Designing Educational Escape Rooms With Generative AI: A Framework and ChatGPT Prompt Engineering Guide

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Abstract: Generative Artificial Intelligence (GenAI) holds the transformative potential to reshape education, particularly in the domain of content creation. One promising application lies in the development of educational escape rooms (EERs) which are increasingly adopted to foster active, experiential learning, critical thinking, and collaboration. Nevertheless, crafting effective EERs tailored to specific learning contexts often poses a daunting and time-consuming challenge. This paper explores the dynamic synergy between Room2Educ8, a framework rooted in Design Thinking principles, and the publicly accessible AI tool ChatGPT. Room2Educ8 provides a structured methodology encompassing vital steps like empathising with learners, defining learning objectives, weaving narratives, devising puzzles, briefing and debriefing participants, prototyping, and evaluating the EER experience. Complementing this framework, the paper presents a collection of sample prompts that illustrate ChatGPT's pivotal role within the EER creation process. By offering innovative ideas, suggestions, and content, these prompts not only expedite ideation and concept development but also simplify prototype creation for testing and refinement. This streamlining process reduces cognitive load, freeing educators to focus on higher-level considerations. The primary contribution of this paper lies in its harmonious fusion of ChatGPT with a structured design framework, effectively demystifying the EER creation process. With its practical guidance, including a prompt engineering guide, it extends the accessibility of EER design to a wide spectrum of educators, encompassing those with limited prior exposure to the intricacies of escape room formats. Beyond its immediate benefits, this paper serves as a gateway to future research prospects within the domain of AI-powered educational experiences, marking a step towards realising the potential of AI in the field of game-based learning.

Keywords: Educational escape room, Generative artificial intelligence, ChatGPT, Design thinking, Game-based learning

1. Introduction

Escape rooms (ERs) are emerging as a novel genre of learner-centric activities meticulously crafted to amplify students' educational progression and foster the cultivation of 21st-century proficiencies across primary, secondary, and tertiary academic settings, as well as within programs dedicated to professional development (Guckian et al., 2020; Sanchez & Plumettaz-Sieber, 2018; Adams et al., 2018). An educational escape room (EER) is an innovative pedagogical concept wherein participants, typically students, engage in a purposefully designed immersive environment filled with puzzles, challenges, and riddles that are linked to unambiguous learning objectives. The primary objective of an EER is to facilitate active and experiential learning through problem-solving, critical thinking, collaboration, and content assimilation (Fotaris & Mastoras, 2019).

EERs can harness the advantages encompassing "competition, adversity, creative thinking, comprehensive environmental exploration, attainment of objectives, diverse interpersonal and object-related engagements, and assurance of safety" (Guignon et al., 2018). The puzzles embedded within EERs are rooted in problem-solving paradigms, necessitating proficient communication and collaborative aptitudes, aspects inherently integral to the adult learning process (Jennings et al., 2013). Moreover, a sturdy narrative framework assumes the role of establishing the backdrop, while reflective activities after the game contribute to the reinforcement of educational aims. EERs can also incorporate puzzles, challenges and scenarios that draw inspiration from diverse cultural backgrounds, thereby facilitating the cultivation of cross-cultural understanding and appreciation (Fotaris & Mastoras, 2022).

These benefits have contributed to the adoption of EERs to introduce, foster, demonstrate, assess, or integrate students' content knowledge and skills into a wide variety of academic disciplines (Veldkamp et al., 2020). In creative courses, students have been asked to become "makers" and develop EERs as a means to demonstrate and improve their creative, artistic, and design skills so that they can come up with innovative solutions to problems (Ma et al., 2018; Li et al. 2018). Additionally, EERs can be used for inductions in a variety of ways, such as introduction to company culture, policies, procedures, and values, orientation to the workplace, safety training, team building, and technical training (Fotaris & Mastoras, 2022).

Researchers have begun to build upon the notion of teachers as designers of learning experiences for students (Elwood et al., 2016). EERs offer the prospect of ushering in novel pedagogical methodologies, as demonstrated by the exponential surge in scholarly works exploring the incorporation of escape rooms within educational frameworks. Nonetheless, the intricate development and meticulous design of EERs that cater to distinct learning contexts necessitate a substantial investment of time and dedication. This is particularly true for educators who may lack prior expertise in game design (Fotaris & Mastoras, 2022), and consequently, might encounter challenges in making effective decisions regarding various aspects of EER design. These may include group size, contextual relevance, time constraints, rules, narrative, and puzzles – all of which intricately shape the learning experience (Taraldsen et al., 2022).

