EDUCATIONAL ESCAPE ROOMS

Challenges in aligning game and education

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INTRODUCTION

Escape rooms have inspired educators all over the world to adapt this popular entertainment activity for education purposes. This article discusses the design and design philosophy of MasterMind, an escape room developed at Utrecht University by a multidisciplinary team of educators, educational researchers and game researchers. MasterMind served as a means of professional development in the use and implementation of online educational tools in academic teaching. Its aim was to playfully introduce university teachers to digital educational tools and help them make informed decisions about employing these tools in their educational contexts. It targeted early majority and late majority adopters of digital technologies in education (cf. Rogers, 1962). A majority of the participants perceived that the experience of playing MasterMind made them more inclined to use digital tools in their own teaching, and that it was an enjoyable and meaningful time investment.

This article analyzes in a post-mortem reflection, the design of MasterMind. Post-mortem reflections are also referred to as post-mortem evaluations, post-project audits, debriefs or retrospectives. Project members identify and analyze elements of a project, product or meeting that were successful and

unsuccessful, and articulate lessons learned (Kasi, Keil, Mathiassen, & Pedersen, 2008; Myllyaho, Salo, Kääriäinen, Hyysalo, & Koskela, 2004). MasterMind project members based their analysis on formal evaluations by questionnaires[1], observations as game masters, and informal contact with participants after the game. The design of MasterMind is analyzed from the perspective of three design challenges that have informed the design process: 1) the participants' transition from the real world to the game world; 2) the alignment of game design and educational aspects within the game world; and 3) the transfer from experiences and knowledge obtained within the game world back into the real world. We argue that educational escape rooms, such as MasterMind, can be positioned in a context of both serious and persuasive gaming and thus need to take into account the design challenges that are particular to both forms of games. Drawing on a general theoretical model for persuasive game design (Visch, Vegt, Anderiesen, & van der Kooij, 2013) and a design framework for the alignment between game goals and learning goals (Van der Linden, Van Joolingen, & Meulenbroeks, 2019), the article reflects on how we engaged with the aforementioned challenges in the design of MasterMind. We appoint successful and less successful design elements of this persuasive game, and describe encountered dilemmas and lessons learned. With this, we hope to contribute to the discourse on serious gaming and help foster the dialogue between serious game designers and educators.

ESCAPE ROOMS IN EDUCATION

Escape rooms are live-action team-based games in which players encounter challenges that are part of a quest that needs to be completed in a limited amount of time (Nicholson, 2015). Parallel to their immense popularity in the entertainment industry worldwide, escape rooms are gaining popularity as educational environments. Both students and teachers perceive that, while participating in escape rooms, students are more

engaged and active compared to regular classes (Cain, 2019). The time-constrained and problem-based games require active and collaborative participants, which makes an escape room an interesting setting for educators.

The development of educational escape rooms started spontaneously with enthusiastic teachers. They share materials on platforms, such as Breakout EDU, which has about 40.000 members (Breakout EDU, 2018; Sanchez & Plumettaz-Sieber, 2019). Educational escape rooms have been developed for a variety of age groups and for various educational purposes: to recruit students (Connelly, Burbach, Kennedy, & Walters, 2018) or for students to get to know institutional services (Guo & Goh, 2016). Other case studies describe students developing escape rooms in order to foster design skills (e.g. Li, Chou, Chen, & Chiu, 2018). Most escape rooms have been designed to foster domain specific skills and knowledge, or to support the development of generic skills and affective goals. Despite increasing scholarly interest in educational escape rooms, there is a paucity of literature on their use in the context of professional development (Fotaris & Mastoras, 2019; Veldkamp, van de Grint, Knippels, & van Joolingen, 2020). This article aims to address that gap.

