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EXITrun – A Lecture as a Virtual Educational Escape Game

Martin R. Wolf, Klemens Köhler
Institute for Digitalization Aachen (IDA), FH Aachen University of Applied Sciences, Germany.

Abstract

Using gamification approaches in Higher Education is an appropriate way to increase student's engagement especially during the time of the COVID-19 pandemic. Escape Games which could be either used as physical experience of a group in a room, or - more virtually - as several puzzles that need to be solved with the target to solve one overarching mystery, are well known tools that can be used in an educational environment as well.

However, despite of existing frameworks and manifold examples it remains difficult to set up a Virtual Educational Escape Game (VEEG) with the proven positive effect on successful learning. This study presents some factors that support successful learning when using a VEEG and compares cost-benefit-ratios for manually versus automatically run VEEGs.

Keywords: *Virtual Educational Escape Games; Game Based Learning; Gamification; Escape Rooms; Educational Games.*

1. Introduction

COVID 19 changed life at schools and universities all over the world. Not just students have been impacted by COVID as they had to learn in a different way, but also teachers, because they had to switch their lectures mostly to a completely digital format. Within weeks teachers had to restructure lessons, get familiar with the use of new learning platforms, or record their subject matter to videos. However, many well-known motivational measures, that work well in a physical world, could not be transferred to a digital environment. Therefore, every tool or instrument that creates a certain motivation at students to actively take part in a virtual lecture, or to engage with learning content was highly welcome.

Virtual Educational Escape Games (VEEG), which are puzzles build into lectures offering a reward when the puzzles are solved, promise to be helpful tools that create an additional learning experience. If these puzzles contain topics of the lecture which encourage the student to engage with the subject matter, VEEGs can have a threefold effect. Firstly, VEEGs may motivate students to stick to the subject matter, secondly, they may increase having fun while learning, and thirdly, they may create a team spirit when puzzles are solved in a team. Both are very helpful effects in virtual teaching situations, and they may make VEEGs a good option to increase student's learning success.

2. Related work

Escape Games (or *Escape the Room Games*) originally derived from text based or online adventure games. The main task of these Games is to find an exit of a certain location (Veldkamp et al., 2020). Beside text or online versions *Live Escape Games* (also called *Escape Rooms*) have emerged, where a group of persons is locked in a physical room and tries to find the exit by solving puzzles in a certain time (Nicholson, 2015). Between 2013 and 2015, physical Escape Rooms emerged globally and became increasingly popular around 2016. Nowadays you find more than 50.000 of these Escape Rooms in more than 88 countries around the globe (Oveit, 2022; IED, 2022a), 2.250 of these rooms are counted in U.S. alone (Room Escape Artist, 2022). In 2016, first *Escape Games* were released in the form of board or card games, or as online versions of Escape Rooms, mostly known as *Exit Games* or *Unlock Games*. Their popularity increased significantly, especially during the Corona crisis (IED, 2022b).

Of course, these kinds of Escape Games can be used for educational purpose as well, because they provide a good opportunity to combine exhaustive learning with having fun by solving puzzles. There is a large number of papers describing a successful use of physical Educational Escape Rooms in higher education in a variety of subject matters (e.g., Järveläinen & Paavilainen-Mäntymäki, 2018; Williams, 2018; López-Pernas et al., 2019; Veldkamp et al., 2020). Most of these papers give creative examples of Escape Room setups, gain insights to

the perception of these rooms to the students and provide conclusions to the learning outcome. There are also many studies on the general topic of Game Based Learning (GBL) which comprises all kinds of games that can be used for educational purpose. Indeed, several meta-reviews reveal improved knowledge acquisition, content mastery and motivation as main general effects of educational games (Jabbar & Felicia, 2015; Connolly et al. 2012).

However, it remains unclear how and to what extent virtual versions of Educational Escape Games contribute to the learning success and which factors drive the learning process. For this reason, this study deals with the questions (1) what are factors for successful learning with a VEEG, and (2) how do these factors contribute to the learning success (see Figure 1) Furthermore, the study also focuses on an economic aspect as it (3) compares the effort of conducting a VEEG with students manually with the effort of an automated version.