One possible strategy to tackle this issue involves employing a framework uniquely crafted to provide educators with direction in the creation of robust and impactful EER experiences. This is achieved through the utilisation of generative artificial intelligence (Gen-AI) systems, which can produce a wide range of outputs, such as texts, images, videos, or code, by employing a data repository that trains them (Sánchez-Ruiz et al., 2023). Arguably, one of the most popular AI technologies used to facilitate learning within the educational context is the Chatbot system (Clarizia et al., 2018), a conversational or interactive agent that provides instant responses to the user (Okonkwo & Ade-Ibijola, 2021), exemplified by OpenAI's well-known ChatGPT tool (OpenAI, 2023). It has an unprecedented ability to carry out remarkably complex tasks like writing an article, story, poem, an essay, summarising or expanding a text, adjusting texts to reflect a different perspective, and even writing and debugging original computer code (Baidoo-Anu & Owusu Ansah, 2023; Taecharungroj, 2023), thus becoming an essential academic tool for students in higher education (Jishnu et al., 2023).

The present paper is a continuation of a longitudinal project about EER design; it delves into a deliberate exploration of how ChatGPT's functionalities can be strategically harnessed during the development of EERs to offer time-saving, idea-generating, and customisable assistance, thus allowing designers to create more engaging and effective educational escape rooms. This is accomplished through the integration of Room2Educ8, a user-centred conceptual framework that derives its foundation from design thinking principles. Notably, Room2Educ8 offers a versatile structure that can be flexibly tailored to various subjects, learning goals, and class sizes (Fotaris & Mastoras, 2022). The core focus of this article revolves around a description of each stage of Room2Educ8, subsequently enabling straightforward application, followed by the provision of specialised prompts designed for employment alongside ChatGPT. These prompts are curated to elicit content generation corresponding to each unique stage encapsulated within the Room2Educ8 framework, including learner personas, learning objectives, S.M.A.R.T. goals, stories, puzzles, clues, hints, game rules and instructions, briefing and debriefing scripts, surveys, interview questions, and evaluation plans.

2. Background

ChatGPT, introduced by OpenAI in November 2022, marks a significant advancement in the field of natural language processing (NLP). Its primary purpose is to comprehend and generate text that closely resembles human language in response to input queries. This capability positions ChatGPT as a versatile tool for a wide range of NLP tasks (Thompson, 2022). Despite sharing a foundation with other Large Language Models (LLMs) and generative pre-trained transformers, ChatGPT distinguishes itself through its unique combination of free accessibility, user-friendly interface, and advanced response generation capabilities (Tate et al., 2023). As a result, it swiftly garnered attention and adoption across various domains. Remarkably, within its first week of launch, ChatGPT acquired an impressive one million users (Mollman, 2022), and in under two months, this number surged to over 100 million active users (Hu, 2023).

ChatGPT belongs to the class of generative language models, built upon the architecture of GTP-3.5 and GPT-4 – members of OpenAI's proprietary series of generative pre-trained transformer (GPT) models. Its latest version ChatGPT Plus reportedly comprises eight models, each with an unprecedented 220 billion parameters. The total parameter count of GPT-4 is estimated to be around 1.76 trillion, making it the largest language model ever created (Lubbad, 2023). Its training data draw from a vast and diverse corpus of internet text, endowing ChatGPT with extensive knowledge encompassing language, facts, and context.

In the realm of education, ChatGPT proves transformative. Its applications include creating virtual tutors, addressing student queries, and tailoring personalised learning experiences. It aids educators in teaching and student assessment, offering recommendations for designing more inclusive and accessible learning activities (Denny et al., 2023). Furthermore, recent research has explored integrating language models into game design processes. Zhu and Luo (2022) employed a generative approach, combining a language model with a knowledge base of existing patents to generate innovative design ideas. Van Stegeren & Myśliwiec (2021) used GPT-2 to

craft dialogues for non-player characters in role-playing games, while Värtinen et al. (2022) applied GPT-2 and GPT-3 to describe quests in similar gaming contexts. Frans (2021) introduced a framework for building Language Model Games, where players manipulate a language model to achieve desired in-game behaviours, as demonstrated in the "AI Charades" demo. In parallel, Charity et al. (2023) employed GPT-2 to suggest game features based on textual prompts. Additionally, Lanzi et al. (2023) proposed a collaborative design framework, blending interactive evolution with ChatGPT to simulate human design processes. This collaboration involves humans and LLMs recombining and transforming ideas, using genetic algorithms for complex creative tasks.