SERIOUS GAMES AND PERSUASIVE GAMES

As the development of educational escape rooms started spontaneously with enthusiastic teachers, no academic literature was found on the development of (educational) escape rooms at the start of the MasterMind project. However, educational escape rooms can be considered a form of serious gaming. Serious game design combines educational design with game design (Lameras et al., 2017; Whitton, 2018). Most research on serious games comprises digital games in educational settings (Ávila-Pesántez, Rivera, & Alban, 2017; Lameras et al., 2017). Systematic reviews on serious games show a wide diversity in

definitions of serious games foregrounding different 'essential' characteristics, such as the role of ICT (Ke, 2016; Lameras et al., 2017). Moreover, authors differ on whether serious games are "games primarily focused on education rather than entertainment" (Miller et al. 2011, p. 1425) or that entertainment and fun come first, as these aspects are considered conditional for learning with serious games (Prenski, 2001; Zyda, 2005). We bypass these differences by following Cook (2005), who offers a broader description of serious games:

> "(…) the application of gaming technology, process, and design to the solution of problems faced by businesses and other organizations. Serious games promote the transfer and cross fertilization of game development knowledge and techniques in traditionally non-game markets such as training, product design, sales, marketing, etc."

There are different reasons why non-game markets, of which education is an example, turn to games to solve problems within their organization. In the case of Utrecht University, games are used to resolve the low acceptance of digital educational tools among staff. The enjoyable and immersive game world can help, motivate, and persuade users to behave in ways they experience as difficult in the real world (Visch et al., 2015). Players experience games as not only enjoyable but also protective worlds where actions have fewer consequences than in the real world and can be practiced over and over again (Whitton, 2018). Games can change behavior in the game world and subsequently in the real world. This is the assumption and ultimate aim of persuasive games, a subset of serious games aimed at creating a user experienced game world that changes the user behavior or attitude in the real world (Jacobs, Jansz, & de la Hera Conde-Pumpido, 2017; Visch et al., 2013). Motivating game elements, such as challenges, draw the player into a game world where

equivalents of real world tasks are carried out. The transfer of effects from the game world to the real world can be actively designed, but is often neglected (Visch et al, 2013). How to successfully design this transfer is one of the challenges for developers of persuasive games.

In a review study on digital serious games, Ke (2016) notes that the effectiveness of games created for educational purposes depends on various aspects: 1) the nature of learning to be fostered (skills or conceptual knowledge); 2) how specific game aspects, such as feedback to players, are implemented; and 3) the way games are used in education, for example as a micro-world to embody a situated practice or an interactive, multimodal representation of conceptual knowledge. Ke's findings imply that the specific nature of the knowledge to be obtained and the educational goals to be achieved should primarily drive the design of learning games. Carefully mapping learning actions onto play actions seems to be a necessary and core mechanism for successful learning-play integration, whereas the narrative that structures and frames learning interactions can be considered supplementary. A systematic review on educational escape rooms draws the same conclusion and showed how specific educational and game design aspects are related (Veldkamp, van de Grint, Knippels, & van Joolingen, 2020). Ideally, the game is designed in a way that players can reach the game goal only by achieving educational goals (Van der Linden et al., 2019). An extra challenge for serious games is to integrate learning and playing without losing what is enjoyable about games (Ke, 2016). In games with poorly developed player experiences, the message is ineffective (Ferrara, 2013). Elements that can help create an enjoyable playful learning environment are puzzles, simulations, role play, humor, surprise, storytelling, and mystery (Whitton, 2018).

In addition, given all these aspects that need to be taken into account, it comes as no surprise that educators "are overwhelmed

by the plethora of design choices and level of complexity entailed in integrating, combining and balancing learning with game features" (Lameras et al., 2017, p.990). Lameras et al. (2017) plead that more dialogue is needed between educators and serious game designers to improve the process of amalgamating learning with gaming. For the design of escape rooms in education, such a dialogue would benefit from more qualitative research that helps understand the concrete considerations and decisions made by developers of educational escape rooms.

