Improving the **motivation** of students using an educational **escaperoom**.

B A C H E L O R T H E S I S

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BACHELOR THESIS

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ABSTRACT

The main goal of this thesis is to design an educational escaperoom about The Cold War that contributes to a gain of motivation among students. Educational escaperooms seem to do so, it is a form of gamification which allows a motivational gain. Also, if teachers decide to give their students the opportunity to have a fun experience like that, motivation is likely to go up. However, a literature review and state-of-the-art review shows that it is not known in what extend a motivational escaperoom can contribute to the gain of motivation. During these reviews some other similar ideas are explored. This report describes the process of designing the puzzles, making them, testing them and it states possible improvements. The potential of the puzzles are present, however, iterations must be made in order to make the puzzles into a finalized escape room which is up and running with real students.

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CONTENTS

1. INTRODUCTION

1.1 SITUATION

Educational escaperooms are live-action team-based games in which players work together to solve puzzles using hints, clues and a strategy to escape from a locked room. During this experience, the players learn something about the assigned topic of the room.

Over the last decade, education is being reshaped through innovative teaching methods, use of technology and individualized learning. An educational escaperoom can complement that movement. Designing an educational escaperoom brings a lot of responsibilities in terms of motivation, education, and safety. But, when accomplished with these responsibilities in mind, it can contribute to a gain of motivation by the players.

The current mission and vision of The Palthehuis Museum is to create an educational escaperoom for students around the age of 14. The theme for the escaperoom is The Cold War and the location of will be in an attic at The Palthehuis Museum.

1.2 CHALLENGES

The goal of this graduation project is to develop an educational escaperoom that contributes to the gain of motivation of the players. The escaperoom overcomes the problems of lack of motivation by students and will keep them motivated to learn new things about the Cold War or other things in general. The escaperoom is developed in a high-fi prototype state.

1.3 RESEARCH QUESTIONS

Continuing on the previous presented situation and challenges, the following research question is defined:

> *How to create an educational escaperoom that contributes to a gain of motivation with young teens?*

In order to answer and support the central research question, the following sub-questions were formulated.

- **How to build an escaperoom?**
    - What is a puzzle?
    - Why do people solve puzzles?
    - How to design a puzzle?
    - How to design a puzzle for an escaperoom?
    - How to design a good escaperoom?

- **How to motivate young teenager students?**
    - What is motivation?
    - Why is motivation important in order to learn something?
    - How to increase the motivation of young teenager students?

1.4 Report Outline

The report is organized as follows. In chapter 2 a literature review and state-of-the-art review are performed which results in a context analysis. In this chapter literature on the topics puzzles and motivation is examined and a state of the art of educational escaperooms are stated. The conclusions are that motivation is important in order to learn something and gamification in the form of an educational escaperoom can help with that. Also, gamified learning experiences such as the diabetes escaperoom, is an example of teaching materials that are 'made fun'. Students showed that it was helpful and motivating to attain the escaperoom.

Chapter 3 describes the method used for this thesis and how this project is approached. In order to find fitting solutions for this particular assignment, chapter 4 examines possible, fitting puzzle ideas. Preliminary requirements are formulated based on the brainstorm session, a stakeholder analysis and research. Based on these findings, puzzle ideas in more detail are chosen and described in chapter 5 based on the prioritized requirements based on the MoSCoW method. The puzzles that will be discussed in this thesis are, the Red Reveal puzzle, the Bookcase puzzle and the Telephone puzzle.

Chapter 6 describes the realization of the puzzles. The LoFi prototypes and, based on tests with the LoFi prototypes, the HiFi prototypes are stated. Chapter 7 describes the two test phases: tests with the LoFi prototypes and tests with the HiFi prototypes. The HiFi tests are conducted with implementations of the findings from the first LoFi tests. Also the results are presented. These tests showed positive results in terms of fun and motivation. All 'must' requirements are met and a lot the 'should' requirements are met.

Lastly conclusions are drawn based on the conducted research. Recommendations are stated in order to make it possible to use these puzzle designs in an escaperoom.

2 CONTEXT ANALYSIS

This chapter covers a literature research which describes what motivation is and how important it is in order to learn something. It also covers a literature research about how to design an actual escaperoom and what the best choices are in terms of puzzles and the whole.

Different kinds of motivation are described as well as requirements for a good escaperoom. Also, the role of teachers in motivation is described. Applying these findings to each other lists a full list of possible requirements that can be used in the design phase of the puzzles.

Furthermore, this chapter will cover a state of the art review describing which educational escaperooms already exist and how relevant they are. The final part of this chapter is an overall conclusion on the context analysis. This conclusion tends to combine the findings in the literature on the topic of educational escaperoom.

2.1 LITERATURE REVIEW

This literature review covers a study on puzzles. How to design them and how to implement them into an escaperoom. This review also covers a study on motivation, different kinds of motivation and how to increase motivation of young teenagers by using an escaperoom. This literature review tries to answer the questions: *How to build an escaperoom?* And, *How to motivate young teenager students?*

2.1.1 The definition of motivation

A motive is an impulse, a need that requires satisfaction, that causes a person to do something. Motivation is an internal process that makes a person move toward a goal. There are two types of motivation, intrinsic and extrinsic motivation. Intrinsic, which means “from within” is the kind of motivation that works with the area of passion from a person. The motivational stimuli comes from within. The individual has the desire to perform a task because it satisfies them. Quite the opposite, others will respond better to extrinsic motivation which, provides that difficult tasks can be dealt with provided there is a reward upon completion of that task. For example an employee of the month award.

Ryan and Deci (2000) found that when people are intrinsically motivated, the quality of their action is leading to better performance. They have more passion for their actions and a stronger sense of commitment. They are more persistent when facing difficulties. Whenever possible, striving for intrinsic motivation works better in terms of results.

2.1.2 Motivation among adolescents in education

Motivation in education can have a few effects on the manner that students learn and how they behave towards subject matter (Prince & Angulo, 2014). It can, for example, lead to enhancement of the cognitive processing, it can lead to improved performances and it can lead to increased effort and energy for a certain task the student is motivated for. Therefore it is of interest of many teachers to increase the motivation of students as much as possible. Students are not always motivated by themselves in terms of education. Therefore teachers find new ways that create situated motivation. This is a form of extrinsic motivation because it is created from the outside. This can help with the motivation of students but it is not an insurance it will.

In 2010, Forbes and Dahl stated that adolescence is a time of changes around motivation. A re-orientation of motivational tendencies. Forbes and Dahl (2010) focus on two examples of these motivational changes. The first one is ‘increases in sensation-seeking’, which is the motivational

tendency to explore high-intensity, exciting experiences. The second example is 'stronger natural interest in contact with potential romantic partners'. The researchers found that these motivational focus changes are very important in growing up but can affect motivation in education. Goodenow (1993) stated that 'relatedness' is one of the core foundations of motivation. Relatedness is described as the presence of secure and satisfying connections with others in one's social milieu. Relatedness may have influence in the sense of belonging and of being supported in a particular context. Middle school for example. When a high relatedness is present, the student is more likely to enhance motivation and engagement in that particular context. Goodenow (1993) also stated that the quality of students' relationships with their teachers to be significantly associated with the students' sense of autonomy personal control, and active engagement in school. Change in school organization can affect the relationship with student and teacher. When students move from a typically small elementary school to a larger middle school. this often results in less personal bonding with teachers. The relationship is less personalized in many cases.

Wentzel (1997) found that 'teachers who care' have a positive influence to students. He defines that caring teachers are the teachers who, for example, makes a special effort, teaches in a special way or makes classes interesting. Teachers who are not caring are described by the following characteristics: don't care about grades, teach a boring class, teaches while students aren't paying attention.

2.1.3 Gamification

One way to make classes more interesting is the use of gamification. This is the approach that uses game design elements and game mechanics in non-game contexts in order to support gameful experiences and further positive behavioral outcomes (Domínguez et al. 2013; Hamari et al. 2014; Landers 2014). In 2014, De Sousa Borges, Durelli, Reis, and Isotani stated that, gamification has been continued to be a popular approach in educational purposes. Supporting user engagement and enhancing positive patterns when using this educational approach. For example, maximize enjoyment through capturing the interest of students and inspiring them to continue learning after having a gamified experience. De Sousa et al. (2014) found that using this method results in positive experiences that can motivate students afterwards. This makes gamification of learning an appreciated approach in education.

Sailer, Hense, Mayr, and Mandl (2017) stated that the majority of studies indicate more positive than negative effects of gamification. The criterion to measure these effects are often measured by the gain of motivation after conducting a gamified experience. The evidence base on the effectiveness of gamification is still lacking due to limitations of researching the effects of gamification in escaperooms.

Without motivation, a player (or student) will not be interested in continue a certain task. The structure of implementing game elements into education is central in the gamification trend and could contribute in designing an escaperoom.

2.1.4 Definition of a puzzle

A puzzle is a game, problem or toy that tests a person's ingenuity or knowledge. In a puzzle, the solver is expected to put pieces together in a logical way, in order to find the solution of the puzzle. There exist different kind of puzzles, such as crossword puzzles, number puzzles, riddles or lock-puzzles. Puzzles are often created for entertainment but they can also be used in more serious situations. For example in mathematical research or education.[1]

[1] This is a generally accepted definition of a puzzle derived from www.en.wikipedia.org/wiki/Puzzle, visited at 15-05-2019

2.1.5 Advantages of solving puzzles

People have solved puzzles for millennia. This age-old activity is popular amongst all ages. These days puzzling starts early in life with different toys that are basically puzzles. See Figure 1 for recognizable toys that are simple puzzles.


[2]

Figure 1: Common puzzle games for kids

Growing up, many people start to solve other kind of puzzles like crossword or sudoku puzzles. These are known for relieving stress and training the brain. And above all, it just feels good to solve any kind of puzzle. According to NIPO, more than 65% of the Dutch population solves puzzles. That means that in almost 5 million households somebody solves a puzzle once in a while. See Figure 2 for examples of common puzzle games that people solve these days.

[3]

Figure 2: Common puzzle games

There are some striking statements on the internet that claim that puzzles can reduce the change of diseases like Alzheimer and dementia but there is no hard evidence for that. David Corcoran, a journalist that has done a few articles about puzzles wrote: "What puzzles can do -- and it almost goes without saying -- is they're fun. They're a form of recreation. They're satisfying to do. And in that way, they can help you keep tabs on yourself. You know if you can solve a puzzle, you know you're still pretty much intact."

[2] Images from www.dhgate.com/product/geometric-intelligence-board-column-shapes/408248689.html, visited at 15-05-2019

[3] Images from www.answersingenesis.org/kids/activities/word-games/, visited at 15-05-2019

2.1.6 How to design a good puzzle

According to Kendall, Parkes and Spoerer, a good puzzle should have a solution which is aesthetically pleasing and gives the user satisfaction in reaching the solution. The appearance of a puzzle really makes a difference in wanting to solve the puzzle. A puzzle has to have 'medium' difficulty. Medium difficulty differs per person. The puzzle can't be too easy because then there is no challenge and satisfaction in solving it. The puzzle can't be too hard either because the user may feel disappointed at not being able to solve it. Defining what medium difficulty means is another challenge itself. But a good puzzle should fit the user(s).

Denksport, a large Dutch puzzle company that designs all kinds of puzzles, divides the levels of puzzles into different categories using stars. One star indicates the easiest puzzles and five stars indicates the most difficult ones. This way, every person can choose for himself what level fits him the best which will make sure the most satisfaction can be obtained by the user.

Scott, K. (2006), stated that a good puzzle has two characteristics. It has to be fun and it has a right answer. He also stated that there are several things that help in making a puzzle 'fun'. A puzzle should be novel: puzzles give us permission to do things that are not practical at first sight. Designing puzzles are therefore a good way of inviting a designer and player to be playful. Also, as stated before, a puzzle should be not too easy and not too hard. Puzzles that are too easy are disappointing; puzzles that are too hard are discouraging. Lastly, a puzzle should be tricky. Shen a perceptual shift is needed in solving a puzzle, the satisfaction of solving one will be greater. But, of course fun is not the same for everyone. Scott, K. (2006) stated that "What may be fun for one person may be torture for another."

2.1.7 The general benefits of escaperooms

In a recent study (Pan, Lo, & Neustaedter, 2017) stated that escaperooms are beneficial for several skills that can be used in everyday life. An escaperoom can contribute to communication skills, teamwork and problem solving skills.

In escaperooms it is often required to have more than one person to complete a given puzzle, such as needing to push five buttons on opposite side of the room at the same time or someone reading instructions to another player in a different room. The need to work together to solve the puzzles is beneficial for teamwork skills. Of course it can result in negative communication and so a negative experience. Then it will also be a good lesson for the participants. To work together, people need to communicate very well so this is also trained by participating in escaperooms. Without communication people most likely will not escape. Good escaperooms are filled with unique puzzles that require out of the box thinking. The puzzles are not easy and obvious, that would be boring. Participating in escaperooms can help people train this skill, the skill of problem solving.