In the realm of game-based learning, though, the incorporation of AI-based systems into teaching and learning is still relatively unexplored by educators. This uncertainty stems from a lack of familiarity and limited experience in using AI to enhance the student learning process, as highlighted by Lameras (2023). Additionally, a comprehensive framework that utilises LLMs in the creation of EERs has yet to emerge. The present paper addresses this gap by presenting a well-structured guide for seamlessly integrating ChatGPT into the Room2Educ8 framework. This guide is a valuable resource designed to assist researchers, educators, and developers interested in crafting immersive and educational escape room experiences.

3. Using ChatGPT With Room2Educ8: A Practical Guide

Room2Educ8 (Figure 1) is a conceptual framework specifically designed to offer educators guidance in creating robust EER experiences and has been developed iteratively with pilot testing and refinements of individual elements since 2018 (Fotaris & Mastoras, 2022). It is based on design thinking, a process that has already been used as an instructional design method for the development of course content or teaching material (Sheehan et al., 2018), in curricular development (Habbal, 2016), and as a teaching strategy to achieve subject-specific learning goals (Panke, 2019).

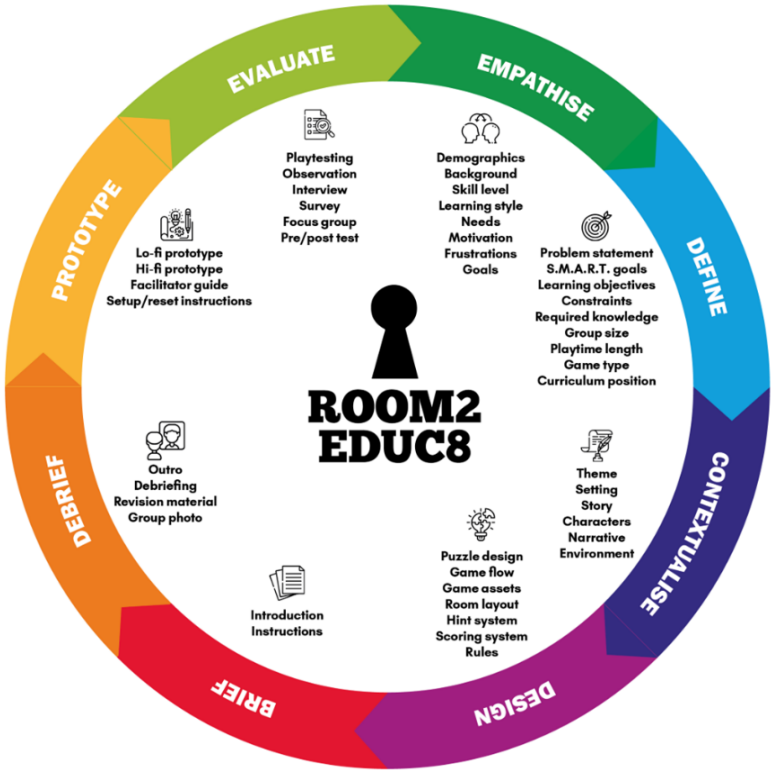

Figure 1: Room2Educ8 framework

Room2Educ8 enables EER designers to utilise ChatGPT as a powerful tool for generating ideas across every stage of the framework. This integration ensures consistency throughout the entire project journey. In this context, the ChatGPT input prompt holds a crucial role as it acts as an instruction or topic given to the LLM, guiding its response by establishing the conversation context and specifying the essential information and desired output format and content (Liu et al., 2023). The "Act as a..." command allows users to specify a persona or character for ChatGPT to adopt during a conversation or toward a particular outcome. Prompt engineering, i.e., the practice of designing and refining prompts to elicit specific responses from AI models, can be a challenging task, as the quality of the AI's responses depends on the precision and clarity of the instructions provided (White et

al., 2023). To overcome this challenge, designers should initially acquaint ChatGPT with Room2Educ8 by offering a concise overview of each stage. This preliminary step ensures that the AI tool comprehends the framework, enabling it to generate relevant responses to the prompts posed by designers. An initiating prompt of the chat that introduces Room2Educ8 to ChatGPT and also provides insights into how ChatGPT can support each framework stage is presented in Figure 2.