MASTERMIND: A BRIEF DESCRIPTION

In spite of considerable university investments in technological innovation in education (e.g. licenses, hardware, software, and workshops), a significant part of lecturers at Utrecht University has not yet implemented technological tools in their teaching. These early and late majorities (cf. Rogers, 1962) need to be personally convinced of the value of an innovative technology before investing time in exploring it (Moore, 1991). Moreover, research indicates that this exploration should happen in collaboration with other colleagues and with enough opportunities for reflection (Ertmer, 1999). MasterMind aimed to address this issue with a mobile, pop-up escape room that allows university teachers to experience and engage hands-on with educational technologies in a playful and safe environment, together with others. A post-game debriefing aimed to help participants to reflect on their experiences and make informed decisions about using (or not using) these tools in their own educational setting. Ideally, the positive experience of playing MasterMind contributes to active implementation of digital educational tools in teaching. This is the persuasive goal of MasterMind. MasterMind can be considered an example of persuasive gaming, as it aims to create a user experienced game world to change the teachers' attitudes and behavior in the real world.

MasterMind consisted of two main parts that each lasted one hour: an escape room and a debriefing. The escape room can host 4 to 6 players who sign up as a team. The narrative setting of the escape room is within the fictive tech start-up company MasterMind, founded by student-entrepreneur Tim Turner. Tim has developed 4D Virtual Reality and creates experiences where people can see, taste, feel and smell alternative realities. While waiting for Tim's presentation about MasterMind, the participants are shown a short promo video of the company. Suddenly, Tim breaks into the video signal with an emergency call that he is stuck in his own virtual world. Players will need to get him out, by solving puzzles based on digital educational tools available for teachers at Utrecht University (see figure 1). The puzzles typically consist of a combination of digital and physical actions. Playing the escape room is followed by a one hour debriefing in which a moderator discusses with the team which digital educational tools they have encountered in the game and how these might contribute to the team's teaching practice. The design process of MasterMind was an iterative process, including multiple rounds of play tests with game specialists, educators and the target audience which provided the input for the further development of the escape room.

Figure 1: Players in MasterMind working on a puzzle that requires both physical and digital activities.

DESIGN CHALLENGES IN MASTERMIND

In line with our previous discussion on serious games, one of the main challenges in designing the MasterMind escape room was to strike the right balance between game design aspects and educational aspects. More specifically, to design the gameplay in such a way that the game goal (liberate Tim) and learning goal (experience specific digital educational tools) were aligned, without losing the fun and pleasure of the game. Another challenge, in line with MasterMind's persuasive nature, was to successfully transit the participant from the real world (teaching environment) into the game world (Tim's start-up presentation at the university), and finally, to support the transfer of knowledge and experience of the tools obtained within the escape room to the participant's practice of teaching: the persuasive goal. In the next section, we will discuss how these three challenges concretely informed the design and design

principles of MasterMind, after we have introduced the analytical perspective that frames our analysis and takes into account these design challenges.

Figure 2 depicts a design framework that foregrounds the different alignments that need to be taken into account to design a successful educational game (Van der Linden et al., 2019). The framework is developed in line with the intrinsic integration theory, which suggests that the learning goal and game goal should be aligned in an educational game.

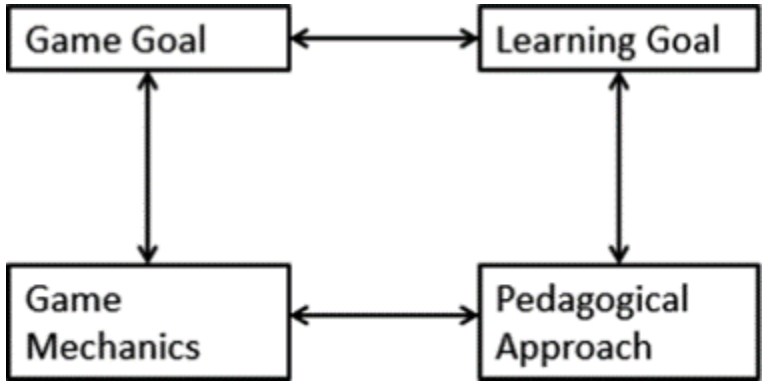

Figure 2: Design framework on alignment between game goal, learning goal, pedagogical approach and game mechanics (Van der Linden et al., 2019).

