

Learning Through Designing: A Visual Inquiry Tool for Digital Educational Escape Games

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Abstract

Digital escape games are getting attention for educational purposes, typically by letting students play a certain game to engage with a new topic and gain knowledge. But what about letting students design escape games instead of just playing them? By following a design-oriented learning approach, this paper explores the educational potential of students creating their own escape games as part of their coursework. We introduce the *Escape This! Canvas*, a visual inquiry tool that supports the process of designing educational escape games from creating a first idea and theme, over specifying a game structure, to reflecting and measuring the actual learning objectives. Our canvas aids in exploring, structuring, and communicating key design elements important for building new digital escape rooms. This paper contributes to understanding the components necessary for crafting educational escape games, offering a practical tool for iterative planning and project communication, and sheds light on the value of the design of escape rooms for educational purposes.

Keywords: Design Canvas; Digital Escape Room; Serious Games

Introduction

Playful concepts entered the education sector in recent years. Educational escape games are a prime example for this trend. Usually played in teams, it is the goal to evade a room by solving tasks within a time limit. Originally part of entertainment, they are now popular in education and training, promoting skills like collaboration, problem solving, and resilience [1]. Typically, students play these games, and teachers assess knowledge gains [2]. In contrast to that, we asked how the process of designing

an escape room through students affects the learning. Designing a game has the potential to offer deeper engagement with a certain topic, requiring students to plan, solve problems, and make several decisions. We propose that creating a digital educational escape game helps students familiarize themselves with new field or phenomenon by working through key components like defining learning goals and crafting puzzles.

To support this design process, we developed and evaluated a visual inquiry tool, the *Escape This!-Design Canvas*. This canvas provides a structured framework for designing educational escape games, promoting creativity and collaboration. Canvases help manage cognitive load, support joint ideation, and have seen success in various fields, including education [3, 4]. In this paper, we discuss the use of *Escape This!-Canvas*, developed as part of a research project at the University of Hildesheim, exploring the potential of serious games in higher education. Emphasizing lifelong learning skills, we argue that educational tools like these escape games can effectively integrate into existing structures while promoting sustainability education.

Research Design

Our research design is informed by design science research and the principles for visual inquiry tools [5, 6]. Design science is a problem-solving paradigm that allows us to rigorously create purposeful artifacts, here in the form of visual inquiry tools, and has already been used to craft results from this class of tools (e.g., [4, 7]). We created checklists and visual guides, including the Design Canvas, to help students design and test escape rooms, focusing on learning gains. Our approach to developing the final version of the Design Canvas was systematic and iterative. Initially, we grounded our work in the existing literature on escape rooms, which informed the first version of the canvas crafted by our team of authors. This initial version was applied in introductory courses to gather feedback. Further refinement was achieved through discussions in workshops and presentations with experts in the field. We then evaluated the canvas through focus groups and interviews. Over 1.5 years, the canvas underwent multiple revisions based on its application in various seminar courses. This paper reports on the final version of the canvas, presenting an in-depth account of the development process, evaluation, and the lessons learned from its implementation.


Artifact Description: Escape This!-Canvas


Through several activities for building and evaluating the artifact, we culminated in the current iteration of the *Escape This!-Canvas*. Capturing eight building blocks to represent main design decisions (see Fig. 1) and guiding questions to prompt users to reflect on important aspects of each building block (see Table 1). In the following, we describe the building blocks in more detail to provide references to the underpinning literature and building activities of the canvas.


The first block *players* seek to get an understanding of the target user, the students who are learning. Numerous factors can have an impact on the escape game's design, including age, prior knowledge, etc. In alignment with the student's background, appropriate *learning goals* need to be formulated. The designers can draw on existing templates, such as SMART [8], to describe these goals. Additionally, they should consider supplemental skills that can be trained through escape games, such as social or problem-solving skills. Closely intertwined with the objectives, *evaluation* techniques are demanded. This enables distinguishing and assessing the two key dimensions of the functionality of the escape game (i.e., does it work? Is it playable?) and the actual increase in knowledge and skills (i.e., what has been learned?) can be distinguished and investigated by the designers.


ESCAPE THIS! CANVAS.
Design your own Digital Educational Escape Game.


Escape Room: _____ Version: _____ Date: _____


Players | Who is learning. 


Theme | What story. 

Learning Goal | What should be learned. 

Puzzle | What tasks. 

Equipment | What tools. 

Learning Evaluation | What has been learned. 

Game Structure | What flow. 


Basic Conditions | In which learning setting. 

Figure 1: A canvas for designing educational escape rooms.

Similar to physical escape games, designers in digital environments can use a series of *equipment*. The options span from text-based tools (e.g., created in Google Forms), through basic graphical games (e.g., created with PowerPoint, Genially, or Whiteboards) to 3D environments in which users can perform activities (e.g., DeckToys, Gathertown, Articulate 360, virtual reality applications). Depending on the setting, various types of *puzzles* can be implemented, such as quizzes to query knowledge or locks, passwords, and combinations to challenge problem-solving abilities. Those elements are interwoven through the underpinning *game structure* and the overall narrative to follow. Escape games can be linear formats (e.g., specific order of tasks), non-linear approaches (e.g., puzzles in any order), or iterative models [9]; some employ gated designs in which a set of tasks needs to be completed to continue the game. It is important to ensure a balance between inputs (e.g., knowledge nuggets), tasks, and rewards to create a seamless game experience. The *basic conditions* describe the setting in which the game is played. For example, games can be designed for home settings where students participate individually or with family members, or in school environments where they work in groups under teacher supervision. The evaluation was only conducted by students in the master seminar and included sometimes multiple rounds of testing, questionnaires, and interviews with the participants.