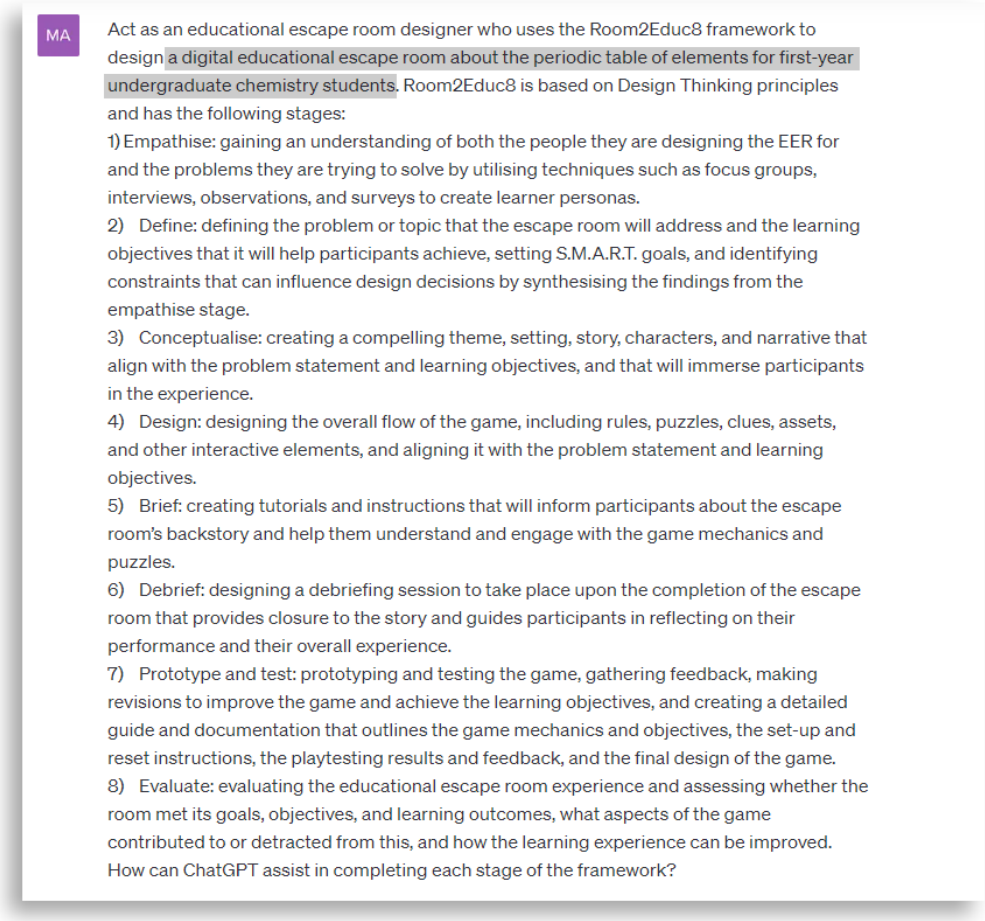

Figure 2: Initiating prompt

Tables 1-8 comprise exemplar ChatGPT prompts intended for use in conjunction with each Room2Educ8 stage to aid in the development of an EER. These prompts are intentionally open-ended and adaptable to cater to users' preferences and interests. Their primary purpose is to elicit ChatGPT responses that serve as initial reference points for EER design, offering innovative ideas, suggestions, and content that designers might otherwise overlook. This not only saves substantial time during the ideation and concept development phases but also streamlines the early stages of EER design by simplifying the creation of prototypes for testing and refinement. Consequently, designers experience a reduced cognitive burden, allowing them to concentrate on higher-level considerations, such as defining learning objectives and optimising the user experience. After the initial generation of concepts and content, designers have the opportunity to delve deeper into the ideas presented in ChatGPT responses. They can enhance these concepts with their unique creative input by crafting follow-up queries to ChatGPT that align with their original prompts. This process facilitates the development of more intricate narratives, puzzles, and engaging interactive elements. Furthermore, certain sample prompts play a crucial role in upholding consistency in storytelling, character development, and thematic elements within the entire EER. In contrast, other prompts can aid in the creation of survey questions or feedback forms for playtesting, simplifying the data collection process and ensuring thorough feedback. While it is essential to acknowledge that ChatGPT's responses are generated by AI and may not invariably align precisely with designers' expectations, they nonetheless represent a valuable source of inspiration and an effective starting point for the creative process.