Van der Linden et al. (2019) emphasize that the learning goal should be leading in the design of an educational game and that game developers in designing the gameplay need to ensure that the game goal can only be reached when the desired learning goal is reached. Additionally, according to the logic of alignment, both learning goal and game goal can only be achieved if they are pursued within a matching structure and logic, meaning that the learning goal needs to be supported by the proper pedagogical approach and the game goal by the proper game mechanics. Which pedagogical approach to adopt or which game mechanics to use should be informed by the learning goal and game goal

respectively. Moreover, Van der Linden et al. (2019) propose that during the iterations of the design process the focus should be on aligning the pedagogical approach with the game mechanics.

In case of the MasterMind escape room gameplay, the learning goal is for teachers with moderate to low technology acceptance to use a set of digital educational tools and to become aware of the functionalities from the both perspectives of the teacher and learners. To align with this learning goal, MasterMind adopted playful learning as its pedagogical approaches, since this aims at an enjoyable, safe environment that offers a positive response to failure and support for learners to immerse themselves in the spirit of play (Whitton, 2018). Within such a safe environment, the pedagogics experiential and collaborative learning can support the learning goal of Mastermind. For the game mechanics to align with this pedagogical approach of playful, experiential and collaborative learning, an integration of the educational tools into the game puzzles and activities is necessary. These puzzles, then, need to steer towards working in a team and having fun. Finally, the gameplay has to be such that only when the tool-based puzzles are solved within time, the game goal can be reached: to liberate Tim from the virtual world.

Figure 3 shows a Persuasive Game Design Model adapted from Visch et al. (2013). The original model is based on three central concepts related to persuasive gaming: gamification, game world and behavioral change design. Persuasive games assume that user behavior and motivations in the real world can be transformed through a process of gamification. In MasterMind the real world is the environment of a university teacher, and the game world is a kick-off meeting for staff at Tim's enterprise. Other than the previous framework, this model does not focus on the game world and game play as much, but describes the players' movement from the real world into the game world and back.

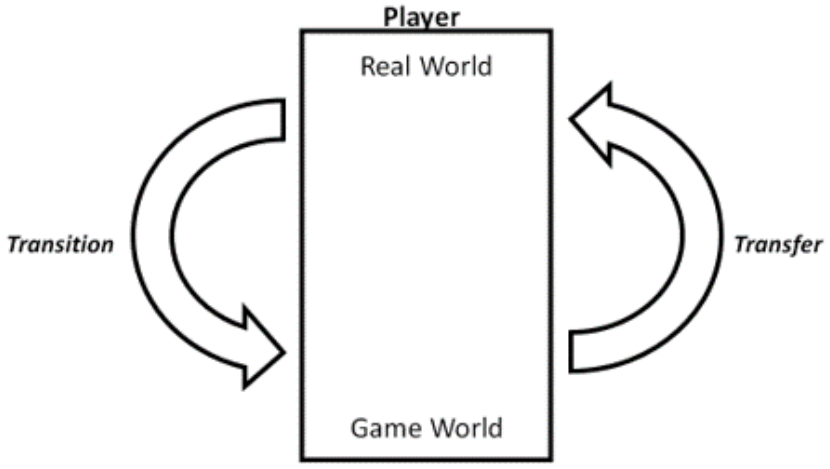

Figure 3: Persuasive game model (adapted from Visch et al., 2013).

In order to address specific behavior and attitude in the game world, it is important that behavioral and motivational aspects from the real world become part of the 'safe' game world; a gamified real world context (Visch et al., 2013). In the game world, these behavioral and motivational aspects can be changed towards the desired behavior or motivation.

If the desired behavior is addressed and realized in the game world, Visch et al. (2013) suggest, it can be transferred to the real world and produce a so-called transfer effect: 'the effect of the user experienced game world on forming, altering, or reinforcing user-compliance, -behavior, or -attitude, in the real world' (Visch et al., 2013). In order for this effect to take place, the transition from the game world to the real world needs to be designed. This 'transfer design,' the authors claim, is often neglected and formed yet another design challenge for MasterMind. A one hour debriefing session was developed to structure and catalyze this transfer, which included a reflection on the experiences and educational content as conditional for learning with escape rooms (Sanchez & Plumettaz-Sieber, 2019).