2.1.8 How to design a puzzle for an escaperoom

An escaperoom is an experience. Designing good puzzles is important but if the puzzle does not fit the room it is worthless in terms of obtaining the most joy out of it. The escaperoom community has accepted the following basic rules in order to design good escaperoom puzzles.

- No Red Herrings (puzzles that are made for distraction, the answer will not be used)
- No outside knowledge needed
- No spelling or grammar mistakes
- Puzzles should be solvable without requiring hints
- Puzzles should not be used twice

There are a lot of escaperoom enthusiasts these days. One of the most influential in the escape room community is thecodex.ca. One of the co-writers is Errol and he devoted an article to the ’13 Rules for Escape Room Puzzle Design’. This article summarizes the rules that can be followed in order to get that awesome experience an escaperoom stands for. These rules are approved by escaperoom enthusiasts from all over the world. It is not a scientific article but reading the comments from people who followed Errol for a long time indicates that he knows what he is talking about. He is trusted in the escaperoom community. A few of his rules are listed in table 1.

Requirement	**Explanation**
Puzzles must be fair	As a puzzle designer, the goal is to let people solve the puzzle and have some sort of satisfaction out of it. Puzzle designers do not take satisfaction when a person can’t solve the puzzle. A good puzzle can be solved and follows the guidelines all puzzles follow. Fair means the player is in control of their win state. The puzzles are meant to be solved. They are designed for players that want a challenge and want to have fun.
Everything needs clues	Nothing is obvious. Even something as simple as a date can be misleading. This is because a lot of countries have different rules in writing down a date. Do not assume people have a certain amount of foreknowledge. A good escaperoom puzzle can be solved with the information that is provided in the room. No knowledge on beforehand is needed. This does not take away that a puzzle can be really difficult to solve.
A puzzle should have one answer	It can be very frustrating when people think they found the answer to a puzzle but it is incorrect. When they followed the clues and think of the answer in a logical way it should be the correct answer.
A puzzle should have a self-validating answer	When the players solve a puzzle, they should be confident they have the correct answer without entering it into a device to validate the answer.
Clues and puzzles should be clearly linked	Puzzles can be linked by some common aspect like shape, color or context.
Correlations should make sense	When a correlation makes sense it will create that ‘aha’ moment which is very satisfying.
A puzzle should not take more than 5 minutes to complete	Puzzles that require a lot of process is fine, working up to the correct answer is exciting. But, when the player already knows how to solve the puzzle and it still takes longer than five minutes it is too long. The fun level drops dramatically.
Tedious work should not be ambiguous on instruction	When players should do something what will take a long time to process, make sure they are doing it the right way. If they spend ten minutes on something, only to learn they did it wrong from the beginning because of ambiguous instruction or they missed something with searching, then they’ll probably spend the rest of their time resetting all your locks to different combinations.
Puzzles should have no destroyable states	In an escape room, you don’t want to design a puzzle where elements crucial to solving the puzzle can disappear. If a clue or an object must be in a particular place in order to solve the puzzle, then don’t allow it to be moved. Either that or provide a way to reset it back to its initial state.
Puzzles must have feedback	Video games have been doing feedback for years. There are countless games telling the player when an attempt was correct, as well as when it was wrong. That too is equally as important, especially if your puzzles tend to be more difficult.

Puzzles should be consistent	Patterns that are set should be followed.

Table 1: Requirements for implementing puzzles into an escaperoom, derived from www.thecodex.ca/13-rules-for-escape-room-puzzle-design/

2.2 State of the Art Review

2.2.1 The Escape Classroom

With this educational escaperoom, students have to compete against other teams in order to escape the classroom before the clock ticks down to zero. They are 'locked' by 'Super Villains' into the classroom. There are clues and puzzles in order to help them escape. The escapes are designed around specific curriculum. To get access to this form of education, teachers can order a try out version. When they like it, and want more they need to take out a subscription in order to be able to use it for a longer period of time. Looking at the reviews and feedback on the Facebook community they are really popular all over the world. The Escape Classroom has more than 65 000 likes on Facebook. They promote their product among teachers all over the world and promise a gain in creativity, innovation, critical thinking, problem solving, communication skills and collaboration. This product is very versatile because everybody can order it online. The downside is that the learning objectives are very basic because it has to fit students all over the world. It can't be personalized to local learning objectives.

2.2.2 Diabetes-themed Escape room

Pharmaceutical students are looking for new ways to train their self-confidence and competence to provide diabetes care. (Wongwiwatthananukit et al., 2013). The 2013-2014 American Association of Colleges of Pharmacy (AACP) encouraged the development of serious games in pharmacy education. The AACP wanted to prepare pharmaceutical students for their future jobs. The goal was to enhance pharmacy and interprofessional education. Therefore, the diabetes escaperoom was developed. The particular goal of the escaperoom is to increase the knowledge of diabetes disease management and to fully engage students in learning by doing. The puzzles are divided in educational topics, skill demonstration and gaming tasks. For example: a sudoku puzzle in combination with 'accurately perform carbohydrate counting'. The outcome of this pilot was positive. Through this game, students improved their knowledge in diabetes management and reported a positive perceived value of this learning activity. (Heidi N. et al., (2017))

	Educational Topics	Skill Demonstration	Gaming Tasks
Puzzle 1	Mechanism of action of oral antidiabetic medications	Demonstrate oral antidiabetic therapy recommendation; Demonstrate ability to match mechanism of action of oral antidiabetic medications; Demonstrate ability to match medication classification of oral antidiabetic medications; Demonstrate consultation[a] of oral antidiabetic medication.	Mason cipher Word jumble Coded message
Puzzle 2	Carbohydrate counting Sliding scale insulin dosing Insulin pen consultation Use of insulin syringe	Demonstrate ability to investigate a patient's personal blood glucose log; Accurately perform carbohydrate counting; Demonstrate live consultation[a] of insulin pen; Demonstrate ability to accurately measure medication using an insulin syringe.	Sudoku Combination lock decodi Math riddle Data hunt

Figure 3: The first two puzzles from the Diabetes Escaperoom

2.2.3 Well rated escaperooms from The Netherlands

According to Escaperooms Nederland[4] the best rated escaperoom from The Netherlands are the two rooms from 'Locked Amsterdam'. The unique aspect at these two room is that it is not just locks and combinations in the correct order. The story is logical and the technical and electronical aspects are very well-developed. This makes the escaperoom a real experience. The rating is 9.4 out of 10 from 120 reviews.

Following up, the rooms from 'Dark Park Zoetermeer' have a high rating as well. Developers used special effects, a unique 3D sound design and a specially produces movie images that deliver a unique experience.

2.3 CONCLUSION

This conclusion consists of two parts. The first part is the overall conclusion about the literature review, the second part is the overall conclusion about the state of the art. Together they conclude chapter 2, the context analysis.

To summarize the literature review, motivation is important in order to learn something. It can lead to improved performances. It is in the interest of teachers to increase the motivation of their students. Situated motivation is very common these days and a way to do that is to use gamification. Using an educational escaperoom can be an example of that. In order to make the gain of motivation as big as possible, the escaperoom should be convincing. Therefore, the puzzles have to be good puzzles. Next to that, the puzzles should fit into the escaperoom well. Not just every puzzle can be in every escaperoom. Table 1 sums up the needed requirements in order to do so. Also, escaperooms can contribute to skills like communication, teamwork and problem solving. Teachers who care have a positive influence to students. Caring teachers who make a special effort, can motivate students in order to engage more with school. Going to an escaperoom, which provides benefits like teamwork, could be a great way for a teacher to be more 'caring'.

To summarize the state of the art, the three projects that are viewed are very different from each other. The first one is a portable escaperoom that teachers can order. They have to print it out themselves. There is a lot of positive feedback from the users which implies that there is a demand for gamified learning experiences. The second one, the diabetes escaperoom is an example of an escaperoom that is particularly made for students in order to motivate them. The escaperoom is an example of teaching materials that are 'made fun', game elements are applied. The students showed that it was helpful and motivating to attain the escaperoom.

[4] www.escaperoomsnederland.nl/top-10, visited at 4-6-2019

3 METHOD

In order to provide clarity about how this project worked, the method has been described. This chapter describes how everything was put together from the beginning on until the last steps. A schematic overview of this can be seen in Figure 4.

The starting point for this project was the given scenario written by the client and Edwin Dertien. This scenario can be found in Appendix B – Scenario by Daniella and Edwin From this point on the researchers started brainstorming in order to generate new puzzle ideas. These sessions can be found in Appendix A – Brainstorm: puzzles. Based on those brainstorm sessions, decisions were made. this resulted in a selection of puzzles. Then the making of the LoFi prototypes started. These are described in section LoFi Prototypes6.2. These prototypes have been tested. Which is, together with the results, described in section 7.1 and 7.2.. Then the making of the HiFi prototypes started. These are described in section 6.3. These prototypes also have been tested. This is described, together with the results, in section 7.3 and 7.4. The last evaluation in the form of recommendations and conclusions is described in chapter 8. The next step is to talk again with the client. This is planned, but did not happen at the time of writing.

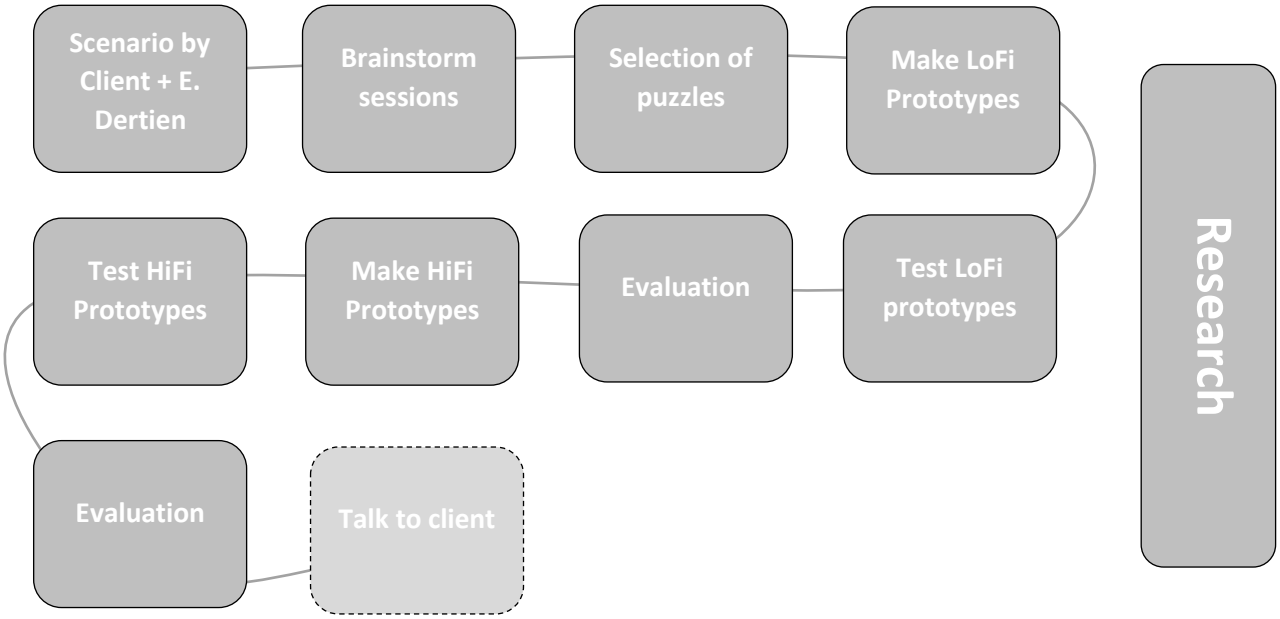


Figure 4: schematic overview of the method of this project

4 IDEATION

To maximize the amount of fun in the escaperoom by making the puzzles as good as possible, an extensive ideation phase is conducted. The ideation phase is the mode of the design process in which idea generation is concentrated on. This phase can go on forever, new findings are found during every phase. These findings can be used for the final design choices.

Different puzzles were divided among the different researchers. This report focuses on the puzzles that matter to the research of the researcher herself. The moodboards focus on all puzzles to prevent the researchers from designing individual puzzles that do not correspond to each other. It is important to stay likewise with each other.

4.1 MOODBOARDS

In order to stay like-minded about the escaperoom ideation, three moodboards were created. These moodboards create an image about how the feel and look of the escaperoom should be. One per room in the escaperoom. The flour plan of the actual place for the escaperoom can be found in Figure 5. The moodboards for every room can be found in Figure 6. This section describes what can be seen in the moodboards and how the researchers interpreted these.

The first room is inspired by the BVD office. Very crime-like aspects such as a wall with most wanted spies, file cases and some 50s-styled attributes. The second room is inspired by an 50s living room. It should as similar to that as possible to enhance the feel of the room. An old phone and television are part of the puzzles as well as part of the living room. An old bookcase will also be used in the room. The third room is inspired by a bomb or launch room. A lot of buttons, lights and sound will give the impression of that.