Table 1: Ways ChatGPT supports EER designers in Room2Educ8's Empathise stage

Aim	Sample prompt
Generate interview and/or survey questions to gather insights about your target audience's interests, preferences, and learning styles.	"Write [*n*] interview questions to understand the preferences and learning styles of the [*target audience*]."
Suggest techniques for conducting effective focus groups.	"Give me ideas on how to conduct engaging focus groups to gather insights."
Summarise the collected data.	"Summarise the key findings from the participant survey."
Provide templates for creating learner personas to represent the target audience's characteristics and preferences based on the collected data.	"Write a detailed learner persona for [*a first-year undergraduate art student*] who [*has little knowledge of the Bauhaus art school and its impact on art and architecture*]. "

Table 2: Ways ChatGPT supports EER designers in Room2Educ8's Define stage

Aim	Sample prompt
Generate problem statements based on the information gathered in the empathise phase.	"Using the information gathered from the focus group and survey, create a problem statement for the educational escape room that highlights the gap in understanding we aim to address and the learning objectives we hope to achieve."
Generate learning objectives based on the problem statement and the information gathered in the empathise stage.	"Create a list of [*n*] measurable and specific learning objectives that align with the identified gap in understanding and the problem statement developed in the previous step."
Assist in formulating S.M.A.R.T. goals for learning objectives.	"Create a list of [n] specific and measurable goals for the escape room's learning objectives."
Create a list of constraints that might impact design decisions.	"Create a list of [n] constraints that must be considered when designing the educational escape room."
Define the required knowledge.	"Create a list of the specific knowledge and skills required for participants to complete the escape room."

Table 3: Ways ChatGPT supports EER designers in Room2Educ8's Contextualise stage

Aim	Sample prompt
Brainstorm immersive themes and narrative concepts.	"Write [*n*] story ideas for themes and stories that align with the learning objectives. Think outside the box and come up with something unusual and original."
	"Using the [*ChatGPT-generated theme and story*], write a detailed plot that aligns with the learning objectives."
	"Develop [*n*] intriguing characters that will captivate participants."
	"Create a narrative that provides context and relevance to the puzzles and challenges."
	"Develop a detailed description of the room layout and game assets that will be used in the escape room, considering the constraints identified in previous steps."

Table 4: Ways ChatGPT supports EER designers in Room2Educ8's Design stage

Aim	Sample prompt
Suggest puzzle ideas that align with learning objectives.	"Write [*n*] puzzle ideas that align with the [*learning objective*s] and suggest ways to tie them into the narrative."
Create clues and hint systems.	"Create a hint system for the [puzzle]."

Aim	Sample prompt
Create a balanced flow of puzzles and interactive elements.	"Create a game flow for the escape room."

Table 5: Ways ChatGPT supports EER designers in Room2Educ8's Brief stage

Aim	Sample prompt
Generate written or verbal instructions for the participants.	"Create a clear and concise outline of the escape room's objectives, rules, and hints."
Create engaging scripts for the briefing video.	"Write a script for an engaging and informative briefing video, which provides participants with a clear understanding of the escape room's backstory, objectives, and rules, while also immersing them in the experience and motivating them to complete the game by highlighting the stakes and rewards of success."
Create an in-game tutorial that helps participants understand the game mechanics and objectives.	"Write an in-game tutorial that guides players through the game mechanics, including information on how to navigate the room, solve puzzles, and access hints."

Table 6: Ways ChatGPT supports EER designers in Room2Educ8's Debrief stage

Aim	Sample prompt
Wrap up the game with a satisfying ending.	"Suggest ways to wrap up the escape room experience with a satisfying ending."
Create an engaging script for the outro video	"Write the script for an engaging and informative outro video that summarises the key learning objectives and provides participants with a sense of accomplishment and closure. The video should align with the theme, setting, plot, and characters developed in previous steps."
Produce a debriefing guide	"Write a debriefing guide that includes [*n*] discussion prompts and reflection questions to help players reflect on their experiences and the learning objectives achieved during the game."

