all players remained engaged, especially after completing the second puzzle, indicating that the design intention of simultaneous puzzle-solving was successful.

5. Escape Room 2: Back to the Present

5.1 Design Process

This educational escape room was designed to introduce the basic concepts of programming. It utilizes a hybrid approach to designing escape rooms, with both a digital component and a physical room, with tangible clues provided to help players progress through the game.

The narrative of this escape room involves the players taking on the role of researchers sent by Mr. Timeval to go back in time to fix an ancient computer. The time machine breaks and the players find themselves in different points in history. The group has to find a way to go back to the present using different clues sent by Mr. Timeval and his assistant to be able to fix the time machine.

5.1.1 Puzzle Design

Each task in this linear escape room was created to teach the players a concept of programming. The integral element of the escape room is a terminal interface that the players can interact with. The terminal shows up, and the players are able to type clues into it to unlock another area. This will be a recurring concept for all the other puzzles, so it is essential that the mechanic is established before they proceed.

In the first puzzle, instructions are given regarding which buttons to press and how to navigate to give players an incentive to move around the game and allow them to progress through the clues found. The players can unlock a safe which is placed in the room. This puzzle allows the players to learn that the physical room also contains clues, and that they have connections to the interface.

The second puzzle introduces data types, where the player has to identify what kind of data types are presented in the interface. Now knowing the data types, the third puzzle challenges the players on these data types in different operations found in the interface. Clues and instructions are found in the room that have the same symbols that correspond to their operation.

The fourth puzzle introduces audio cues to create a unique and engaging experience. The puzzle uses an Arduino board to enhance the experience. In the final puzzle, players must correctly place three blocks of information into slots to form a conditional sentence that returns them to the present time.

5.2 Limitations, Implementation and Feedback

Due to the limited time to construct the escape room, several components were not very sustainable. The electrical components of the puzzle involving the Arduino were exposed and are prone to damage. The physical wheel for the gear puzzle was flimsy. Several bugs were found within the digital component that made it possible to skip a significant portion of the puzzle. Many of these issues could have been addressed given more time to test the components before the final exhibit.

The escape room went into five groups of players playing the escape room. The first group found a bug that allowed them to skip through all the interfaces and win the game. In

both the first and second group, the players expressed the lack of connection between the clues to the answers to the puzzle. Improvements were made to address these issues.

Groups with players who have a background in computer science had an easier time connecting the clues to the solutions, as they would know the context of where the puzzles were derived from.

6. Discussions and Future Work

The course has created seven escape rooms exhibits all with different learning and educational context. These two escape room case studies showcase successful implementations of educational escape rooms made possible through the course content of the escape room class. The mixed media approach allowed for both tangible and intangible objects the players can interact with to increase points for immersion and productivity, as discussed by Abrahamson (2005).

Further research on this design will be employing a standard on player questionnaires and interviews will prove useful in gathering quantifiable and quality data. Exploring monitoring techniques such as looking into player behavior and the order of focus of the players as they play through the escape room to further increase observation while an escape room game is played.

Additionally, future study on identifying areas where educational content can be better integrated into the gameplay will further develop the effectiveness of the media. The knowledge acquired from this, and future research can benefit the field of instructional design in the creation of educational escape rooms that are engaging and useful for teaching.

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