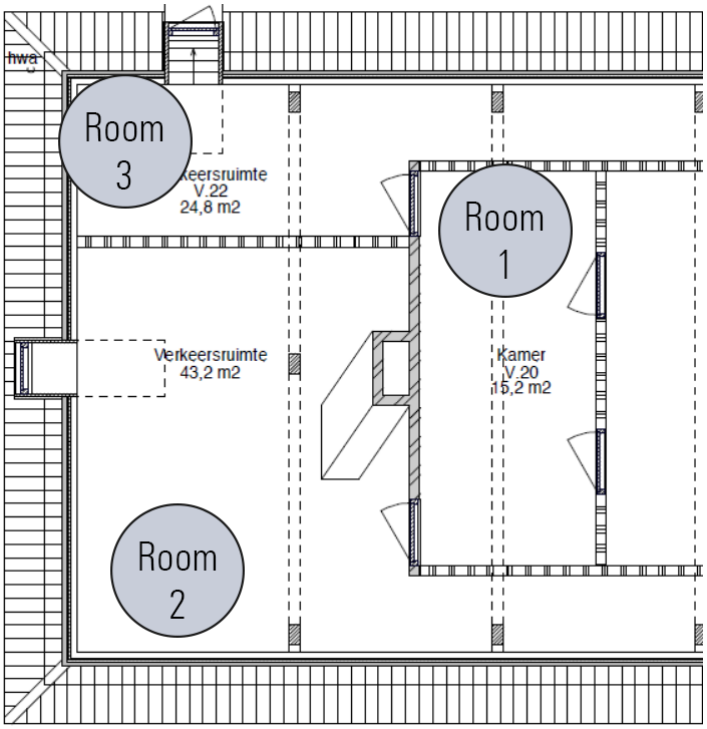


Figure 5: Floor plan of the attic, the room for the escaperoom with the corresponding room numbers.

Figure 6: A moodboard for every room.
Left, room 1: the 'BVD' office. Middle, room 2: the living room. Right, room 3: the launch room.

4.2 BRAINSTORM

This section describes the most important puzzle ideas that came forward during different brainstorms. There were more ideas but the puzzles described here did have the most influence in the design choices that were made afterwards. These puzzles influenced the puzzles the researcher had to develop further. In the brainstorm the learning objectives were not taken into account. The full list of puzzle ideas can be found in Appendix A.

Puzzle idea 1 | Red Reveal

Use a red reveal glasses to see a certain code or hint. A red reveal glasses is a glasses with red glasses. When people look through this glasses everything that is red disappears. The rest of the colors, mostly blue, can be seen vividly. This is used in a lot of escaperooms and toys.

 [5]

Figure 7: Example of a red reveal glasses

Puzzle idea 2 | Book Safe

A secret book safe in a book which the title is given by another puzzle. The book safe contains the hint to the next puzzle.

[5] Image from www.kristenanncarter.com/design.html, visited at 28-05-2019

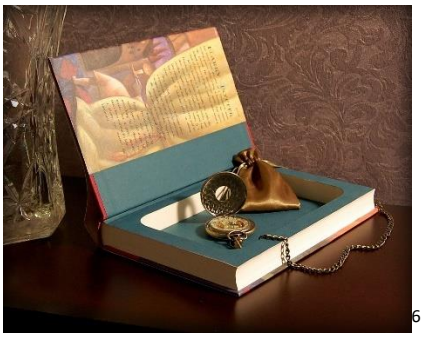
 [6]

Figure 8: Example of a book safe

Puzzle idea 3 | Thermochromic rub

Use thermochromic rub to reveal a hint on a chair. Thermochromic rub is a material that is black, but when it touches something heated, like rubbing of hands it changes to a transparent material. The idea is to place this on a chair so when the players will sit on the chair, the material changes transparent from the heat of the body. A hint will show in order to solve the next puzzle.

 [7]

Figure 9: Example of thermochromic rub

Puzzle idea 4 | Telephone

The telephone puzzle idea was present from the beginning of the project. The supervisor of this project thought of this idea. The idea is that an old rotary telephone will be converted with a little computer inside. This will make it possible to call certain numbers in order to hear a voice message from the telephone.

 [8]

Figure 10: Example of a rotary phone

[6] Image from www.secretsafebooks.com/products/harry-potter-sorcerers-stone-rowling-1, visited at 28-05-2019
[7] Image from www.sfxc.co.uk/products/thermochromic-rub-reveal-plastic-film-with-adhesive-backing-31-c, visited at 28-05-2019
[8] Image from www.en.wikipedia.org/wiki/Rotary_dial, visited at 28-05-2019

Puzzle idea 5 | Google Cardboard

Using Google Cardboard, a present world will be shown with Trump in it. A modern living room with a huge tv. On that tv a short film will play. Players will see a speech of Trump where Trump talks about the INF agreement. The players need to watch that. The end of the video will be a hint or code that is a transition to the next puzzle. The room is has the same interior as the escape room but modern.

Figure 11: The VR world with Trump's speech on tv

Puzzle idea 6 | Bookcase

The Bookcase puzzle idea was present from the beginning of the project. The supervisor of this project thought of this idea. The idea is to use a book shelf as a secret door. The door can open when a certain combination of books is touched or pushed. The right combination can be found in other puzzles in the room.

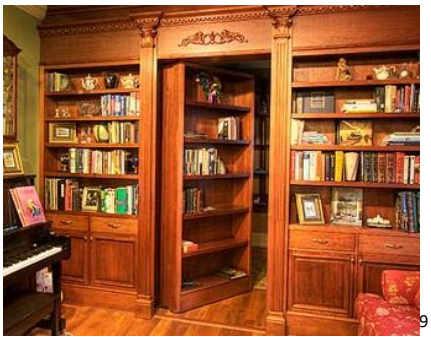


Figure 12: example of a secret bookshelf door

4.3 STAKEHOLDER ANALYSIS

By doing a stakeholder analysis, all the stakeholders with their characteristics related to the project are described. It can help to identify the interest of all stakeholders. Stakeholder analysis's can also be used to generate knowledge about the relevant actors about their behavior, intentions, interrelations, agendas, interests and the influence or resources they have brought (Brugha, 2000). A stakeholder is a party that has an interest in the project. A stakeholder can either affect or be affected by the business.

[9] Image from https://www.instructables.com/id/Bookcase-door-1/, visited at 28-05-2019

The stakeholder analysis is conducted due to the many parties involved in this project. The stakeholder analysis is based on findings of the researcher and is in no means based on facts but it is supported by research to do so (Brugha, 2000). It is based on estimations and made for understanding of the stakeholders with their power and interest.

Mapping the stakeholders into a matrix, the level of power and interest can be determined. Figure 7 holds this matrix. This matrix is conducted from the stakeholder analysis below. The x and y axis both are discussed with every stakeholder. After that the stakeholders are places in this matrix for an overview, a summary of the stakeholder analysis.

4.3.1 Users

The users are the people that will interact with the system, will use the system. For this project, the main users are young teenagers that will go into the escaperoom. These teenagers are students that go to middle school and follow the havo or vwo program in The Netherlands. They are around the age of fourteen. The users have a high interest but their power is on the lower side because they will have little influence in this research. Tests are mainly done with students around the age of 22, not the real target group. The final escaperoom will not be released during this project so the real users do not have high power. The interest is higher assuming that students always are in for a fun experience like an escaperoom.

4.3.2 Developers

Developers are the people that are involved in the developing of the project. In this project the researcher herself is one of the developers. However, the researcher has to work together with other developers in order to succeed this project. To get a straight overview of all the developers involved, Table 2 is made. Because there are a lot of developers working at this project, communication with each other is key. Some decision makers are also the developers and interests can clash.

Developer	Function	Role
Edwin Dertien	First observer & Founder of AssortiMens	Helps with some projects within the project.
People who come to AssortiMens for daytime activities (Autistic people)	Specialists on specific skills (f.e.: programming, 3D printing, laser cut)	Can carry out certain tasks
Daniella van der Stelt	Project leader from The Palthehuis Museum, the client	Supervises the overall project.
Mark and Jet	Building	Make the overall feel of the room. Make furniture, walls and the floor.
Famke and Chantal	Fellow researchers	Every individual has her own research question and therefore develops different puzzles and conducts different research.

Table 2: all developers and decision makers involved in this project

4.3.3 Decision-makers

Decision-makers are the ones who have high power in the development of the system. These people are responsible for the project. They want, and have to be involved in the overall decisions and important steps that are made.

The client for this project is The Palthehuis Museum from Oldenzaal with Daniella van der Stelt as the project leader. The client has high interest and high power. The client manages the money for the builders and has contact with the township in order to realize this project. They museum is interested in developing an educational escaperoom. The goal of The Palthehuis Museum is to have to room up and running in October 2019. This means that the researchers will deliver a concept of the actual escaperoom along with the research, test results and other findings.

Another decision-maker is Edwin Dertien, supervisor from the University of Twente. The supervisor has medium interest and high power. Medium interest because Edwin Dertien has a lot of projects like these. A critical observer is also present: Karin Slotman. She has low interest and medium power.

4.3.4 Visualization of the stakeholder analysis

In order to get an overall view of all the stakeholders involved, the visualization in Figure 13 is made. This visualization is made using the 'power/ interest matrix' from Gardner et al. (1986). These authors indicate that defining the stakeholders in not just about establishing the interest of each stakeholder group, but also about making an inventory of how much power stakeholders can influence over the policy of the project or organization. Gardner et al. (1986) indicate in outline how an project/ organization should deal with the different interests of the various stakeholder groups.

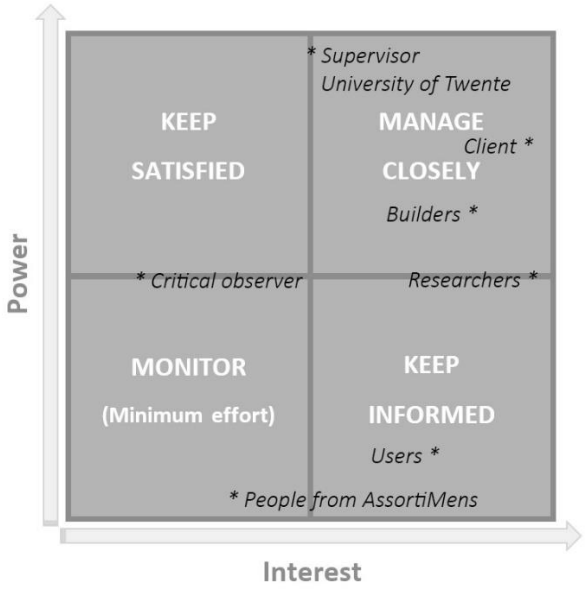


Figure 13: Visualization of the stakeholder analysis

4.4 SCENARIO

In the first weeks of the design process, research has been done. Research about escaperooms in general and also about specific topics like motivation, the cold war and characteristics of the time period. Most findings can be found in chapter 2, otherwise they will be explained in this section. Based on these findings certain design choices have been made. The most important ones will be described in this section.

The first thing that had to make sense was the scenario of the escaperoom. This would be the basis of the project. The first concept of the scenario idea, made by Edwin and Daniella, has been adapted along the way. This first scenario concept can be found in appendix B.

After all the research that has been done, and some input from people from AssortiMens, something did not make sense. The idea of a bomb chamber was not logical. Nobody had a bomb chamber in the cold war. It was all about nuclear weapons. So, for some spy to have a bomb chamber in the room was not the most logical. Following the requirements in order to design the best escaperoom possible, the room should have purposeful décor and a logical story with logical links. Therefore, the scenario has been changed. The renewed scenario can be found in appendix C right after the first scenario.

4.5 CONCEPTS

When comparing the ideas of the brainstorming section with the requirements found in the research that has been done, several choices can be made. The dropouts and the promising ideas are stated. A small recap of the puzzle ideas:

- Red reveal
- Book safe
- Thermochromic rub
- Telephone
- Google cardboard room
- Secret bookshelf door

4.5.1 Dropouts

Looking at the requirements three different reasons for an idea to fail can be formulated. Namely, confusion, not realizable in the timespan given for this project, lack of skill and inability to provide feedback.

- Book safe

In order to follow the basic escaperoom rules, accepted by the escaperoom community which can be found in section 2.1.7, it is not a good idea to have another book-related puzzle in the room. The secret bookshelf door will be the goal of the second room so tis puzzle will get priority. Therefore, the decision is made to not include a book safe puzzle in the room. This is predicted to be too confusing next to the other puzzles.

