



Creating an Online Escape Room Game for Older Adults: Needs Assessment, Design Process, and Usability Testing

Amir Doroudian^(✉), Simone Hausknecht, and David Kaufman

Faculty of Education, Simon Fraser University, Vancouver, BC, Canada
{adoroudi, shauskne, dkaufman}@sfu.ca

Abstract. In this project, an online escape game for older adults was developed collaboratively with five novice developers and 12 older adults who tested the prototype game at several stages of the development process. We followed a User-Centered Design (UCD) process to develop the game. During the design process, older adults tested the game and it was refined based on their feedback and the research team's observation of their play. We found that incorporating older adults into the design process significantly improved the design, as they provided insights that would not have been available otherwise. We also concluded that the older adults' involvement in the design process could make the game better tailored to their needs. The game is currently being field-tested.

Keywords: Older adults · Escape room · Need assessment
User-Centered Design

1 Introduction

The cognitive and socio-emotional benefits of playing digital games for older adults have been the focus of a large number of studies recently [1–7]. An important finding of these studies has been that since most digital games have not been specifically designed for older adults, their self-efficacy in playing these games is often diminished, which would, in turn, result in their disengagement from this promising medium. It is, thus, imperative for researchers and game designers to develop digital games that are aligned with older adults' interests, capabilities, and needs to increase the possibility of active cognitive involvement, meaningful intergenerational interaction, and effective use of the new technology.

There are several ways of developing digital products that are tailored to the needs of the end users. To create a genuinely engaging digital game, it could be developed in collaboration with the end player [8]. To achieve this in a systematic way, user-centered design (UCD) could be an appropriate approach. UCD is an “approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and applying human factors/ergonomics and usability knowledge and techniques” [9, p. 2]. The International Organization for Standardization (ISO) has also defined several characteristics for UCD, namely, iterative design

process, involvement of the users in the design, the importance of whole user experience, designing based on user experience evaluation, inclusion of multidisciplinary perspectives and skills, and profound understanding of the end users, the tasks, and the environments.

We saw UCD as an appropriate approach for the purpose of developing a virtual escape room for older adults. A virtual escape room is a digital simulation of real-life escape rooms. Escape rooms, also known as escape games, are collaborative, adventure games in which a group of players are locked in a room with the goal of escaping the room by solving a series of puzzles and finding clues within a time limit [10]. We selected escape rooms because we decided that escape rooms could be an appropriate intervention to foster social and cognitive engagement among older adults. Escape games seem to offer a good environment for meaningful interaction, because of their collaborative nature, that necessitates working together to complete the game, and the fact that the players are physically involved in the narrative of the game – a unique feature that can make the game more engaging to the players. The positive response we receive from the older adults who played real-life escape rooms in the first phase of this study confirmed our assumptions.

Furthermore, the gameplay of escape rooms demands players to make choices and go through trial and error to proceed in the game. Small, Moody, Siddarth and Bookheimer [11] conducted a study on the impact of search engine use on cerebral activation in older adults and revealed that regardless of having extended experience with searching on the internet, the older adult participants showed a significant increase in their brain areas that control decision-making and complex reasoning when making choices online. We reasoned that escape rooms involve constant choice-making and complex cognitive activities that could encourage meaningful interaction for the older adult players.

We also decided to incorporate a learning purpose in the game, because research suggests that older adults tend to use new technology if they perceive positive outcomes [12]. However, it was of outmost importance that this learning content, as well as the art style of the game, should be suitable for older adults. Finally, the following affordances were set for the game:

- *Social engagement*: the game play should allow for meaningful collaboration.
- *Cognitive challenges*: the game tasks should follow an ascending order of difficulty to increase engagement and minimize frustration.
- *Emotional benefits*: the game activities should be entertaining, low-stress, rewarding, and non-threatening to older adults' self-esteem.
- *Self-efficacy*: the game should not interfere with the user's belief that they are able to successfully complete the game tasks.
- *Life-long learning*: the game should allow for self-reflection and considering technology for learning.