Figure 1. Research focus

3. Design concept of the Virtual Educational Escape Room

Shortly after the outbreak of the COVID-19 pandemic, we developed two different VEEGs with the general goal to motivate students and to increase interest and participation in the subjects IT Service Management and Business Information Systems. In the first term, a completely manual VEEG was used which caused high facilitation effort. In the second term, a web-based, automated version of this VEEG has been inserted, in which most of the processes were automated, and the facilitation effort was reduced accordingly.

Both VEEGs were designed according to design-frameworks (Clarke et al., 2017) and design proposals (Breakout EDU, 2022) with a special focus on the design of puzzles. On the one hand, puzzles were designed to increase the duration of engagement with the subject matter, on the other hand, they should strengthen getting to know each other as well as cooperation among students. By solving the respective VEEG, students get an access code that revealed one of the questions of the final exam.

The manual VEEG was designed as a multi-path-based Escape Game (Veldkamp et al., 2020) with six parallel paths for each student, with alternating individual and group puzzles (Figure 2, left). The automated VEEG had a strongly sequential structure (Figure 2, right), with only one group puzzle, shortly before the final “escape” puzzle with the exam question as solution.

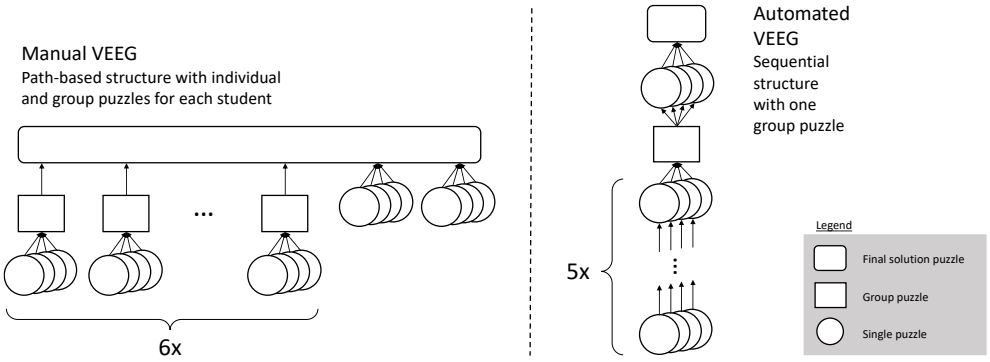

Figure 2. Structure and puzzle paths of the manual and the automated VEEG

For technical reasons only a limited number of group puzzles could be implemented in the automated VEEG, and it was also not possible to support a high number of parallel puzzle paths. Therefore, the manual and the automated version of the VEEG differed regarding its structure even if the design of the puzzles was similar. Furthermore, the automated VEEG needed to have a stronger story, and we decided to introduce the "Hacker Kane", who has stolen the exam exercises of the lecture and hid one exercise behind a code that could be solved with the puzzles.

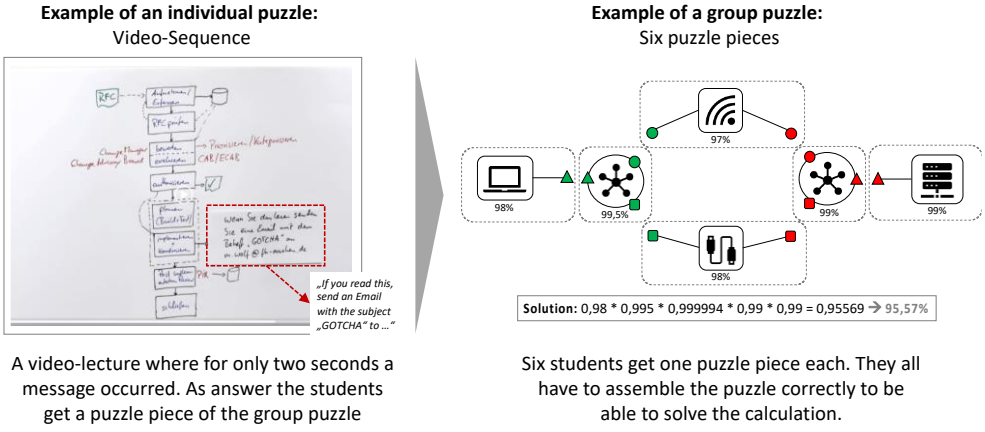

Figure 3. Examples of an individual puzzle and a group puzzle.