- Thermochromic rub

The idea to put thermochromic rub on to a chair is a dropout because it will not work in reality. The idea is very cool but putting this material on a chair is not a clue for rubbing it, or sitting it long enough in order that it will get transparent. Looking at the requirement: ‘Everything needs clues’ that can be found in Table 1: *Requirements for implementing puzzles into an escaperoom*, it is not a good idea to use thermochromic rub on a chair. The chair would be the ‘hint’ but this hint will not be obvious enough. People who are in an escaperoom usually are very busy running around, they will not sit down and relax on the chair. The reason for this dropout is the inability to provide feedback.

- Google cardboard room

In order to make this work, real skills for modeling are needed. Looking at the time frame this would not be realistic because the researcher should do a lot of learning in terms of modeling. When

proceeding with this puzzle idea, it would probably not turn out the best way possible. Therefore it is a dropout due to lack of skill.

4.5.2 Promising ideas

- Red reveal

This puzzle can be adapted in many shapes and forms. A glasses can be used to read the hidden message. But to stimulate teamwork, a red window can also be hang. This would make sure not just one person could read the message at a time. It would require teamwork in order to solve the puzzle.

- Telephone

This puzzle is able to meet almost all of the requirements. It has instant feedback because when the right number is called, the participant immediately knows that he called the right one. No outside knowledge is needed except for knowing how to call a number on a rotary phone. Most likely at least 1 person will know that.

- Secret bookshelf door

This puzzle is able to meet almost all of the requirements. If the puzzle is developed as the idea above, the puzzle has instant feedback. However, this puzzle might not be realized in the timespan of this project. Also, the researcher herself is not skilled in building such huge interactive bookshelf. She needs help with that by the builders. This is consulted and accepted by the client. Therefore, the concept will be developed but the prototypes will not be that far developed.

5 SPECIFICATION

The specification phase is the phase where the found requirements of the ideation phase are specified in to more detail. Taken the context analysis and the ideation into account, requirements can be formulated. A few sketches are made in order to specify into more detail what the envisioned puzzles should look like. Not every part of every puzzle is included. Details will be specified in the next chapter.

Similar to Table 1, Table 4 is created. The difference with the first table is that this tables uses a prioritized list of requirements. These are prioritized based on the MoSCoW method. This method, developed by Dai Clegg, is a method that is often used to prioritize lists of requirements. The abbreviation MoSCoW stands for Must have, Should have, Could have and Won't have. In Table 3, every part is explained shortly.

Mo	Must Have: The most vital things you can't live without.
S	Should have: Things you consider as important, but not viral.
Co	Could have: The "nice-to-haves".
W	Won't have: Things that would be good to implement but are not yet possible in this phase.

Table 3: The abbreviation MoSCoW explained

Combining as many requirements as possible, the envisioned red reveal puzzle should look like the sketch below. The red reveal puzzle is for stimulating teamwork. Therefore the choice is made to use a window instead of a pair of glasses. This makes sure that the person who can read the instructions has to communicate with the players inside room 3. Teamwork is needed to complete this puzzle.

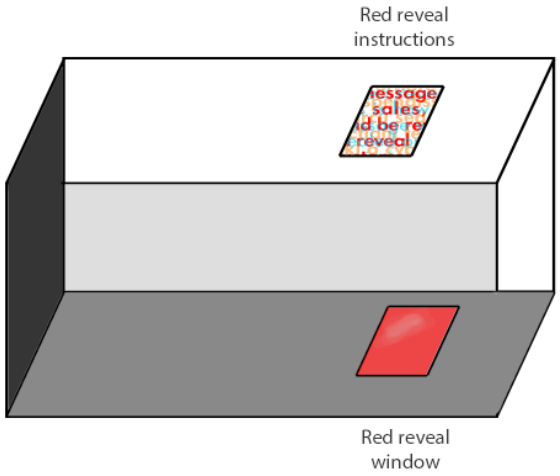


Figure 14: Sketch of the Red Reveal puzzle placed in room 3. Only when the players look through the window, the instructions can be read. This means that players have to go back to 'room 2' to read the instructions.

The telephone puzzle should look as similar as possible to an old rotary phone. This puzzle is all about hints. There is only 1 right number that gives the answer to the next puzzle. This can be found by, first, opening a suitcase with a lock on it. In this suitcase is a little puzzle. On this puzzle is the name of the person that is in the telephone book. When calling this number the answer to the next puzzle will be given. When other numbers are called, random facts about the cold war will be played.

The bookcase puzzle will stay in the prototype phase. This puzzle can only be made in collaboration with the builders[10]. The first builder dropped out of this project due to personal reasons. Therefore, this puzzle will stay in the prototype phase.

Must	Puzzles must be fair Puzzles must have feedback No Red Herrings[11] No outside knowledge needed No spelling or grammar mistakes Puzzles must be solvable without requiring hints Puzzles cannot be used twice
Should	Everything needs clues A puzzle should have one answer A puzzle should have a self-validating answer Correlations should make sense A puzzle should not take more than 5 minutes to complete Clues and puzzles should be clearly linked
Could	Tedious work could not be ambiguous on instruction Puzzles could have no destroyable states Puzzles could stimulate teamwork Puzzles could stimulate skills like creative thinking Puzzles could be consistent
Won't	Puzzles won't be a finished product The room won't be fully in theme

Table 4: Requirements of the puzzles, prioritized using the MoSCoW method. These requirements are based on chapter 2 and 3, the research and the ideation phase.

[10] See Table 2: all developers and decision makers involved in this project
[11] Puzzles that are made for distraction, the answer of the puzzle is not needed in the escaperoom

6 REALISATION

The realization phase leads towards design choices which are made using the requirements stated in the last chapter. This chapter describes how the prototypes are made, which technologies are used and why certain design choices are made. Two test phases are conducted which will be discussed in chapter 6. The HiFi prototypes are designed after the first test phase but are described in this chapter.

6.1 THE PUZZLES EXPLAINED

In order to understand the cohesion between all the puzzles, a scheme is made. There are a lot of aspects to every puzzle which are visualized in the scheme below, Figure 15. This scheme has changed a lot during all the different phases of designing. The figure below is the final one which the researchers used to conduct user tests.

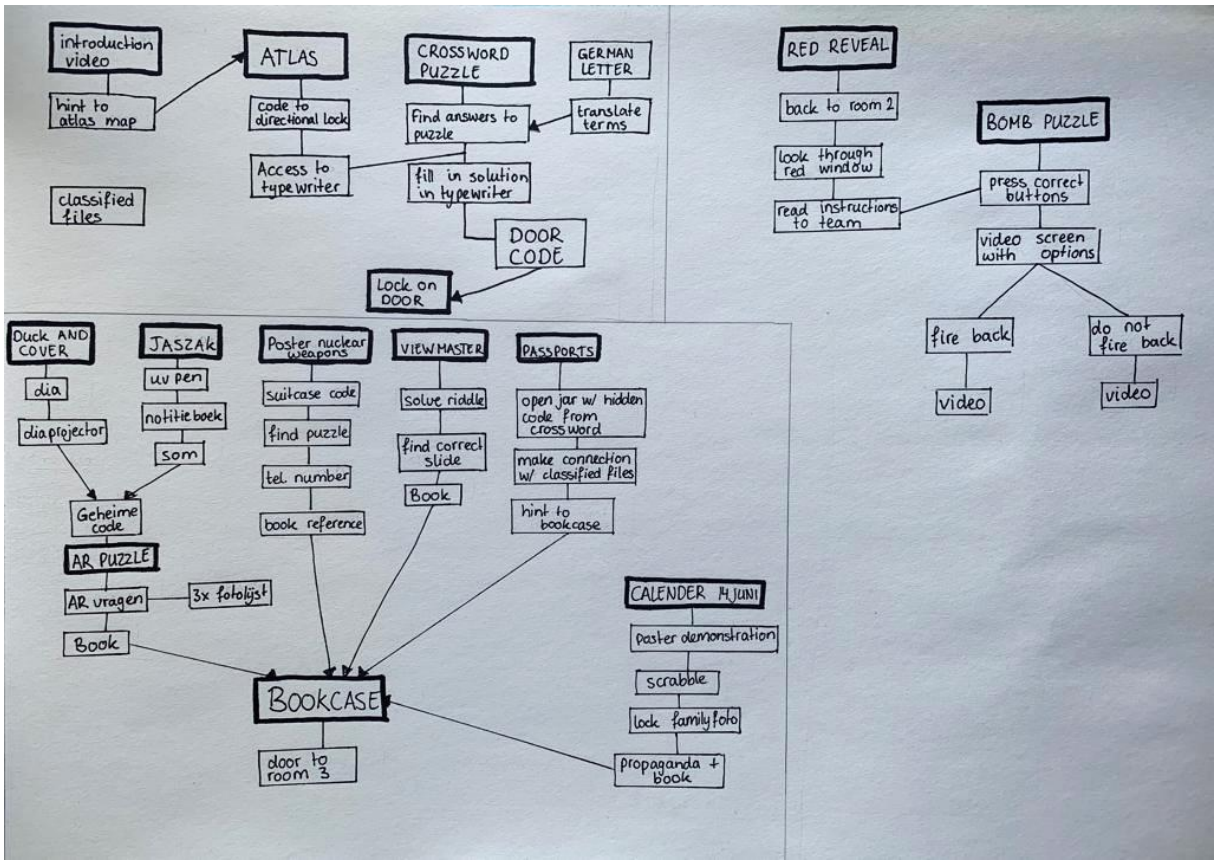


Figure 15: Flowchart of all the puzzles in the envisioned escaperoom. The three different rooms are divided with lines. This flowchart is made by Famke who is one of the researchers.

6.2 LOFI PROTOTYPES

To test with LoFi Prototypes, paper prototypes are made. A description can be find below.

Telephone puzzle

In order to test the telephone puzzle an iPhone was used instead of a rotary phone. A picture of a rotary phone was used to imply the feel of the puzzle. The telephone number that had to be filled in was not a real phone number but the code to unlock the phone. The background of the iPhone has been changed into the numbers of the rotary phone.

The phonebook that had to be used to find the right person to call existed out of a lot of post-it notes. This phonebook was inside an envelope with a picture of an address book.

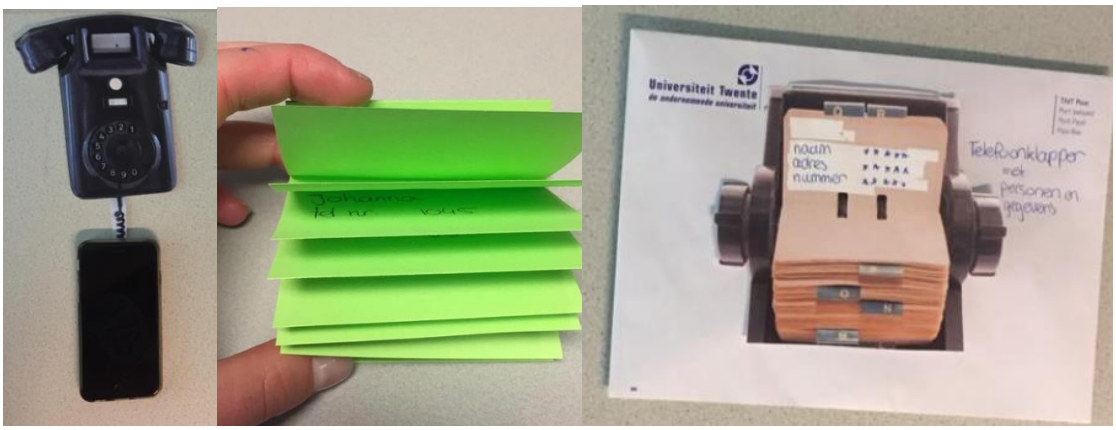


Figure 16: LoFi prototypes of all the parts of the telephone puzzle

Red reveal puzzle

In order to test the red reveal puzzle a glasses with red glass is used. The encrypted message was printed and hang on the whiteboard. A big difference with the final idea is that the glasses can be moved. In the final design, the red reveal glass is fixed. The code that reveals when looking through the red glasses where the letters 'K I R A J', which was the code for 'stopping the bomb' in the launch room.

Figure 17: LoFi prototype of the red reveal puzzle

Bookcase puzzle

In order to test the bookcase puzzle, several book titles have been printed and hang up on the whiteboard. The 'interactive system' was faked by making a noise every time a test person touched a book title. When the correct book titles where touched the researchers told the test person that the secret door was opened. Then the test person could walk to the next room.