In order to test the above affordances and to measure the extent to which the proposed goals are achieved, we have been conducting an empirical usability test on the game's end users; i.e. older adults. *Usability* is defined as “the extent to which a

product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” [13, n.p.]. According to Rubin and Chisnell [14], “usability testing employs techniques to collect empirical data while observing representative end users using the product to perform realistic tasks” [14, p. 19]. In this project, we are using a rather non-formal testing approach, by conducting an iterative cycle of tests intended to expose the deficiencies in usability and playability [14]. This is a rigorous, user-centered approach that has fewer constraints and yields quantitative as well as qualitative data that could inform the design and the refinement of the game.

1.1 The Prototype Game: *A Tale of Tales*

“A Tale of Tales” is the virtual escape game we developed in this project – a collaborative game that is intended to provide an interactive social experience by engaging older adults in literary themes and through the use of digital communication technologies. The game is multi-platform and can be played on MS Windows, Mac, Android, and Gear VR. The objective of the game is to engage older adults through elements of real-life escape rooms, such as interactive storytelling and alternate reality. The game we intend to eventually publish will have three “chapters,” each representing a different storyline in a new game universe. The current prototype game, however, has only one chapter, whose theme borrows elements from Lewis Carroll’s *Alice in Wonderland*. This theme was decided upon due to older adults’ familiarity with the story and the positive feedback we received from older adults when we discussed various themes with them. This would reduce game stress and possibilities of confusion.

The game starts with *the Ink Monster*, a “story thief” in a unique storyline, who leads the players to explore notable works of literature through puzzles and interactions with characters from those works. In the prototype game, the Ink Monster leads the player to the world of *Alice in Wonderland*. The gameplay is based on the premise that the players’ duty is to recover the stories the *Ink Monster* has stolen. There are three rooms with different riddles and puzzles to solve in order to get out. The players must help each other to make it through the rooms and get the story back from the Ink Monster. This is a two-screen game in which two players pair up online and communicate via an embedded VOIP application. Player one is inside a maze and player two has mainly the role of the navigator with a birds-eye view of the maze and leads player one to the rooms. Once in a room, each player sees a different view and plays different roles to solve the puzzles. For example, in the first room, where there is a crossword puzzle, player one has the clues to the words, while player two sees the crossword table. Figure 1 depicts screenshots from the game.

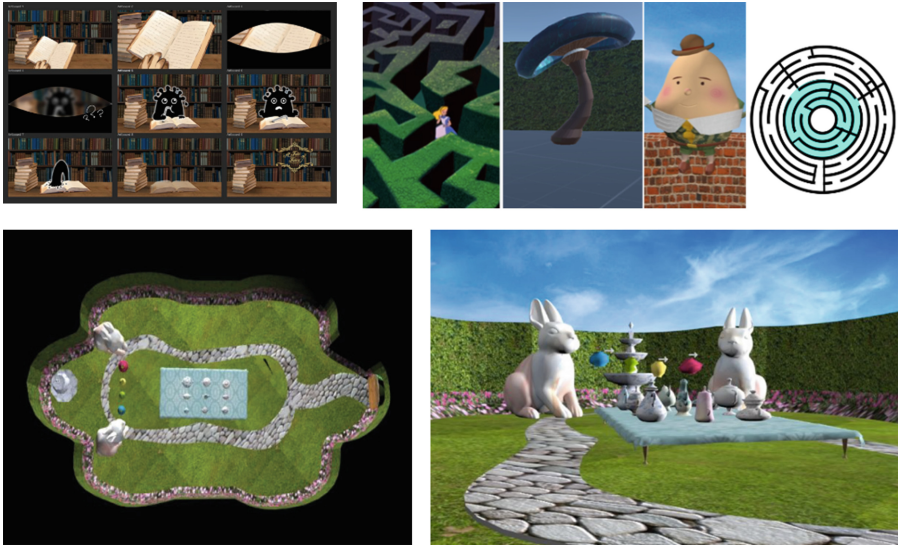


Fig. 1. Screenshots from the game – The Ink Monster (top-left), the Maze (top-right), Player Two’s view of a room (bottom-left), Player One’s view of the same room (bottom-right)