In the following analysis, we describe each part of the Mastermind escape room – pre-game, in-game and post-game – followed by the design considerations in relation to the design challenges. We look into how aspects (behavior, motivation, attributes) of the real world of the participants have been translated into game elements that have been incorporated in the design of the game world (challenge one). We also reflect in more detail on how specific game aspects and educational aspects have been aligned in the design of the MasterMind escape room (challenge two). Additionally, we describe which design strategies MasterMind developed and employed to facilitate a meaningful transfer of experiences, knowledge and ideas obtained within the game world back into the real world (challenge three).

PRE-GAME: MAILING AND WELCOME

The aim of the pre-game experience was to facilitate the transition from the real world to the game world by creating tension and preparing players for the game play.

One week prior to the game, all players in a team (N= 4-6), received an email from the (fictive) protagonist of the game: student/entrepreneur Tim Turner. He thanks the participant for signing up to the kick-off presentation of his new company MasterMind, shares time and location details and asks participants to be present 10 minutes early. In all communication with the participants, the emphasis was on the narrative, not on the educational goal or pedagogical approach.

On the day of the game, players were welcomed by a game master in a separate informal reception room. The reception room was equipped with game attributes such as the classic boardgame mastermind and playfully hidden game rules. Meanwhile, the game master walked back and forth between the actual escape room and the reception room, checking if Tim has arrived yet. After a few minutes, the game master invited the players to take a seat in the escape room. The game master told them that Tim

went away to fix a technical issue, but that he is expected to return swiftly. Hereafter, the game master guided the players to the actual escape room, and started a promo-video of Tim's company MasterMind.

Design considerations

The preparation of mental settings is important for this target group, because the game will require them to perform actions and behaviors they do not perform in the real world, namely the hands-on engagement with innovative educational tools.

The in-narrative mailing allows players to relate to the protagonist, student Tim before the game starts. The contrast of Tim's request to arrive early and him being late is designed to create a tension that might enhance the urge to take action as soon as the game begins. The reception room serves as a transition space, between the real world and the game world. Here, players have the opportunity to leave behind their day-to-day work and get into a playful mood with their team, a familiar strategy in the design of escape rooms (Clare, 2016). The provided rules and tips for how to play an escape room help to boost playfulness and anticipation for gameplay. This is again designed to increase the urge to take action once the game starts. But more importantly, these tips make implicit game rules and mechanics explicit, preparing players for the game mechanics that will be used. Players that have never played an escape room before will for instance not search the room for clues, unless they understand that this is a regular activity in the game world. Making rules and mechanics explicit might allow for an easier transition from the real world to the game world.

Evaluation

The participants' immersion succeeded. After the game master invited players to the presentation without Tim, some players indicated they preferred to wait or to look for Tim. This

indicates the realistic narrative, setting and players' expectations regarding the presentation of the student start-up. On the other hand, other players entering the reception room, recognized escape room elements, concluded that an escape room had begun, and directly showed behavior accordingly. It is questionable whether the playful way the information on gameplay (rules and tips) was presented to the players, was the most effective.

We wonder whether or not to explicate in the pre-game mailing that participants will enter a real life escape game. On the one hand, this would increase clarity for the participants about what to expect, on the other hand this might affect the level of immersion.

IN-GAME: SETTING AND NARRATIVE

To reach our persuasive goal, a balance had to be struck between a setting in the game world that would be out of the ordinary enough for the participants to show out of the ordinary behavior, and a setting that would allow for easy transfer of game attitudes and skills to the professional practice of the participants in the real world.

The setting of the escape room was within the fictive tech start-up company MasterMind. There was a lot of equipment with a 1980's look and feel present in the room. The call to action is Tim's cry for help to reset the system to liberate him from the virtual world, which was the game goal.