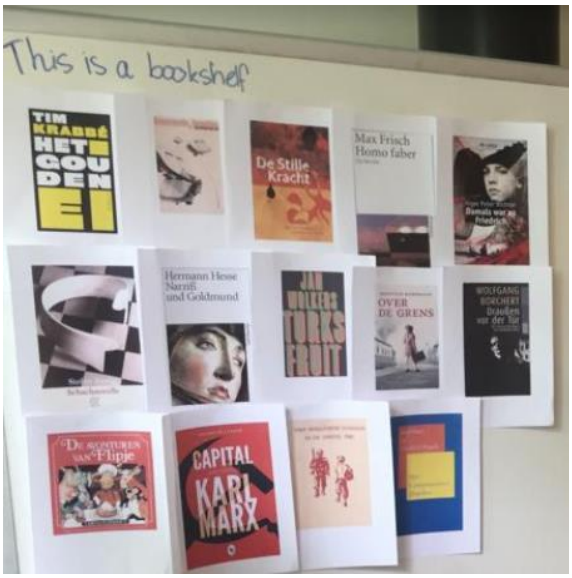


Figure 18: LoFi prototype of the bookcase puzzle

6.3 HiFi Prototypes

To test with HiFi prototypes, the LoFi prototypes are made into real puzzles. The phone isn't from paper anymore and the red reveal glass feels more like a window. The bookcase is still in the paper prototype phase but more thoughts went into designing it. All the 'must' requirements are met and the 'should' requirements are almost met.

Telephone puzzle

The telephone puzzle is part of a larger whole that exists out of different small puzzles. In Figure 19 an overview of the table in the 'living room[12]' can be seen. The different aspects are explained in the description. This HiFi presentation of the Telephone puzzle already feels like an escaperoom. Pieces like the suitcase, the phonebook and the telephone itself are ready to use in the real escaperoom.

To complete the Telephone puzzle, different puzzles should be solved in advance. First the poster has to be found which is inside the folder. The code comes out of this poster is: '211', the date and time that is on the poster. When the participant enters this code into the lock on the suitcase the suitcase opens. Inside the suitcase is the next puzzle. An encrypted message. A 'spionage befehl'. The output of this puzzle is D.SMIT, which is the name that has to be looked up inside the phonebook. The corresponding number to this name is the number that has to be called with the telephone. The output of the telephone is an audiofile which refers to a booktitle.

[12] See Figure 5: Floor plan of the attic, the room for the escaperoom with the corresponding room numbers. to get a view of the different rooms in the escaperoom.

Figure 19: Overview of the desk in room 2. Different aspects of the telephone puzzle are numbered. (1) The folder with the poster of the "kruisraketten nee" inside. (2) The suitcase which can be opened with the code from the poster. (3) The phonebook. The name that has to be called can be found in the puzzle inside the suitcase. (4) The telephone

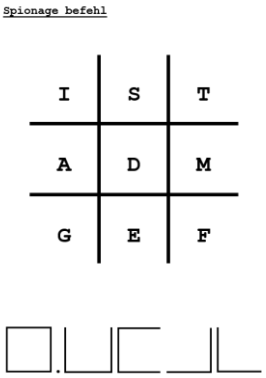
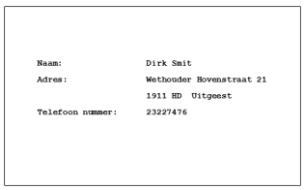
Inside the folder (1)	Inside the suitcase (2)	Inside the phonebook (3)	Inside the phone (4)
		62 individual people with their name, address and telephone number. 	An audio file which is a book reference. It refers to the book title: *"Manifest der kommunistischen partei – Karl Marx"*

Table 5: small puzzles that are part of the Telephone Puzzle

The Bookcase puzzle

The bookcase puzzle is the puzzle that combines all the puzzles. A lot of puzzles in the room have a ‘book reference’. This is also visualized in Figure 15. The idea of this puzzle is that it is an interactive system which reacts to touch. All the books have a sensor in them that light up when the books are touched. To complete this puzzle, al the references have to be found and the corresponding books have to be pressed in the right order. Then the secret door/ bookcase opens to the next room. Because this puzzle has to be developed together with the builders, the puzzle is not further developed than a paper prototype version that can be seen in Figure 20. This was printed on A1 format so it felt like a real bookcase. However, it was not interactive and during the testing phase the wizard-of-oz technique was used to simulate the interactive bookcase.

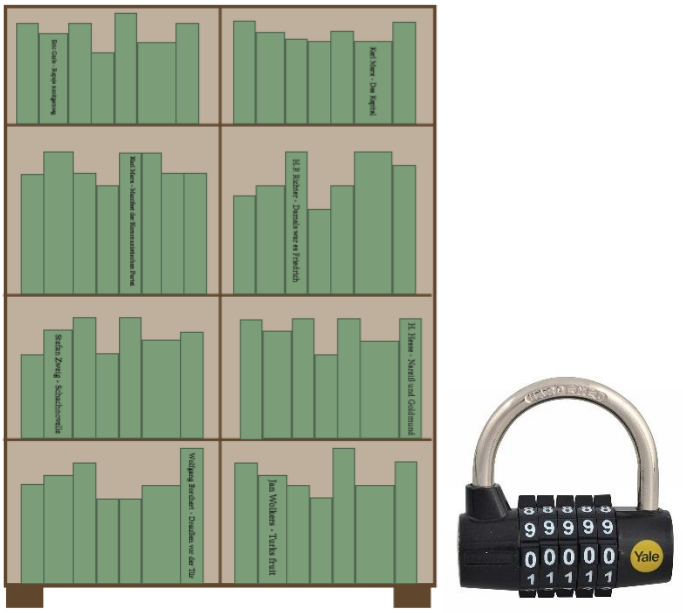


Figure 20: Paper prototype of the bookcase

Red Reveal puzzle

The Red Reveal puzzle is the final puzzle that has to be solved in order to get the right instructions for the last puzzle, the puzzle that unlocks the choice of firing back or do nothing. This puzzle is made by another researcher. The solution of the puzzle is the right order that the buttons have to be pressed. In Figure 21 the setup as well as the puzzle itself can be seen.

The first step that has to be made when participants enter the third room is that they need to realize that they need to walk back to the second room in order to look through the red window. Then the roles are as follows: one person needs to give instructions, one person needs to write them down on, in this case, the whiteboard and another person needs to put every other participant with the right button. When everybody is working together, the puzzle can be solved.

Figure 21:The red reveal instructions. left: the HiFi setup. middle: what players see when standing in the third room. Right: what players see when looking through the red reveal window. The answer is the right order for the next puzzle.

7 EVALUATION

In the evaluation phase, the LoFi and HiFi prototypes are tested with potential users. Three types of tests are conducted: the LoFi test with fellow students as test persons, the HiFi test with fellow students as test persons and the HiFi test with potential users. The LoFi test was to exclude major mistakes in the relation of the puzzles. The HiFi tests are conducted in order to see if all the identified requirements are met.

First an explanation of the different tests is given, second the results are given and third, conclusions are drawn. Combining all the results of the different tests results in conclusions regarding the concept and the HiFi prototypes. Using the conclusions, the puzzles can be placed in the context of the real escaperoom with some further adjustments.

7.1 LOFI TESTING

The LoFi testing phase is important to maximize the number of times to refine the design before committing to the HiFi prototype. It gives quick feedback about the puzzle ideas. It effectively educates researchers in possible design mistakes. The division of roles was as follows. Famke and Linde were observing, making short notes and stepped in where needed. They also explained to the participants how the puzzle is envisioned when the participant did not interpret the LoFi prototype correctly. Chantal was the one who took minute. She wrote an expanded report with observations, times, facts and impressions.

In order to get insight in how users experience the prototypes, four user tests are performed. The LoFi prototypes, as described in section 5.2, have been used for usability testing with real users who understand the principle of paper prototyping. These people have been tested with paper prototypes before so they will most likely be less distracted by it then a potential user of the puzzles. For this phase it is not a problem that the test persons are not part of the potential user group because this is about big design mistakes that can be foreseen with a wider spread of users. A simple room is used in order to execute the LoFi test round. In Figure 22, the setup is displayed.

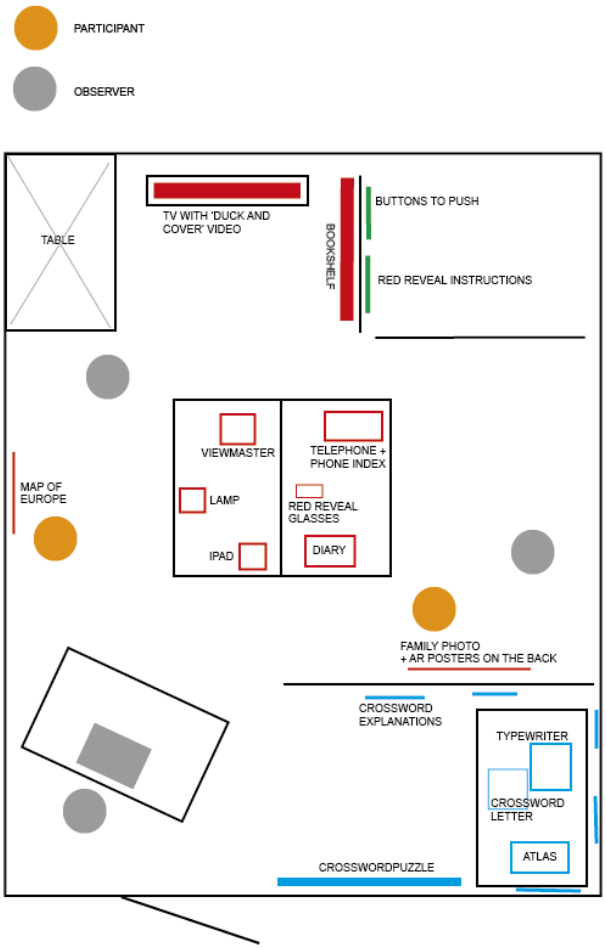


Figure 22: A visualization of the LoFi test room setup

LoFi Test 1

Date	May 9, 2019
Amount of participants	1
Who	Creative technology student, 21, male
Description	*1 person who attempts to escape from the LoFi test escaperoom to see if the puzzles have a logic relationship to each other. He is asked to think out loud.*

The participant enters the first room. He solves the puzzles after some confusion and trials, this took 19 minutes. Then he enters the second room. He observes all the stuff in the room. It is a lot at a time. The participants finds the first book references and makes the connection to the book case directly. The participant tries different stuff. He touches the book, and tries to take the book outside of the bookcase. The observers tell the participant that the bookcase is interactive and when touching the books a light lights up. The participant knows he has to find more book references and goes further with the telephone puzzle. He gets the phone unlocked and listens to the audio file. He also finds another book reference behind the painting. He also tries the red reveal glasses at the bookcase. Nothing happens. After finding all the book references and touching the books, the researchers tell the participant he can move to the third room after 38 minutes. He sees the red reveal message and

immediately knows what to do, he takes the glasses and reads the instructions. After 40 minutes he escaped.

LoFi Test 2

Date	May 9, 2019
Amount of participants	2
Who	Creative technology students, 21 & 27 years old, male & female
Description	2 persons who attempt to escape from the LoFi test escaperoom to see if the puzzles have a logic relationship to each other and to see if the puzzles require teamwork.

Changes as opposed to LoFi test 1: more names in the telephone book which makes it more difficult to guess which name needs to be called. The gambling factor is made smaller doing this.

The participants enter the first room. After 12 minutes they enter the second room. The two participants tend to solve every puzzle together. They do not split up to solve puzzles separately. Again, they guess which number they need to call. They guess the right one. After 28 minutes they enter the third room. Immediately they make the connection between the red reveal instructions and the glasses. After 30 minutes they escaped.

LoFi Test 3

Date	May 9, 2019
Amount of participants	2
Who	Creative technology students, 18 & 19 years old, female & female
Description	2 persons who attempt to escape from the LoFi test escaperoom to see if the puzzles have a logic relationship to each other and to see if the puzzles require teamwork.

Changes as opposed to LoFi Test 2: more names in the telephone book

The participants enter the first room. After 11 minutes they enter the second room. They instantly make the assumption that they need to call someone from the phonebook. They also recognize the book titles and assume that they need to do something with them. After 30 minutes they enter the launch room. They make the connection with the red reveal glasses and escape in 32 minutes.

LoFi Test 4

Date	May 9, 2019
Amount of participants	2
Who	Creative technology students, 21 & 23 years old, male & female
Description	2 persons who attempt to escape from the LoFi test escaperoom to see if the puzzles have a logic relationship to each other and to see if the puzzles require teamwork.

No changes as opposed to LoFi Test 3.

The participants enter the first room. After 11 minutes they enter the second room. They spent a long time observing all the different stuff in the room. They do not assume they have to call someone. They wonder if they should sort the names in the telephone book. They do not do that but start looking for names in the rest of the room. They compare names from the bookcase to the telephone book. After a while they find the solution. After 32 minutes they enter the third room and immediately make the connection with the red reveal glasses.

7.2 RESULTS OF THE LOFI TESTING PHASE

The results of the questionnaire can be found in Appendix D. Only the results for the questions about the puzzles of the researcher are shown and evaluated. Questions about the rest of the puzzles are not. The most important findings from the LoFi tests are insights in design mistakes. Mistakes that can be fixed easily and make puzzles better according to the puzzle requirements.