Individual puzzles usually consisted of "strange things" that appeared in videos (Figure 3, left) or on slides (e.g., colored letters or symbols in the slides, specific results in the exercises, etc.). Many times, the puzzles were spread over the whole video or slide-set. In one case, for example, spoken letters appeared from time to time in the audio track of a video. All these

letters built a question to the content of the lecture that needed to be answered. In this way, students had to watch the whole video to solve the puzzle.

After solving an individual puzzle, the students received an answer which was either a part of a new puzzle which only could be solved in a group (Figure 3, right), or an entry to the next individual puzzle. When solving all puzzles, the students received the key to the "exit door" of the VEEG. With this key they could open a webpage that contained one original exercise of the exam.

Both VEEGs were tested with different groups of students. The first, manual VEEG was used with students at the end of their second study year at the elective lecture IT Service Management. In total, 54 students took part in the lecture of which 34 participated in the VEEG. The second, automated VEEG was used with first-year students in the introductory lecture of Business Information Systems. 76 students took part in this lecture and 46 of them started to play the VEEG. None of the students took part in both lectures that any recognition effects could be excluded. Both VEEGs started round about in the middle of the term and ended at the last lecture. At the manual VEEG a Pre-Post-Test was conducted, the first one briefly after the release of the first puzzle, and the second one two weeks after the last lecture. For organizational reasons a Pre-Post-Test could be conducted only at the manual VEEG. Therefore, the survey of the automated VEEG focused on usability and design issues of the VEEG-tool as well as on the effort of its usage.

4. Results and Discussion

As mentioned in chapter 2 several effects on the learning success by using a VEEG were tested in scope of the first, manual VEEG. 22 students (out of 54 – ratio 41%) took part in the Pre-Test, and 14 students (out of 39 who participated in the VEEG – ratio 36%) in the Post-Test. As shown in table 1 clear increases can be ascertained at the "Time spent for Subject Matter" as well as at "Sympathy to the teacher". Neither an increase, nor a clear decrease occurs at the "Interest in" the subject matter. Regarding "Importance of Subject Matter" no clear result could be found. The students have been asked to rank the importance of their subject matters in the term and the results before the VEEG were lower than after the VEEG. On the other hand, the survivorship bias may have been significantly in this case and, therefore, the results should be interpreted only qualitatively. This finding strengthens the assumption that (1) successful learning is strongly dependent on the VEEG itself and (2) it is very difficult to combine a subject matter with the game story. However, a slight increase can be detected at "subjective learning success" even if this value was not calculated based on objective results and might be biased. Furthermore, the usage of a VEEG seems to prevent un-motivation. There was a slight increase in motivation of students, but this can be attributed

to the effect of student's perseverance. Figure 4 summarizes the results according to the research focus.

14 students (out of 46 who started the VEEG – ratio 30%) took part in the survey of the second, automated VEEG. Even if the results have not been raised in scope of a Pre-Post-Test and therefore are subjective, they match the results of the first survey. Accordingly, no increase was detected regarding the "Interest to" and "Importance of" the subject matter. However, a strong correlation (cov = 0,78) was found regarding the number of puzzles solved and the increase of interest in the subject matter. This means, the more student liked the subject the more successful they took part in the VEEG. For this reason, it may not be sensible to use a VEEG with a group with low interest to the subject matter as it will not result in a more successful learning.

Table 1. Results of the manual VEEG survey (Pre/Post).