Design considerations

Given the learning goals on specific digital educational tools, the escape room needed to be a technology-rich environment. However, the target group was unlikely to be intrinsically interested in technology and may even be deterred by it. Therefore, the technology that was presented in the narrative

(4D virtual reality) is obviously science fiction. Through their 1980's look and feel, all the physical equipment made it obvious that this is not something the players have to worry about in daily life while it created an acceptable environment to work with technology.

Tim, a student was chosen as protagonist, introducing him in the mailing and promo video as someone teachers can relate to. The call to action is urgent, confronting teachers with a challenge they have never had at hand before, making it sensible that new types of solutions and behaviors are needed to solve this problem. On the other hand, helping a student with a problem does align well with the professional practice and real world roles of the players, allowing for an easier transfer. This is in line with the situated learning theory, which states that learning should take place in a practice in which it would normally be applied (Lave & Wenger, 1991).

Evaluation

The design of the game setting appeared an area of tension following the projects' various goals. The learning goal for teachers was to experience and learn about educational tools, which asks for a technology-rich environment. The persuasive goal was to persuade technology 'laggers' or avoiders to perform behavior they are unfamiliar with in their professional practice. Our solution was to design a setting which is obviously fiction, with the digital tool based puzzles in a *physical* form with a *1980's look* and a narrative on *4D reality*. However, this interferes with the situated learning theory requiring the exercise setting to be congruent with the professional practice (Lave & Wenger, 1991). In balancing these goals and their consequences in terms of design elements, the play tests with the target group had a crucial role. In the final setting, players easily touched and managed the digital tasks using physical equipment with a 1980's look. Physical attributes seemed to give players more feeling

over control of technology. These observations are interesting to research in more detail in the future.

IN-GAME: PEDAGOGICAL APPROACHES

Ertmer (1999) identifies collaboration as an important strategy to address teachers' reluctance to use technology in education, this was part of our pedagogical approach. Collaborative learning requires all members of a team to be active. This was created by the amount of puzzles available at the same time for players in combination with the time restriction, which lowers the threshold to start with the technology-based puzzles.

The escape room aimed at facilitating teacher teams. Players share the same experience during the start and the end of the game. In mid-game, several puzzles were open to work on synchronously. Most teams split up to work in pairs on these puzzles, with pairs helping each other when needed.

Design considerations

The puzzles were organized and individually designed in a way, that collaboration between players was needed, mirroring the help teachers can get within their own immediate working environment. In addition the puzzles were constructed in a way players experienced the student, and were possible the teacher perspective. This is also in line with the situated learning theory, which states that learning should take place in a practice in which it would normally be applied (Lave & Wenger, 1991).

Evaluation

There were no differences observed regarding communication or degree of collaboration in teams with members who knew each other or not. The participants felt social dependence and started to work together. A mentioned drawback in the questionnaire results and debriefing is that not everyone had

hands-on experienced all tools, which might be important for technology avoiders. At the same time, the omission of the experience gave urgency for a discussion of the tools during the reflection on the tools afterwards. The amount of team members (3-5) and the degree of communication in a team seem boundary conditions for solving the puzzles.

IN-GAME: PUZZLES

The escape room aim was to introduce teachers to six digital educational tools[1] they could use in their own teaching. Therefore current tool versions were used in the puzzles, no simulations or mockup versions. Puzzles typically consisted of a combination of digital and physical activities. The physical activities were most of the time primarily designed for fun and engagement while the digital activities addressed the learning goal of the escape room (to use a set of digital tools and become aware of their functionalities).

Design considerations

The selection of the tools was informed by their availability within the real world. All tools were supported by Utrecht University. Moreover they were selected to cover a variety of educational functions. Implementing the actual tools in the game design allowed players to experience the real product, but this limited possibilities in designing the puzzles. Practical matters were also taken into account, such as the possibility to adapt the tool to design puzzles and the ability to quickly reset the tool for the next group of players. Puzzles were constructed in a way players experienced the student perspective and, if possible, the teacher perspective on the tool, this strengthens situated learning. Although most tools required only digital activities to engage with their functionalities, physical actions with a puzzle

1. Selected tools: Augmented Reality application: HP Reveal, Virtual Reality application Rico Theta, Traintool, Scalable Learning, Feedback Fruits, and assessment tool Remindo.

twist were added in the design for a number of reasons: to appeal to this specific target group of teachers belonging to the early and late majority, to link the digital activities in the narrative, to stimulate interaction between players, and to stimulate fun, immersion and diversity in activities.