Among the key ingredients for a good escape game is the *theme*. In our case the topics surrounded the sustainability development goals (SDGs) which resulted in environmental settings like a boat or a botanical garden. Designers might ask themselves which story, narrative, genre (e.g., mystery, fantasy, future), and characters (e.g., protagonist vs. antagonist) best align with the learning goal. For instance, in terms of sustainability one might want to draw on future scenarios depicting how the world will be in 50 years if nothing (e.g., world systems) is changed. The remaining game elements must be harmonized with this theme to create an immersive environment.

Building block	Key questions	Example outcome
Players	Personal, cultural, or educational background? What prior knowledge can be built on?	Age, education, needs, prior knowledge, ...
Learning goals	What learning needs should be fulfilled? What learning goals should be achieved? What competencies and skills should be trained?	Goals, skills, abilities, ...
Learning evaluation	How to measure learning success? How to ensure the game's applicability	Proof of concept, success, ...
Theme	Which story fits the learning goal? Which characters (e.g., protagonist) are helpful?	Story, genre, character, ...
Equipment	Which are supporting digital tools? Which digital material should be embedded	Design software, resources, ...
Puzzle	What types of quizzes are suitable? What types of locks, passwords, combinations?	Quizzes, locks, tasks, ...
Game structure	Linear, non-linear, iterative game flow? How to balance tasks and rewards?	Flow, sequence, balance, ...
Basic conditions	How much time (e.g., restricted by lectures)? Any budget, equipment, or content constraints?	Constraints, context, ...

Table 1: Example key questions to guide the canvas's usage.

Demonstration and Evaluation

Course Context and Educational Goal

The course where the design canvas was tested aimed to teach serious game design and sustainable development through the creation of digital educational escape rooms. The main goal was to enhance student's ability to apply theoretical knowledge in a practical setting, specifically focusing on the design of engaging learning experiences through games. This process was part of the seminar's examination, allowing students to build games aligned with specific educational goals, such as promoting sustainability or fostering problem-solving skills.

Illustrating the Applicability of the Design Canvas

Feedback collected from students during the summer and winter terms of 2023 emphasized the canvas's ability to reduce design complexity and support structured project organization. Students noted that the canvas helped break down the design of escape rooms into manageable steps, making it easier to focus on specific tasks. This structure facilitated better self-organization and more effective time management. By guiding students through a step-by-step process, the canvas provided a clear orientation in managing the complexity of creating an escape game. Additionally, the students appreciated the supporting resources, such as PDFs and tool links, which fostered clear instructional guidance and topic familiarization.

Exploring the Usefulness of the Design Canvas

Students successfully designed and implemented educational escape rooms during the seminar. A digital escape room with a "time travel" theme showcased the practical application of the canvas. In post-course evaluations, we gathered qualitative feedback from focus groups comprising 13 students across four groups. The feedback sessions aimed to understand student experiences and their perception of the course content.

Key highlights from the course included the opportunity to work in teams, which fostered communication, cooperation, and collaborative problem-solving skills. The visual nature of the canvas greatly facilitated communication and collaboration, ensuring everyone

was aligned. As one Master student noted: *“The canvas was really helpful in making sure we all understood what needed to be done and how to go about it.”*

Our approach allowed students to apply their theoretical knowledge in a practical context, helping them grasp complex concepts more effectively. For example: *“What I enjoyed about it was definitely when you do it with friends, it can end up chaotic. I don’t think the focus was on learning success there, but it was more about getting to know people and doing something together to strengthen the bond as a team.”*

Students appreciated the balance between creative freedom and structured guidance provided by the course. The flexibility to design their escape rooms from scratch, while having access to resources and support, was particularly valued. For instance: *“We could create it ourselves, and the challenge of designing was both rewarding and educational.”* Overall, the canvas helped to reduce the complexity of the design process by providing a structured approach (e.g., [...] *break down the complexity of designing an escape room into manageable components.*) This was crucial in helping students focus on specific tasks and elements of their escape rooms without feeling overwhelmed.

Conclusion

Initial feedback indicated a high level of engagement and enjoyment among participants. The use of the Escape This!-Canvas significantly contributed to making the complex process of designing educational escape rooms more manageable and engaging. Participants showed a marked improvement in their understanding of sustainability. The canvas facilitated the creative and interactive aspects of the course. Students appreciated the opportunity to apply their knowledge practically while being guided through a structured design process. In the words of a participant: *“The highlight was that we could create it ourselves. Taking on the other perspective of designing was challenging and rewarding.”* The initial results indicate that the canvas was effective. Our findings suggest that serious games, under certain conditions, can enhance learning outcomes and student engagement in higher education. This study has several limitations. The small, homogeneous sample puts in question whether the findings can be transferred. A control group for comparison is needed. Lastly, long-term effects on learning and skill development were not assessed, necessitating longitudinal studies. As we concluded our seminar, we were able to show the effectiveness of design thinking tools as a pedagogical tool. The data gathered from the seminar can help education, where serious games and or escape games can become cornerstones of effective learning strategies. In conclusion, we hope to complement the stream of research on gamification, serious games, and educational escape games as well as shed light on the design and communication of escape game projects (e.g., through students).

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