Table 7: Ways ChatGPT supports EER designers in Room2Educ8's Prototype and Test stage

Aim	Sample prompt
Provide a checklist for playtesting, along with guidance on gathering meaningful feedback.	"Write a detailed testing plan that outlines the steps to be taken during the prototyping and testing phase, including a list of tasks, responsibilities, and timelines." "Create a checklist for playtesting the escape room and gathering meaningful feedback."
Create a facilitator guide.	"Write a list of setup and reset instructions for the escape room facilitator."
Assist in refining the escape room design based on playtest feedback.	"How can I incorporate playtest feedback to improve the overall escape room experience?"
Provide tips for creating comprehensive documentation for the game.	"What should I include in the documentation to guide setup, gameplay, and reset instructions?"

Table 8: Ways ChatGPT supports EER designers in Room2Educ8's Evaluate stage

Aim	Sample prompt
Suggest criteria for evaluating if learning objectives were met.	"What factors should I consider when assessing whether the escape room achieved its educational goals?"
Provide ideas for gathering participant feedback on the experience.	"How can I get constructive feedback from participants to evaluate the escape room's effectiveness?"

Aim	Sample prompt
Create a post-game survey/feedback form.	"Create a post-game survey to be distributed to participants immediately after they complete the escape room. Use a combination of [*n*] closed-ended (quantitative) and open-ended (qualitative) questions to gather both numerical ratings and detailed comments."
Write post-game interview questions.	"Write a script for a post-game [interview type] interview to measure the effectiveness of the escape room in achieving its learning objectives and gather feedback on the game mechanics, puzzles, hint system, and any other elements of the game that could be improved in the future."

4. Use Case

To ensure ChatGPT's ability to assist in the creation of an EER, a set of prompts was crafted, aligning with each phase of the Room2Educ8 framework. The AI-generated responses informed the design of a digital EER about the periodic table of elements, specifically designed to captivate the interest of first-year undergraduate chemistry students. Presented below are a few selected prompts that were employed during the Contextualise and Design stages (Figure 3):

- "Come up with 10 story ideas for an EER about the periodic table of elements, the atomic weight, and the atomic number Think outside the box and come up with something unusual and original."
- "Come up with more unusual ideas that haven't been done so often before."
- "What locations can we use for the Atomic Art Heist?"
- "What items could we find in the Art Gallery in a Haunted Mansion?"
- "Give me 3 puzzles that need to be solved in the Art Gallery in a Haunted Mansion that cover the learning objectives of understanding the periodic table of elements, the atomic weight, and the atomic number. The puzzles should make use of the items found in the Art Gallery in a Haunted Mansion."
- "Rewrite the previous puzzles, using the following format: puzzle title, learning objective, description, clues, location, solution."
- "Create a hint system for each one of the 3 puzzles."
- "Using the Art Gallery in a Haunted Mansion, generate a detailed plot and character descriptions that align with the puzzles."
- "Write a detailed description of the room layout and game assets that will be used in the educational escape room."
- "Using the theme, setting, plot, and characters developed in previous steps generate a script for a video introduction that sets the stage and provides background information for the educational escape room."
- "Write an in-game tutorial that guides players through the mechanics of the educational escape room, including information on how to navigate the room, solve puzzles, and access hints and clues."
- "Write the script for an engaging and informative outro video for our educational escape room, which summarizes the key learning objectives and provides players with a sense of accomplishment and closure. The video should align with the theme, setting, plot, and characters developed in previous steps and effectively reinforce the importance of the mission the students just completed and their role in it."
- "Create a game flow for the educational escape room."

All prompts were crafted following a foundational set of prompt engineering principles. Foremost among them was the emphasis on clarity and specificity, ensuring that each instruction was initiated with a clear and precise directive. To personalise responses, the persona of an EER designer was designated for ChatGPT to embody, tailoring its interactions accordingly. Furthermore, maintaining alignment with the EER's learning objectives was essential to ensure that the prompts effectively supported the educational goals. The active use of feedback loops allowed for prompt refinement, resulting in iterative improvements. Contextual clarity was incorporated when needed to guide the AI's output effectively. Additionally, real-life scenarios were utilised for certain prompts, grounding them in practical and relatable situations.