7.3 HIFI TESTING

The HiFi testing phase is important to cover not only the user interface of the puzzles in terms of aesthetics, but also the user experience aspects in terms of interactions an behavior of the participants. Also the HiFi tests are conducted in order to see if the requirements are met. The HiFi prototypes, which can be found in section 6.3, are made in order to come as close to the envisioned puzzles as possible. The division of the roles was as follows. Famke and Linde were observing, making short notes and stepped in where needed. They also explained to the participants if they did not interpreted a HiFi prototype correctly. Chantal was the one who took minute again. She wrote a short minutes.

In order to get insight in how users experience the escaperoom, five user tests are performed. Four of them with students from The University of Twente. One of them with real potential users from Bonhoeffer College from Enschede. These were 6 students that participated in a vwo+ Programme. Attending the escaperoom was a gift of their teacher because they were the students with the highest score. They had the extra time because they were ahead on other students.

All the participants signed a consent form which there are two versions of. One for the parents of the middle school students and one for participants above the age of 18. The consent form that is used for the parents can be found in Appendix G – Consent FormThe one for participants above the age of 18 is not included. It is very similar only the words ‘uw kind’ are changed into ‘jij’. The consent form is approved by the ethics committee. This can be seen in Appendix F – Consent Approval.

For the first four test, a room named ‘play’ in the Design Lab was used to conduct the user tests. For the fifth test, a classroom at the Bonhoeffer college was used. The results are merged together because the researchers found that it did not make much of a difference between the participants from the middle school and the participants from high school. It appeared that puzzle solving is not that much age-related.

HiFi Test 1

Date	June 18, 2019
Location	Play room, Design Lab
Who	A mix of master and bachelor students (5)
Escape time	46 minutes
Description	This is the first test. The participants were really enjoying themselves. They had been in an escaperoom before so they knew how it worked.

HiFi Test 2

Date	June 19, 2019
Location	Play room, Design Lab
Who	Creative Technology students
Escape time	52 minutes
Description	These people were doing everything together but somehow it worked because they solved all the puzzles. They had fun, they

	laughed and they were excited about some specific puzzles. They AR puzzle was really amazing to them.

HiFi Test 3

Date	June 19, 2019
Location	Play room, Design Lab
Who	Creative Technology students
Escape time	25 minutes (they skipped puzzles due to errors, the researchers asked the group to re attain the room. After that they escaped in 42 minutes)
Description	Due to an error in the bookcase prototype, the participants skipped a lot of puzzles. The bookcase puzzle prototype is too easy to gamble the code. This should be fixed in the next round. They were very fanatic and had a good time. They were proud that they skipped puzzles.

HiFi Test 4

Date	June 19, 2019
Location	Play room, Design Lab
Who	Bachelor students
Escape time	50 minutes
Description	Good test round. The guys were very busy. They did laugh while solving puzzles and also because they were making jokes. They were motivated to solve the escaperoom without using hints. The puzzles sometimes were too hard without hints and this resulted in a little bit less motivation at the end. This is noticed because at first they were all very fanatic and in the end they seemed a little bored. They also told the researchers that it felt a little too long. Overall they had fun.

HiFi Test 5

Date	June 20, 2019
Location	Bonhoeffer college, Enschede
Amount of participants	6
Who	Students from a middle school who are in a vwo+ Programme
Escape time	58 minutes
Description	These students were exited to try out the escaperoom. This was told by their teacher. They were very concentrated on the puzzles. In the beginning they did every puzzle together and after a while, mainly in the second room they split up. One time a student asked her fellow student something about the grades of a class. The other students reacted a little bit angry and told her to concentrate. They did not want her distraction. That was interesting because it shows that most of the students were very motivated to solve the escaperoom. They had fun and were proud that they escaped.

7.4 RESULTS OF HIFI TESTING

To test if the requirements for 'good puzzles' were met, four questions were asked to 21 participants. These four requirements are the ones that are not qualified as 'met' yet. The other requirements either were already met or could not be tested by a questionnaire. In this section all the 'must' requirements from Table 4: Requirements of the puzzles, prioritized using the MoSCoW method. These requirements are based on chapter 2 and 3, the research and the ideation phase. are discussed.

puzzles must be fair

"As a puzzle designer, the goal is to let people solve the puzzle and have some sort of satisfaction out of it. Puzzle designers do not take satisfaction when a person can't solve the puzzle. A good puzzle can be solved and follows the guidelines all puzzles follow. Fair means the player is in control of their win state. The puzzles are meant to be solved. They are designed for players that want a challenge and want to have fun." – from table 4.

All the researchers' puzzles are solved by every test group which indicates that puzzles are fair. The players were in control of their win state. Some groups needed little hints but that was mostly due to that the puzzle was in a prototype stage instead of fully developed state. For example, every group needed a hint for the bookcase puzzle because that was not an interactive system. Overall, this requirement is met but at the same time, this is a requirement that is always ready for improvement. How this can be done is explained in the next chapter.

Puzzles must have feedback

"*Video games have been doing feedback for years. There are countless games telling the player when an attempt was correct, as well as when it was wrong. That too is equally as important, especially if your puzzles tend to be more difficult." – from table 4.*

This requirement is partly met. 15 out of 21 participants agreed or definitely agreed on the statement "I knew immediately when I solved a puzzle correctly". (See Appendix E – Results HiFi testing for the chart belonging to this question). 3 were neutral and 3 did not agree. The feedback in the puzzles have to be improved. How this can be done is described in the next chapter.

No Red Herrings

This is a requirement that the researchers took into account from the beginning on. Therefore they did not include distraction puzzles into the escaperoom. During the user tests the researchers found that there were no aspects in the room that distracted the participants. The participants fully focused on the puzzles that the researchers designed. This requirement is met.

No outside knowledge needed

This requirement is partly met. This was measured by the statement "I was convinced I could solve the puzzle without in front knowledge". 5 out of 21 did not agree and 7 out of 21 were neutral, the rest agreed or definitely agreed (See Appendix E – Results HiFi testing for the chart belonging to this question). This requirement needs to be more clear. How this can be done is described in the next chapter.

Another important finding around this requirement is some quotes from participants from the actual target group. A few of them said that they would like to have a class about the specific topic before entering this escaperoom. That would make it more satisfying for them to solve the puzzles because they knew, for example, the presidents on the pictures.

No spelling or grammar mistakes

This is a requirement that the researchers took into account from the beginning on. Therefore they paid attention to this. This requirement is met. There are no spelling or grammar mistakes inside the escaperoom.

Puzzles must be solvable without requiring hints

This is a requirement that the researchers took into account from the beginning on. Therefore they paid attention to this. However, this requirement is only met partly. During the HiFi test phase the researchers needed to provide hints. This, as explained before, was due to the state of the prototypes. They were not developed fully. The telephone puzzle was solvable without hints. The Red reveal puzzle as well, except the fact that the window was not a window but just a glass placed in between the two rooms. How this can be improved is described in the next chapter.

Puzzles cannot be used twice

This is a requirement that the researchers took into account from the beginning on. Therefore they paid attention to this. This requirement is met. The researchers made sure that a puzzle is only used once. This is also illustrated in Figure 15, there can be seen that all the different objects in the room function for 1 purpose.

Correlations should make sense

"When a correlation makes sense it will create that 'aha' moment which is very satisfying." – from table 4.'

This requirement is tested with two statements and is partially met. The first statement is "I had a 'aha-moment' while solving one or more puzzles". 20 out of 21 agreed or definitely agreed to this statement. Only 1 participant was neutral. (See Appendix E – Results HiFi testing for the chart belonging to this question). The only doubtful thing about this question is that it is does not cover for all puzzles individually. If the participant only had an 'aha-moment' one time they already could agree to this statement. The second statement is "The puzzles had where logically connected to each other". 16 out of 21 people agreed and agreed definitely. 5 were neutral.

Having fun

This was not stated as a requirement before but is very useful when looking at the motivation of students. The statement "I did have a nice experience in the escaperoom" was the most striking. 100% agreed definitely or agreed. (See Appendix E – Results HiFi testing for the chart belonging to this question). Why this is that useful will be explained in the next chapter.

8 CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

This bachelor thesis describes the process of designing and creating an educational escaperoom. The concepts of these puzzles ready to implement into the location for the escaperoom at the Palthehuis Museum. The puzzles are tested in a HiFi prototype state but need to be developed further if the puzzles are going to be used in a real escaperoom with real users.

The main research question for this thesis was as following: '*How to create an educational escaperoom that contributes to a gain of motivation with young teens?'* The topic of this thesis is presented by Edwin Dertien, AssortiMens and The Palthehuis museum.

After conducting a context analysis, using a literature review and a state-of-the-art review, it was concluded that without motivation, a player (or student) will not be interested in continue a certain task. The structure of implementing game elements into education is central in the gamification trend and could contribute in designing an escaperoom. Also, 'teachers who care' have a positive influence to students. Teachers who make a special effort are considered as 'teachers who care'. This can be done by giving their class the opportunity to participate at an escaperoom. Also, in escaperooms it is often required to have more than one person to complete a given puzzle, such as needing to push five buttons on opposite side of the room at the same time or someone reading instructions to another player in a different room. The need to work together to solve the puzzles is beneficial for teamwork skills. Lastly requirements are stated in order to design good puzzles and how to implement those into an escaperoom.

The puzzles first were made using the paper-prototyping method. These LoFi prototypes were tested among students. The findings from these test were taking into account and applied to the HiFi prototypes. These were made with a mix of real items and as little as possible paper-prototyping. The HiFi prototypes are evaluated via user tests among students and real potential target group participants.

The following conclusions can be drawn based on the evaluation. In general, the escaperoom was up and running in the HiFi test phase. All the participants were able to escape and had a good time attending the escaperoom. The escaperoom meets almost every 'must' requirement and a lot of 'should' requirements. Participants had fun. However, to be able to get this concept in the foreseen location at the Palthehuis Museum, adjustments have to be made. People required hints in order to understand some prototypes and the test room was definitely nothing like the foreseen escaperoom. The feel of the room can be improved with more details, real division between rooms, real locks, real everything. People were aware of being observed. To what extend the appearance of the room is necessary in order to have a trustworthy escaperoom should be investigated.

The client was satisfied with the developed prototypes. The client felt sorry for the fact that the foreseen end result was not reached. The developed concept however, adds value to the project. The builders can now, with these concepts and the recommendations in section 8.2 in mind, complete the escaperoom.

More positive findings are that this educational escaperoom is a nice addition to a normal class, more than a way to educate. Attending the escaperoom is stimulating and motivating because the participants seem to have a lot of fun. Participants engage a lot more with a topic if they have fun which leads to motivation.

8.2 RECOMMENDATIONS

This section states recommendations in order to improve the research, and to be able to another study that lays on this one. The recommendations are divided into: the prototypes, the test and general recommendations.

The prototypes

In order to motivate students even more while and after attending the escaperoom, the prototypes and eventually the actual puzzles can be improved. Looking at the test results based on the general escaperoom requirements and puzzle requirements that should contribute to motivation the following recommendations have been done.

The feedback in the puzzles have to be improved. For the bookcase puzzle this can be done by further developing the prototype with real sensors which will indicate feedback. This, instead of the wizard of oz method. The feedback of the telephone puzzle is already good but, can be better if the poster of the demonstration will be adapter in a puzzle format. Now it is only reading off the poster which is not that great of a puzzle. The feeling of solving it will be better as well. The feedback of the red reveal puzzle is quite good already but when the window is blended in a little bit more into the room, the surprise effect would be better because the puzzle would be harder to solve.

In order to improve the confidence of the participants in terms of knowing that they can solve every puzzle without in front knowledge can easily be done by explaining it to them before they enter the escaperoom. Or, the decision can be made to require the participants to study on beforehand so they can apply their knowledge in the escaperoom. This would be a whole new field to investigate because this would mean that they cannot escape from the room without studying up front.

Looking at the requirement that puzzles should not be too hard an not be too easy, the telephone puzzle should be harder. Every test group solved this puzzle first. This can be done by adding more puzzles in order to solve the telephone puzzle or by making the existing puzzles more difficult.

The telephone puzzle can also be improved by changing the name cards inside the telephone book by other paper. The paper that is used now is really weak. Also, to shorten the time of restarting the escaperoom, the cards should be attached to something. This way, the cards cannot be taken out of the holder. This will save time when participants take all the cards out of the holder. The re

User tests

Participants in the LoFi and HiFi tests were aware of being observed. The researchers were in the same room as the participants. The user tests can be improved if the researchers hide more. For example if the observations can be done with a camera. This would already be better because this feels more like a real escaperoom. In almost all escaperooms cameras are present which, if the escaperoom is a good one, should not be distracting at all.

Also, only one user test with the real target group has been conducted. In order to get more accurate results, more tests can be done. More testing methods could be used. For example intensive interview sessions for more quality research. This would allow for more meaningful results and better interpreting.