One puzzle, for instance, was aimed at engaging with a tool for practicing communication skills, using video assignments, called Traintool. First, players needed to find a spoken password in a physical puzzle, then they received instructions in the educational tool on how to speak to convincingly to people and machines. The next step was to practice this skill by recording a video in the educational tool. After doing this, they received feedback on their performance within the tool, just as students would. They subsequently had to apply this feedback on the found password and unlock a physical machine by saying a piece of text in a specific manner in a microphone. Then, a physical reward in the form of a code is unlocked. Altogether, this puzzle allowed teachers to experience how students can receive instruction, practice communication skills, and receive feedback in this platform and then apply the learned skills in practice. So, in order to reach the game sub-goal (the unlocked code), players should also meet the learning sub-goal (using the specific educational tool and discovering its functionalities).

The last puzzle of the escape room was designed as a team activity with all players standing around a table. Because it was the last puzzle and not all teams would be able to finish it, this puzzle was not directly linked to one of the learning goals for the escape room. However, it did contribute to the escape room being a shared experience and facilitated group discussions during the post-game debriefing.

Evaluation

According to van der Linden et al, 2019, the game goal and

learning goal need to be aligned. This was easy to achieve for designers, as the puzzles which needed to be solved to liberate Tim (game goal), were digital educational tool based (learning goal). In the selection of the tools, next time we would take into consideration the length of the tools university license contract. After the selection of tools, the designer's dilemma is to use current tool versions or mock-up versions. Use of the current versions increases the game world mirroring the real world, however it limits the creation of tool-based puzzles as the current versions are usually robust to user manipulation. In addition, current tool versions are sensitive to manufacturer's maintenance or availability of the tool.

The designed puzzles were based on regular student tasks or teacher handling of the tools in combination with a puzzle twist to increase the playfulness. The puzzle twist for some assignments took more time in a lot of groups than expected. We would lower this puzzle aspect in a future escape room puzzles, to balance the players' time spent more on learn the tool than on the puzzle aspect. In relation to the evaluation in the previous section on team size and communication, we would advise smaller teams and easier puzzles for an escape room with such a persuasive goal and learning goal.

The success rate of about 60% of the teams finishing in time, does not seem successful in the effort to achieve all learning goals. However, the last puzzle did not have goals in terms of educational tools, but was successfully designed to finish the game collaboratively as literally all hands were needed to solve the puzzle. The puzzle had three rounds creating a collective feeling of success in between the rounds and made it possible to anticipate in differences in progression and success in the teams. Another possibility for future escape rooms, to anticipate on the teams differences in progression during gameplay, would be for game masters to differentiate the degree of guiding. Guiding in educational escape rooms appear to be delicate balancing

between the players feeling of autonomy and ownership and teachers' wish players to achieve all learning goals (Veldkamp, van de Grint, Knippels, & van Joolingen, 2020).

POST-GAME

The first moments after gameplay were designed to reduce the adrenaline and evoke positive emotions to increase players' openness to reflection with regards to their own teaching practices during the debriefing.

The game ended when Tim had been liberated from the virtual world or when 60 minutes had passed. The success rate of players was about 60%. A specific video started, depending on the outcome (i.e. whether Tim was released or not). When the teachers succeeded in their mission, Tim showed his gratitude. When players did not succeed, Tim is set on a tropical island, saying that life in virtual reality is not so bad after all. Then it was time for the team photo, taken with a cardboard version of Tim.