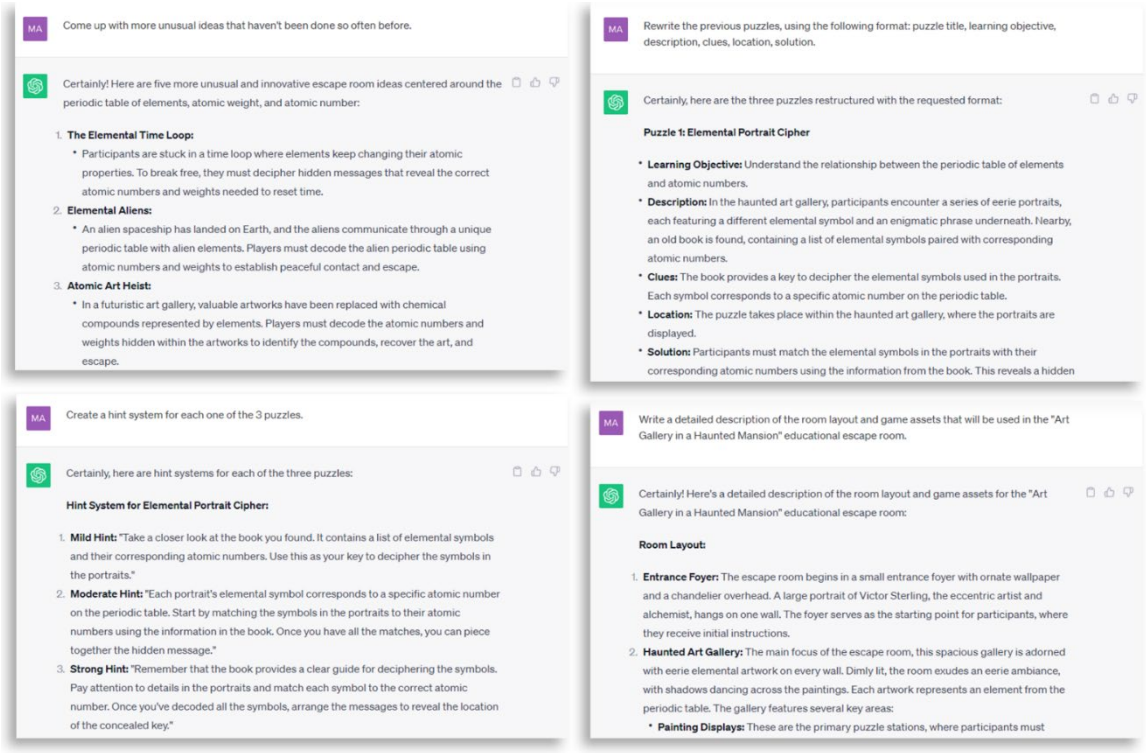

Figure 3: Prompts used during the Contextualise and Design stages

5. Conclusion and Future Work

Room2Educ8 simplifies the process of aligning learning objectives with puzzles and narratives, resulting in a cohesive and immersive interactive story that enhances learning experiences (Fotaris & Mastoras, 2022). The decision to integrate this framework with ChatGPT stemmed from the goal of making EER design more accessible to educators, especially those lacking prior experience with escape room formats or facing time constraints. ChatGPT's user-friendly interface requires no specialised technical skills, ensuring educators with varying levels of tech proficiency can benefit. Additionally, ChatGPT's quick content generation reduces the time educators spend on content creation, allowing them to focus on essential aspects of teaching and learning. The included prompt engineering principles provide a valuable reference for crafting effective prompts, while the sample prompts can be easily adapted to various subjects, significantly improving the efficiency and effectiveness of the EER development process.

One limitation of this study is the restricted testing of the digital prototype by students, primarily due to time constraints. Subsequent efforts will involve the development and thorough assessment of EERs designed with Room2Educ8 and ChatGPT to scrutinise their impact on the overall learning experience. Additionally, a follow-up study is planned, wherein Education students, pre-service teachers, and professionals in the education sector will utilise Room2Educ8 and ChatGPT to design EERs. Their feedback and responses to the proposed framework will be systematically recorded and analysed.

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