General recommendations

The feel of the room can be improved with more detailing in the room, real division between rooms, real locks, real everything. In what extend the appearance of the room is necessary in order to have a trustworthy escaperoom should be investigated.

APPENDIX A – BRAINSTORM: PUZZLES

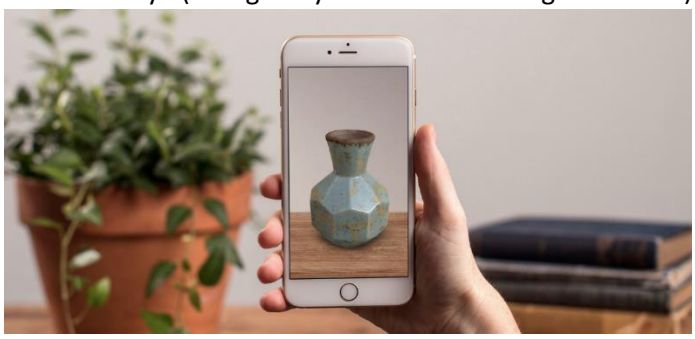
General:

- Two escape rooms within one - opposite sides of the story (teams within the room) but need each other? - bigger groups within the room.
- Distractor puzzles?

Specific puzzles:

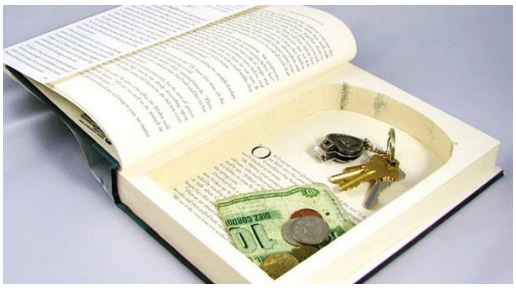
- Something with glasses having to put them onto look with a different view- that way for example only being able to see colors in blue and guess the code.

- Using AR to see something where there is nothing - see something in a painting - more than meets the eye (using a rhyme on the wall to guide them)

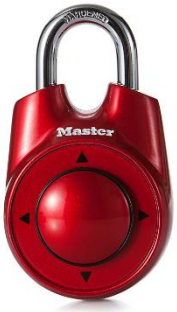


- Other Way to use AR - there would be a screen showing the output of a webcam (being watched) - they have the hold the correct object in front of the camera to see the secret message
- Using a view master with codes hidden in pictures about that time. (not very historically correct probably)

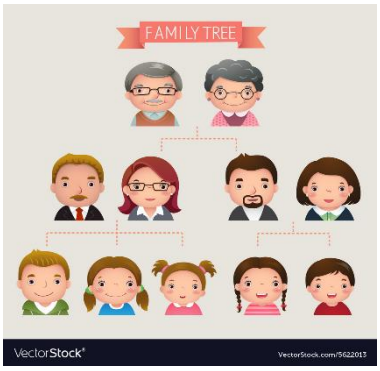
- Something with RFID bringing items close to each other? - ordering the books in a certain manner gives you the opportunity to open the secret closet
- A certain book title given by another puzzle contains items to solve/open another puzzle - the amount of money found in the book is the input for a combination lock



- The directions on a map for a path that was often traveled inputting on a dial lock

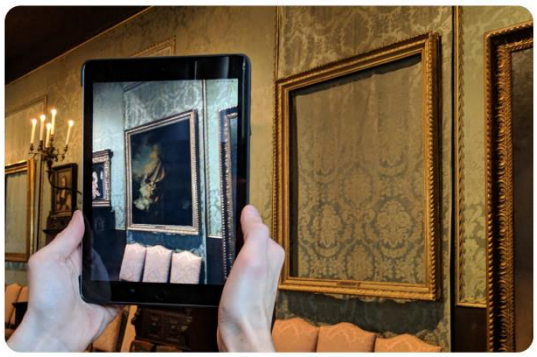


- Something with a family tree? - magnets on front of a board ; if the magnets are on the correct place a light goes on - all 5 the lights show the tree is correct. - Clues about the family tree throughout the room on the walls. X is the grandma of X. X went with her mother X to the shop. X has three children. → convert presidents etc.

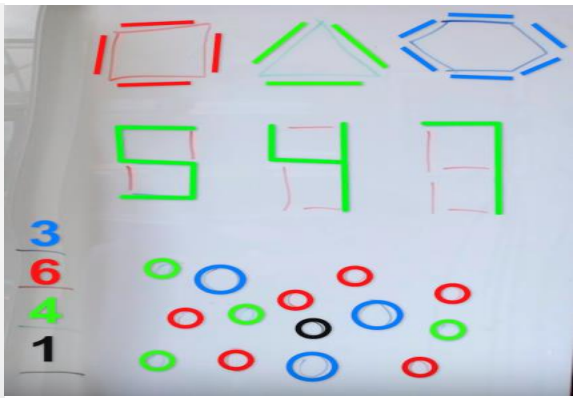


- Using a ambient tracking (Kinect) - they have to notice that the shapes move according to what they do and then move the pieces to the correct place.
- Painting/picture with moving eyes - blinking Morse code.

- Hide some clues in the actual museum : look with tablet and AR for clues - empty diary etc. - filled if you look with AR



- Keys with a color pattern the amount of sides of a shape corresponds to the sloth the key needs to be placed in.



- The amount of different colored stamps on a passport form a code pattern.

APPENDIX B – SCENARIO BY DANIELLA AND EDWIN

Je komt binnen in een Hollandse jaren 50 huiskamer. Een huiskamer waar in eerste instantie niets bijzonders te zien is. Een stoel, lamp, kast, televisie en een kalender met de datum van die dag. 5 maart 1952. Maar op de tafel staat een doosje met brieven (6 brieven) en een paar foto's (1 familiefoto), 2 oude ansichtkaarten en 1 brief ligt, half afgeschreven op tafel..

De brieven zijn in het Duits geschreven en blijken afkomstig van een oost Duitse familie, vrienden en het Russisch partijbureau. Uit de brieven wordt duidelijk dat de mensen die in het huis woonden vanuit Oost Duitsland naar Nederland zijn "gevlucht" maar zijn hier klaarblijkelijk door de Russen mee zijn geholpen en spionnen zijn.

Aan de laatste brief op tafel kunnen we opmaken dat de familie op het punt stond om te vertrekken en dat in allerijl hebben moeten doen. Maar waarom? De klokt tikt en de mensen in de escaperoom hebben 1 uur de tijd om uit te vinden waarom ze zijn vertrokken en de actie die zij in gang hebben gezet te stoppen.

(#1) Als zij de met UV licht onderstreepte woorden in de Russische brief kunnen vertalen met het Russische woordenboek dat in de kast staat lezen zij de woorden Safehouse, zet de bom op scherp, coördinaten en een telefoonnummer van de KGB, dat gebeld kan worden in geval van nood.

(#2) Op het tafeltje in de woonkamer staat een ouderwetse draaitelefoon. Ieder telefoonnummer dat je draait geeft de boodschap, dit telefoonnummer is niet in gebruik, controleer het nummer en draai opnieuw. Alleen het telefoonnummer van de KGB werkt, als je dit nummer draait wordt er een code genoemd. Deze code staat gelijk aan de code van een kluis/of cijferslot van een laatje of iets wat opengaat dmv een code.

(#3) In de kluis ligt een kaart van Rusland (of van de wereld) en een lijst met coördinaten. De coördinaten leiden naar plaatsen. Als je de eerste letters van de plaatsen achter elkaar zet krijg je het woord SOUVENIR
(#4) In het hele huis verspreid staan 5 Russische Souvenirs

- Trabant
- Beeldje van Lenin of Stalin
- Faberge ei
- Snow globe rode plein
- Matroesjka

Ieder souvenir herbergt een letter/of cijfer/ sleutel die je nodig hebt om verder te komen.
(met sleutel, kluis, met kleiner kluisje, nog kleiner kluisje enz enz) zoals een matroesjka

(#5) Boekenkast vol met boeken. De woordenboeken Duits, russisch enz, die kunnen eruit. De andere boeken staan vast. Bij een goede combinatie van boeken die tegelijk worden ingedrukt, glijd de boekenkast open en kom je in de controlekamer.

APPENDIX C – FINAL SCENARIO BY RESEARCHERS

Doel

Binnen 1 uur de onbekende dreiging vinden en deze veilig stellen.

Thema

De Koude Oorlog.

Rol van de spelers

De spelers zijn werknemers van de binnenlandse veiligheidsdienst. Er is een dreiging binnengekomen rondom een huishouden in Nederland. De spelers zullen het huis binnen moeten treden om de dreiging te onderzoeken. Het huishouden blijkt dan een spionnen gezin te zijn afkomstig uit Oost-Duitsland, die dus samenwerken met de communistische partij. Naarmate de tijd verstrijkt, zal de dreiging steeds reëler worden. Kunnen ze de noodsituatie stoppen?

Sfeer

- Kamer 1 (BVD kantoor):

Spelers moeten zich inleven in hun rol. Serieus en verantwoordelijk sfeer creëren.

- Kamer 2 (normale woonkamer):

Een andere tijd intreden. Tegenstrijdigheid tussen de 'normale' woonkamer en de toch onbekende wereld. Het gevoel van onwetendheid en spanning. - Gevoel van verraad.

- Kamer 3 (kamer met de bom):

Ultieme stijging van spanning - altijd op de hoede voor een 'uitbarsting'/ oorlog.

Leerdoelen

- Belangrijke begrippen uit de Koude Oorlog
- Duitse vertalingen
- Verdeling IJzeren Gordijn
- Binnenlandse veiligheidsdienst (BVD)
- Spionage
- Propaganda
- Grootste leiders uit de Koude Oorlog
- Actuele ontwikkelingen wat betreft kernwapens (Trump)
- 'Kruisraketten Nee Demonstratie' (grootste ooit in NL)
- Het principe van de Koude Oorlog: wapens zijn koud gebleven
- Domino effect (politieke denkwijze uit de Koude Oorlog)

Kamer 0 (Ontvangstruimte met tafel ~ duurt 5 min max):

De spelers worden welkom geheten en krijgen wat uitleg over de escaperoom. Ze zullen de rol krijgen (d.m.v. badges) van een medewerker van de BVD (binnenlandse veiligheidsdienst). Hier zullen ze ook informatie krijgen over deuren/brandveiligheid/sloten etc.

BEGIN

Kamer 1 (BVD kantoor ~ 15 min): vlag van de BVD, Nederland. Dingen die er op duiden dat de leerlingen spionnen in de gaten moeten houden. (Denk aan: opnameapparatuur, wanted lists, BVD logo etc. Hier komt ook een 'medewerkers van de maand lijst' te hangen, waar de beste voorgaande groepen op staan.) Een van de deuren is een soort voordeur met een hangslot eraan.

Ze krijgen wat achtergrondinformatie over de BVD - in de vorm van een video van de baas van de BVD in uniform die zegt:

> ‘Goedendag, fijn dat zulke slimme krachten zich hebben aangesloten bij onze organisatie. Samen kunnen we zorgen dat iedereen in Nederland veilig blijft tijdens deze spannende tijden. De binnenlands veiligheidsdienst is een uitermate geheime organisatie, we vertrouwen er op dat jullie discreet met deze informatie zullen omgaan. We hebben in anonieme tip binnengekregen, die onze hoogste prioriteit heeft. Jullie eerste missie is het tot de bodem uitzoeken van deze dreiging, jullie hebben 50 minuten de tijd. De informatie ligt in deze kamer. Succes!’

De tijd begint te lopen.

1. In de kamer ligt een duitse brief waaruit kernwoorden over de koude oorlog moeten worden gehaald. Er ligt ook een woordenboek bij voor het geval. Via een **kruiswoordpuzzel** (puzzle X) worden de begrippen gecombineerd met de betekenissen. (Bijvoorbeeld ‘kommunistischen Reich’ staat in de brief, op de kruiswoord staat dan iets van ‘rijk in de Koude Oorlog waartoe de Sovjet Unie behoorde.’)
2. Naast de brief staat ook een typemachine, hierop zal het antwoord van de kruiswoordpuzzel moeten worden ingevuld om de code van de deur te ontcijferen (de letters zijn namelijk verwisseld met cijfers op deze typemachine).

3. In een van de jaszakken aan de kapstok zit een **geldbriefje en een UV-pen** (puzzel X) zit in de andere jaszak. Door deze te combineren vinden ze een jaartal (die nog niet nodig is voor de huidige kamer).

4. Na een paar minuten komen er **coördinaten** (puzzel X) op het scherm te staan waar eerst de video op afspeelde. Deze moeten worden opgezocht in de atlas die op het bureau ligt, waar als hint staat in een originele manier iets in de trant van: typ het antwoord van de kruiswoordpuzzels in op de typemachine.

Daarmee vinden ze code van het hangslot aan deur naar de tweede kamer (woonkamer).