2 Statement of Purpose and Research Questions

In this study, we explored a UCD game design process to develop a virtual escape room targeted at older adults of 65 years of age and older, as this is the common retirement age in many countries. UCD allows the designers to understand the end users’ interests and needs. Furthermore, since there have been very few virtual escape games designed and studied for this specific demographic, it is necessary to gain insight into the opportunities and constraints of these game designs. In addition, we wanted this game design project to satisfy the following criteria:

- Empower and engage older adults who are not savvy with digital games and gaming platforms to use this technology
- Provide a social, interactive experience for older adults
- Create a game template to be used as a model and provide reusable assets for future game development
- Provide an educational experience for older adults through fun, social activities in a literary setting

More specifically, we are addressing the following research questions in this study. This paper presents the results of the first two questions and the third question will be discussed in a subsequent paper.

1. What are the needs of older adults in an escape game?
2. How useful is a UCD for developing a digital escape room for cognitively normal older adults with low-to-intermediate levels of experience with digital games?

3. With regard to the goals set for the game:
 - a. To what extent does the game initiate social engagement?
 - b. How do older adults perceive their experience of playing the game?
 - c. What types of collaboration occur between the players?
 - d. What are the affective benefits of the game for older adults?

3 Method

To answer the research questions, we designed a three-phase study. In the first phase, we conducted a thorough need assessment by conducting tests in real-life escape rooms with older adults. The second phase involved the development of the online escape game in collaboration with older adults. Zhang, Doroudian, Kaufman, Hausknecht, Jeremic, and Owens, the researchers involved in this project at that point, discussed and provided an overview of the need assessment phase and the UCD design more extensively [15].

This paper is an extension of Zhang et al. [15]. In this paper, we focused more on the results of the second phase and the extent to which UCD proved to be a useful approach to game design for older adults. Finally, the third phase, which is a test of the usability of the prototype game, is currently at the data collection stage and the results will be reported in due course.

3.1 Participants

For the first phase of the study, 10 mobile and cognitively normal older adults of both sexes, aged 65 and older, were recruited from Simon Fraser University's senior programs to play real-life escape rooms. We used the age marker of 65 because, methodologically, it is a practical way to identify old age. Moreover, conceptually, it is the age that many countries and social institutions recognize as the age of retirement. Participants also completed a demographics survey with questions about their social and academic background, as well as their experience with escape rooms.

For the second phase of the study, the above procedure was followed to recruit 12 older adults of 65 years of age and older. The only exception was that we also asked them about their experience with digital games. It is to be noted that eight of the participants in the second phase also participated in the first phase. This is because we reasoned that they could help us overcome the limitations they perceived in the first phase. Finally, for the third phase, which is currently in progress, 30 older adults with the same characteristics are playing the game in pairs.

3.2 Research Design

Phase one was intended to learn about older adults' perceptions of playing an escape game and observe the way they interact in it. In this phase, the participants played two escape rooms with different themes and storylines at *SmartyPantz* escape room in Vancouver, BC. They attended a focus group interview after each game to answer

questions about their experience in the game. The questions elicited responses that included the highlights and the least interesting aspects of the game, things they would do to improve the game, and their overall assessment of the game. Their game sessions were filmed and later observed by the research team. This phase helped us identify older adults' playing patterns and their needs in the game.

The second phase consisted of developing the prototype virtual escape room following a UCD procedure. For this phase, we collaborated with five novice developers completing their capstone project who were graduate students of digital media at the Centre for Digital Media (CDM) – a multidisciplinary graduate institution in Vancouver, British Columbia. We also recruited 12 older adults who gave us feedback over three sessions: once, they were consulted about the game design and, twice, they tested two prototypes of the game. The design process lasted for 13 weeks. During this time, we held weekly meetings with the developers for brainstorming, feedback on their progress report, and laying out the next steps. Creating a theme for the game, sketching the gameplay, and discussing the possible puzzles and the educational content were among the things we achieved in our meetings. The software applications our developers used to develop the game were the Unity game engine and Adobe Photoshop. The feedback from the older adults was an integral part of our decision-making. It should be noted some of the older adults we consulted during the design process were the ones who had participated in the first phase of the study and could provide us with valuable insights that will be discussed later in this report.

