Escape Games in Physics Education: Students' Attitudes and Flow Experience

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Abstract. Escape games provide challenging puzzles that can only be solved when working together in a team. The puzzles and the theme can be adapted to a variety of topics, allowing educators to turn these games into unique learning activities. Although educational escape games aim to provide a flow experience while at the same time supporting players in acquiring new knowledge, these goals are seldom evaluated. In this study, the game experience of high-school students is measured during and after taking part in an educational escape game. In addition, students' perceived learning outcomes and attitude towards educational games are assessed.

1 Introduction: Games Based Learning and Educational Escape Games

Games can help learners to practice new skills and acquire new knowledge in a playful way. In the context of education, game-based learning refers to a type of games characterized by specific learning goals. What makes educational games special is their potential to have players reach an optimal experience (flow state) while at the same time supporting learning. Therefore, the design process of these educational games focuses on engaging activities with defined goals and progress indicators, immediate and clear feedback, and a balance between perceived challenge and perceived skills - all prerequisites of a flow experience. A mental state of flow is characterized, for example, by intense and focused concentration, distortion of temporal experience, and an intrinsically rewarding experience [1]. That means that players of educational games might be fully absorbed in an enjoyable game without noticing time passing while acquiring new knowledge and skills [2].

In the past 10 years, a new type of live-action team-based game became extremely popular all over the world, so called escape (or adventure) games. Inspired by several influences reaching from role playing, digital adventure games, to treasure hunts, interactive theater, and movies, traditional escape games are based on a locked room and a number of puzzles which need to be solved by a team of players in a limited amount of time in order to reach a specific goal such as escaping from the room. After a brief introduction by a game master, participants explore the space looking for clues, solving the first puzzles which lead to something else, for example to new clues, new equipment, or a new room. The game master monitors the participants and might give hints to help participants if they get stuck. As the time goes by, puzzles get more complex, often leading to a final meta-puzzle, which requires players to combine several clues from previously solved puzzles. After the time is over, the game master helps the players during the debriefing session to arrive back in the "real world" by explaining the puzzles and let them cool down [3].

Escape games are fun and engaging activities that require teamwork, communication and delegation skills, as well as critical thinking while fully absorbing players in a different reality making them attractive activities for corporate training. However, if adapted to a specific learning content, the puzzles themselves can provide rich and engaging learning activities. A number of studies explored the feasibility of escape games in different educational contexts such as computer science [4], nursing training [5], or physics of fluids [6]. There are even commercial toolboxes, which can be used for hundreds of (partially free) educational escape games developed for a variety of subjects and topics [7].

Although reports of educational escape game designers are overwhelmingly positive, little is known about students' experiences of the activity, in particular if and how many of them

really reach a flow state and how individual difference can be explained. Furthermore, students' attitudes and their perceived learning outcomes are rarely evaluated.

2 Research Questions and Methods

Which level of flow state do the participants in an educational escape game reach? How does this state develop over time? How do participants describe their experience retrospectively? And what do they remember and learn while taking part in educational escape games?

This study took place in the framework of a newly developed antimatter-themed physics escape game involving advanced level puzzles (e.g. on Feynman diagrams, magnets, UV LEDs, and electric circuits) and advanced equipment (such as 3D printers, X-ray machines, digital sun dials, and semiconductors) with high-school students aged 16-18. The game has been developed in an iterative process following the escapED framework [8] which suggests a 6-level approach focusing step by step on participants, learning objectives, game mode and theme, puzzles, equipment, and evaluation.

During, and after the game, players filled out the Game Experience Questionnaire [9]. This questionnaire has been developed to assess the multi-facet nature of game experience including immersion, tension, competence, flow, negative and positive affect, challenge and social pressure. In addition, students filled out open questions about their perceived learning outcomes as well as their attitude towards educational games.

3 Conclusion and Preliminary Findings

Escape games can provide fun and engaging learning activities for high-school students. However, careful design and an iterative design process are required to avoid frustration among participants and instead foster a mental state of flow. The next steps of this project include the detailed analysis of the game experience and students' answers to several open questions. The results will be presented at the conference.

References

[1] M. Csikszentmihalyi and I. S. Csikszentmihalyi (Eds.), *Optimal experience: Psychological studies of flow in consciousness*, Cambridge university press, 1992

[2] N. Whitton, & A. Moseley (Eds.), *Using games to enhance learning and teaching: a beginner's guide*, Routledge, 2012.

[3] S. Nicholson, *Peeking behind the locked door: A survey of escape room facilities*, White Paper, 2015, available online at http://scottnicholson.com/pubs

[4] C. Borrego, C. Fernández, I. Blanes and S. Robles, *Room escape at class: Escape games activities to facilitate the motivation and learning in computer science*, JOTSE **7** (2017), 162-171.

[5] J. L. Gómez-Urquiza, J. Gómez-Salgado, L. Albendín-García, M. Correa-Rodríguez, E. González-Jiménez and G. A. Cañadas-De la Fuente, *The impact on nursing students' opinions and motivation of using a Nursing Escape Room as a teaching game: A descriptive study*, Nurse education today ***72*** (2019), 73-76.

[6] A. I. V. Vörös and Z. Sárközi, *Physics escape room as an educational tool*, AIP Conference Proceedings **1916** (2019), No. 1, p. 050002.

[7] Breakout EDU Website https://www.breakoutedu.com

[8] S. Clarke, D. J. Peel, S. Arnab, L. Morini, H. Keegan and O. Wood, *EscapED: a framework for creating educational escape rooms and Interactive Games For Higher/Further Education*, International Journal of Serious Games **4** (2017) 73-86.

[9] K. Poels, Y. A. W. De Kort, and W. A. IJsselsteijn. *Game Experience Questionnaire: development of a self-report measure to assess the psychological impact of digital games*, 2007, available online at https://research.tue.nl/en/publications/d33-game-experience-questionnaire-development-of-a-self-report-me