After some time to cool down and share game play experiences, the debriefing took place in the reception room, linking the player experiences to teacher experiences. For each puzzle, the players who were most involved in that part of the escape room explained the puzzle (gameplay) and what they thought was the educational potential of the tool for their teaching practice. The facilitator could add his expertise and experience with the tools to the discussion. After all tools had been discussed, participants brainstormed about applying the tools for their own teaching. Technical and educational support were offered to teachers who liked to implement some tools or practices, and follow-up actions were able to be planned.

Design considerations

For most players, the escape room was a challenging activity, leading to a sense of fulfillment and joy when they succeeded in

their mission to rescue Tim. However, when players fail, these positive emotions were not triggered. As a solution, we chose to offer comic relief by illustrating that Tim is happy in his new surroundings in the virtual world. For both endings, the cardboard version of Tim had a different function. For the successful teams, it functioned as a reward to be able to take a picture with Tim, the student they saved. For players that failed, again this is an object for comic relief: "Since Tim is virtualized, he couldn't make it to take a picture with you, but we did print a cardboard version for you." The team photo is an almost ritualistic part of most escape rooms. It makes explicit that – whether successful or not – the endeavor was a team effort, emphasizing the shared experience.

After a few minutes, all players moved over to the reception room for the debriefing. Again, the reception room functioned as a transition space, this time between the game world and the real world. The debriefing was designed to facilitate a shared reflection on the experiences with educational tools during gameplay, considering reflection is a key strategy for technology acceptance among teachers (Ertmer, 1999). During the debriefing, the individual player experiences of different puzzles were shared. The conversation was steered from player experience to teacher practice by the facilitator for each puzzle and thereby each tool. The debriefing ended with focusing entirely on applications in the real world and follow-up actions to support teachers in their practice.

Evaluation

The players appreciated both videoclips, as it reduce the feeling of failure for the teams who did not achieve Tim's liberation in time. The comic relief of the clips and the photo shoot with the cardboard Tim regulated successfully the transition to the adrenaline-high activity to the reflection on the experiences with the tools and their functionality. This lasted nearly an hour.

Hereafter, the transfer to their own teaching practices was guided. So, this started after two hours of mentally intense activities. Some participants were at that point mentally too exhausted for an adequate reflection on the implementation in their professional practice. In future, we would start sooner with the implementation in teachers practice. The thorough exchange of the tools can be shortened by delivering a hand-out with the main point of the tools' functionality, and shortly address the players' experiences. As this part doubles with the discussion of the implementation in teaching practice, when participants also relate and discuss their experiences with the tools.

CONCLUSION

In this article we analyzed the design of the educational escape room MasterMind with a specific focus on three challenges that have informed the design process: 1) the participants' transition from the real world to the game world; 2) the alignment of game design aspects and educational aspects in the game world; and 3) the transfer from experiences and knowledge obtained within the game world back into the real world. In our analysis of the design, we have demonstrated that these challenges are inextricably linked to one another and call for an integrated design approach, especially when the educational escape room does not only aim for learning goals, but a persuasive goal as well. This is even more crucial if the target group are early and late majorities in professional development, who need to be personally convinced of the value of an innovative technology before adopting it. This article adds to the studies on educational escape rooms in that it shows the importance of paying as much attention to the design of the game play – making sure that the learning goal during gameplay is achieved – as to pregame, and to the transfer of the learned behavior into the real world to achieve persuasive goals.

Figure 4: Integrated design approach for educational escape rooms

We propose an integrated framework (see figure 4) that can help designers to focus on alignment in tackling the main design challenges in persuasive games. The overarching persuasive goal starts the loop, steering the alignment of the design processes of gamification, gameplay and transfer. For the design of educational escape rooms, available models comprise step-by-step procedures (Botturi, & Babazadeh, 2020; Clarke et al., 2016; Eukel, & Morrell, 2020; Guigon, Humeau, & Vermeulen, 2018). However, these models do not take into account design challenges for educational games, as described in the previous section. We believe that future educational escape rooms will be more persuasive in attaining their goal, when pre-game, gameplay, as well as post-game design are all driven by the same persuasive goal and learning goal and game goal are properly aligned within the game design.

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STATEMENTS ON ETHICS

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