In the third phase, which is in progress, the prototype game is being tested with 30 older adults in order to further refine it by: observing the interactions of the older adults, learning more about their experience, and identifying the game's deficiencies in design and content.

3.3 Data Collection

Following an exploratory study, two surveys were used to collect qualitative data: one survey on the demographics data of the participants and the other on their experience with the game. Moreover, semi-structured focus group interviews were conducted to elicit rich data about the participants' experience and perceptions. The focus group format helped the participants to be more motivated to contribute, as they debated the pros and cons of the game. Finally, the research team observed the game sessions through filming in the first phase and collecting field notes in the second phase. Similar procedures are being followed in the third phase of the study – usability testing of the game.

3.4 Data Analysis

For the qualitative data, which comprised most of the data we collected in the first and the second phases of the study, a deductive qualitative analysis was performed by following these steps. First, the interviews were transcribed and the transcripts, field notes, and the open-ended survey questions were consolidated. Second, the above data were coded into various themes and categories and thematically analyzed. The themes included aspects such as surface design elements, game content, playability, and communication. Further, the quantitative data from the surveys were analyzed by

generating the descriptive statistics using IBM SPSS. Finally, the results from the qualitative and quantitative analyses were triangulated and interpreted. Similar data analysis procedure will be followed for the third phase of the study – field testing.

4 Results and Discussion

This is an ongoing project intended to explore a UCD procedure to develop a virtual escape room for older adults. The project consisted of three phases. The results of the first phase – which addressed the first research question and were discussed in Zhang et al. [15] – showed that almost none of the 10 participants in the first phase had experience playing either a real-life or virtual escape room. Furthermore, almost all older adults found their real-life escape room experience to be rewarding and novel. However, when solving a puzzle took too long or when players could not work efficiently as a team, they reported frustration. In addition, they believed that lack of a leadership, mainly due to excessive deference, negatively affected their play experience. This finding is consistent with our observation of their play. Some players attributed it to Canadians' tendency to defer to others. On further reflections, however, we decided that it was most probably due to lack of familiarity and closeness between the players – a limitation we tried to account for in the second phase by holding ice breaker sessions. Most of the other complaints had to do with the design of the room which was not appropriate for older adults. For example, the dim lighting limited the visibility of texts and small items.

The most common suggestions for game improvement that we elicited from the interview transcripts included:

1. assigning roles to players
2. more detailed guidance before the game
3. easier communication with the staff for hints
4. better lighting
5. more diverse puzzles
6. extended time limit

All participants reported that they would like to play a virtual version of escape rooms. The findings of this need assessment informed the design of the virtual escape game. To answer the second research question regarding the usefulness of UCD for game development for cognitively normal older adults who have lower-to-intermediate levels of experience with digital games and enjoy collaborative games, we used our observation, our experience as collaborators, and the insights of the novice developers. Moreover, the results of the usability test, which is to be tested in the third phase, will supplement our data in this regard.

During the 13-week procedure period of the virtual escape room design, we adopted a multidisciplinary UCD process that satisfied all the characteristics of UCD as laid out by ISO (2010), except that older adults were not involved in the brainstorming sessions. This is because we decided that we had enough feedback from the need assessment phase. In this phase the 12 older adults who collaborated in the game development had an average of “a few times a week” exposure to digital games.

However, they reported that they are not technology savvy and most of their digital game exposure is limited to mobile/tablet as well as watching, and/or occasionally involving in, their young relatives' play.

One of the most important ways UCD helped us during the virtual escape game development was through the feedback we received from the older adults. The older adults in this phase provided us with feedback on the game three times: (1) on our concept game when the prototype was still not playable, (2) on the first playable prototype, and (3) on the refined prototype.