	Pre-VEEG	**Post-VEEG**	**increase**
Number of questionnaire-participants	22	14	
Time spent for Subject Matter (h)	6,16	8,22	**33%**
Interest in Subject Matter (scale 1-7)	2,27	2,01	-11%
Importance of Subject Matter (scale 1-7)	2,36	2,14	-9%
Motivation (scale 1-7)	-	4,56	-
Unmotivation (scale 1-7)	-	**1,87**	-
Sympathy to teacher (%)	31%	64%	**106%**
Subjective learning success (scale 1-7)	*3,68*	*4,25*	***15%***

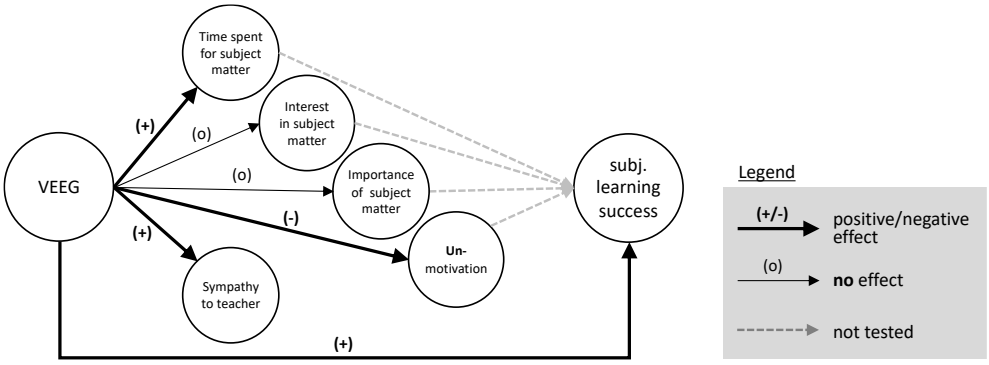

Figure 4. Research results according to the research focus.

Finally, the total effort of the development and conduction of both VEEGs was analyzed. Even if the lecturer's effort to run the VEEG was – as expected – significant lower at the automated VEEG (22%), it took 15 times longer to develop the web-tool for the automated VEEG then the manually built Excel-sheets, that were necessary for the manual VEEG (Figure 5, left). This means, VEEG-automation may only be worthwhile if it is foreseeable that the VEEG will be used frequently and for a high number of students. However, regarding automation of VEEGS it should also be considered, that automation results in a lower teacher-student interaction (Figure 5, right). This may cause a higher dropout rate which reduces the probability that students intensively engage with the subject matter.

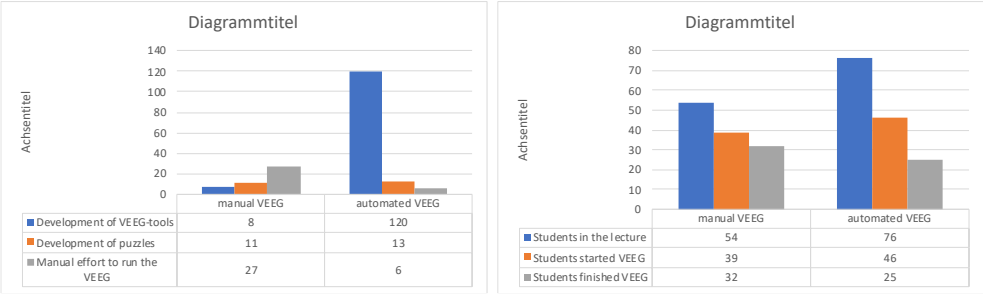

Figure 5. Spent effort for manual and automated VEEGs and its finisher ratio.

5. Conclusion

The use of Virtual Educational Escape Games (VEEGs) in lectures, especially in digital or remote lectures, is an appropriate tool to keep students engaged and to build up a relationship not just functionally but also personally. However, the necessary amount of time that need to be spent for preparing and conducting a VEEG should not be underestimated. Even if automation tools are used that dramatically decrease the time required, the time that need to spend for creating puzzles is still significant. Furthermore, automation of VEEGs seems to counteract or neutralize some of the positive effects of manual VEEGs. Therefore, automated VEEGs should be developed and used carefully and only if aspired positive effects cannot be achieved in another way.

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