The older adults' feedback on the concept game resulted in choosing a literary theme for the game, as well as defining a storyline that connects the puzzles together. As discussed in Zhang et al. [15], our observation revealed that older adults were more comfortable with stories and puzzles familiar to them. Accordingly, we devised game tasks that are known to them to minimize the unfamiliarity stress. Their feedback also confirmed our idea of the maze and role assignment to the players. However, since the older adults we involved in the development were not familiar with what is practical technologically, they came up with ideas for the game that were not helpful and sometimes tended to derail our plans. Moreover, on several occasions, the older adults could not agree on what they want and would insist on ideas that were not feasible from a development standpoint.

The most important feedback we received from the older adults on the initial prototype of the game regarded: (1) the speed of the game, which was too fast for them, (2) the controllers, which they found confusing at times, as they needed to use the keyboard, and (3) the voice chat communication, which was difficult and ineffective, since a third-party application (Skype) was needed. They also gave us ideas for the possible collaborative puzzles; however, most of these ideas were beyond what was possible with our software.

Finally, we refined the prototype based on the design recommendations. We slowed down the game speed, added touch control capabilities, and embedded a VOIP inside the game. The older adults played the refined game and shared their experience with the researchers. This time, lack of real-time instructions was a common complaint. Moreover, some players reported that merely navigating the other player was not rewarding enough, while others said it became boring at some points. These comments resulted in designating a more active role for the navigator player in the game. To address this, we used crossword puzzles and bingo-like puzzles which were shown to have worked quite well with them. Also, a basic scoring system was created for the game that rewards the players based on puzzle completion in a certain time limit. As for the lack of real-time instructions for guiding the players in the game, our plan is to embed real-time guidance by adding a talking character that can help the players. Finally, the players suggested that the game could have been more engaging if it were even more story-oriented, rather than puzzle-oriented. This suggestion requires fundamental changes to the game. We will need to receive similar feedback during our usability testing before we decide to act upon this suggestion. Currently, we are working on a talking character that guides the player in real-time.

From our findings above, we concluded that UCD could be useful for the refinement process in a game design project for older adults. The feedback that the older adults gave us on the various prototypes significantly improved the game both in

design and content. Moreover, our observation of the older adults' play gave us valuable insight into how the design works and can be enhanced. Therefore, UCD is most helpful when it comes to improving the formal design features of the game and the overall play experience. However, UCD could potentially hinder the development of the game in the early conception stages, due to contradicting suggestions and largely impractical ideas from older adults with varying levels of knowledge about game design. A strategy to overcome this challenge could be, first, informing them of what is possible and, second, providing a strict set of guidelines on the design. Furthermore, deciding on when to involve the older adults during the design process could increase the usefulness of their feedback.

Currently, for the third phase, we are testing the usability of the refined game with 30 older adults to answer the third research question. The data for this phase will be collected through observation, surveys, and interviews and the results will be reported in due course.

5 Conclusion

Thus far into the study, the findings of the first two phases have had several implications for us. First, the findings confirmed the necessity of an exhaustive need assessment as an important precursor to a successful design. The need assessment in this study involved giving older adults opportunities to play real-life escape rooms and then provide us with their valuable feedback that we later drew upon to design the online escape room. It also allowed us to analyze, and document, their interaction patterns while playing the game. In turn, this provided insight into the planning of the maze of the online game.

As we have asserted above, developing digital products, including digital games, requires some forms of end-user collaboration in the design process. Furthermore, we regard usability testing as a formative practice, rather than a summative one. In other words, the end-user feedback should be used in iterative refinement of the design.

Despite the valuable results this study has yielded so far, it has some limitations that we hope to overcome in our future research. As mentioned earlier, this study failed to incorporate older adults into the whole design process. It is still not known whether it would be practical, efficient, or productive to integrate older adults into the whole design process, including the major design decisions. In addition, our participants were not diverse enough. Their demographics showed that they were mostly educated, middle-class, white, North American older adults. Therefore, further research is required with larger, more diverse population of older adults to investigate the usefulness of this UCD for digital game development.

In the third phase of this study, we are doing our best to overcome the lack of diversity limitation we had in the first two phases.

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