Kamer 2 (woonkamer/ leefruimte ~ 25 min) Ze komen binnen. Alles ligt er normaal bij. Jaren ‘70/’80 woonkamer. Niet een volledig huis maar een deel van een huis. Een huiskamer waar in eerste instantie niets bijzonders te zien is. Een stoel, lamp, kast, televisie en een kalender met de datum van die dag. Op de tafel staat een doosje met brieven en een paar familiefoto’s. Schoenen en kleding. (persoonlijke items). Voor veiligheidsredenen bevindt zich ook een **noodknop** in deze kamer.

- Er staat een draaitelefoon die werkt en waar nummers op ingevoerd kunnen worden.
    - Hier hangt een duidelijk briefje bij over het opvragen van Hints (maximaal 3).
- Er staat een tv.
- Er staat een boekenkast.
- Er ligt een tablet in een lade van een kastje.
- Familiefoto hangt aan de muur.
- Viewmaster in de speelhoek.
- Dagboek met een pagina tekst

In de woning lijkt een normaal jong koppel wonen met één kind (foto ergens).

1. Er staat een **Televisie** aan hierop rouleren verschillende video's; o.a. over de grote dreiging van de kernwapens (Eventueel wordt de afstandsbediening verstopt met een andere puzzel). Een van de video's laat zien wat er van de mensen verwacht werd als er een bom

zou komen - duck and cover. De video laat erg overdreven zien dat mensen moesten duiken en zichzelf beschermen. Deze video zal aangevuld zijn met een beeld waarin iemand zich in de kamer bevindt en door te duiken een geheime verstopplek bekijkt (puzzle X). Af en toe “Glitch”, beelden van raket tussendoor - foreshadowing event.

2. In de geheime verstop plek bevinden zich meerdere paspoorten en een **licht-sjabloon**. De meerdere paspoorten laten zien dat het niet om een normaal Nederlands gezin gaat, het blijken Oost-Duitse spionnen te zijn. Het ‘licht-sjabloon’ moet voor een lamp in de kamer geplaatst worden. Deze lamp zal schijnen op een landkaart die aan de muur hangt en zo de verdeling tijdens de koude oorlog weergeven (ijzeren gordijn).

Er ligt een **dagboek** (met één beschreven bladzijde, wat uitgescheurde bladzijden, ook lege bladzijden). Het dagboek bevat informatie over de spionage aard van het gezin. Hierin staat iets over ‘Kennis is macht, de spionnen wilde weten hoe de Nederlandse bevolking dacht over de regering en ontdekken waar de zwakke punten liggen.’ [Boek reference]

Er ligt een envelop op een tafel met een pen ernaast. In de envelop zit een **‘red-reveal’** kaart waarop een boek wordt genoemd. (de spionnen gaven hun informatie niet zomaar prijs). [boek reference]*3]

3. Er ligt een **tablet** in de kamer die vergrendeld is. Op de achtergrond staat een vraag in het duits. De tablet kan worden unlocked met de code van de vorige puzzel (code op geld in jaszak). Als de tablet ontgrendeld is opent een camera (die gebruikt kan worden om voorwerpen te scannen in Augmented Reality).

Na +- een kwartier krijgen de spelers indicaties van dat er een bom is in de andere kamer door constant zacht gepiep. Zo wordt duidelijk dat ze moeten proberen in die kamer zien te komen.

4. De familiefoto uit de jaren 60 in de kamer kan worden omgedraaid. Achter deze foto zijn **propaganda posters** en andere informatie die de spion heeft verborgen te vinden, zoals INF en NPV verdrag. Als deze posters met de tablet worden gescand, zet dat op de tablet een programma met vragen en video's over de belangrijkste leiders tijdens de koude oorlog in werking.

5. Als alle vragen goed zijn beantwoord komt er een raadsel op de tablet die verwijst naar de **draaitelefoon**; waarbij de kaart van Europa de oplossing brengt. (bijv. Wie viele länder gehören zum kommunistischen Reich? Hierbij moeten ze de rode landen op de kaart tellen). Het nummer wat hier uitkomt is een verwijzing naar de pagina van het telefoonboek. Hierin is bijvoorbeeld een telefoonnummer gehighlight.

In de kamer staat een stoel waar **thermoplastic** overheen is geplakt. Door op de stoel te zitten wordt een boodschap zichtbaar. Er staat een raadsel verborgen wat wijst op de geheime wereld achter de boekenkast. [Boek reference]

Er ligt een **viewmaster**; wanneer hierdoor gekeken wordt zie je de vergelijkingen tussen de koude oorlog en de wereld vandaag de dag. Tussen de afbeeldingen van toen en nu zit een afbeelding van een boek, die weer naar de boekenkast verwijst. [Boek reference]

6. Het raadsel kan gebruikt worden om een nummer in het **telefoonboek** te vinden, die vervolgens ingevoerd kan worden op de draaitelefoon - waarmee een van de vrienden van het stel wordt gebeld. Deze vriendin zal vertellen over een grote demonstratie die bezig is in Nederland en

hoe ze bang is (Komitee Kruisraketten Nee). In de boodschap refereert ze naar een van de boeken in de boekenkast. [Boek reference]

7. De laatste doorgang bestaat uit het doorkomen van de **boekenkast**. In de boekenkast kunnen meerdere boeken ingedrukt worden. Alle spelers moeten meewerken en samenwerken om de boekenkast open te kunnen krijgen.

Kamer 3 (Bomkamer ~ 10 min)

Door een geheime boekenkast komen ze in deze kamer. In de kamer is op een scherm te zien dat er een bomdreiging is gedetecteerd. De spelers moeten beslissen of dat de bomdreiging echt is en ze hebben de optie hebben om terug te vuren of juist niet. Er is een grote red-reveal in de kamer waarop een stappenplan staat. Dit stappenplan hebben ze nodig om te reageren en uiteindelijk te kiezen of ze bommen afschieten of niet. De spelers zullen moeten samenwerken door verschillende knoppen in te drukken.

Kamer heeft: groot besturingspaneel, met scherm waarop een bom richting X te zien is. Grote klok die aftelt. Bij minder dan 5-10 minuten gaan zwaailichten aan. Het eindigt op het scherm met een video waarin de gevolgen van hun beslissing te zien zijn/ worden uitgelegd.

Optie 1 (ze hebben terug gevuurd): *'De keuze die jullie zojuist hebben gemaakt, zo in de koude oorlog hebben geleid tot een derde wereldoorlog. Een domino-effect zou in werking zijn gesteld. Zodra Amerika ziet dat er een kernwapen was afgevuurd, hadden zij terug gevuurd.'*

Optie 2 (ze hebben niet terug gevuurd): *'Jullie hebben de goede keuze gemaakt. De dreiging bleek een reflectie van zonlicht te zijn, wat het detectiesysteem als een bedreiging zag. Dit is in de koude oorlog vaker voorgekomen. Zo heeft Stanislav Petrov in zijn eentje de derde wereldoorlog voorkomen.'*

<u>Boodschap</u>
Vier eindsituaties:

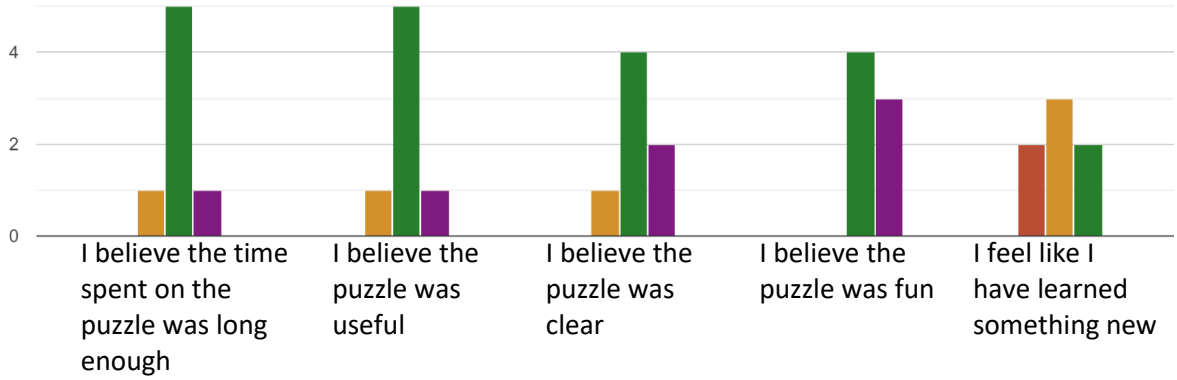
- De deelnemers zijn zo sloom dat ze niet doorhebben wat er gaande is. Ze hebben geen idee dat er een bom kamer in huis is. (Deze situatie moet voorkomen worden.)
- De deelnemers zijn bij de bom kamer maar zijn niet tot een beslissing gekomen. Krijgen dan iets te zien van wat de twee keuzes tot gevolg zouden hebben.
- De deelnemers beslissen om terug te schieten. Ze starten zo de derde wereldoorlog. Laat zien dat hun beslissing een domino effect zou hebben.
- De deelnemers beslissen om niet terug te vuren en voorkomen zo een wereld oorlog. Dit is dus wat er de hele koude oorlog lang gebeurde. Geeft voorbeeld van zulke situaties die echt zijn gebeurd (Stanislav Petrov).

EIND

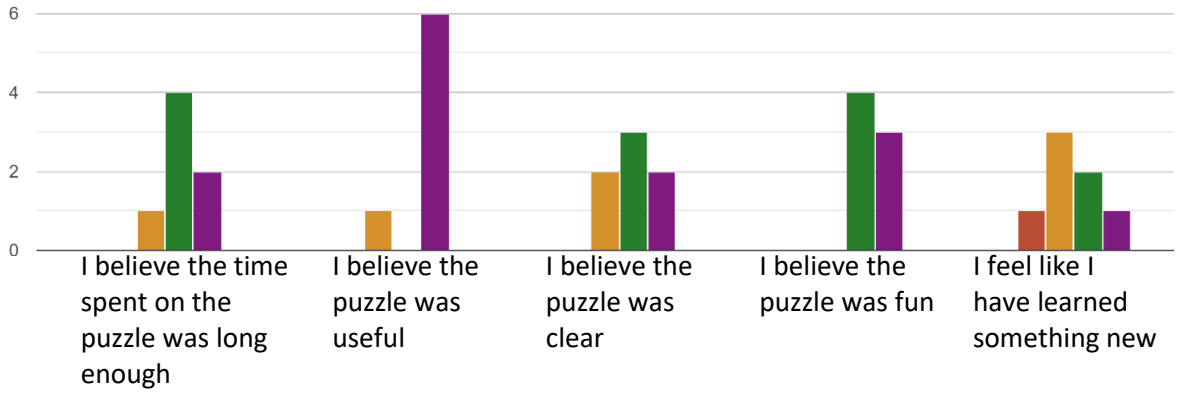
De tijd is ten einde. Spelers komen terug in de normale wereld. Terugkomst in Kamer 0: Gaan op de foto voor de medewerkers-wall of fame!

APPENDIX D – RESULTS LOFI TESTING

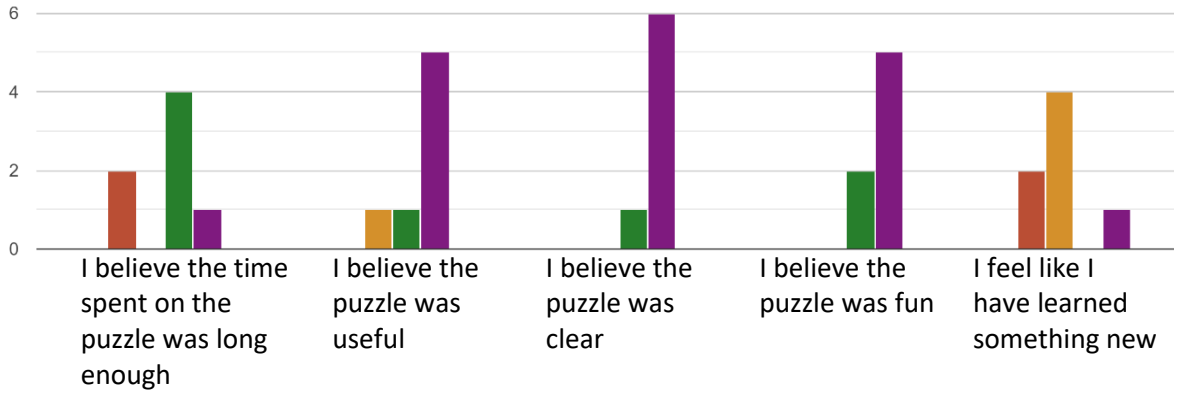
Telephone puzzle



Bookcase puzzle



Red Reveal puzzle



Remarks/possible improvements:

#1 “Try to provide more constraints and guidance in allowing users to performs chronologically. The projector puzzle was currently quite obvious as a demonstration was provided on how to find the object. It could be made more obscure to make the escape room more challenging.”

#2 “Really liked the cross word puzzle, with the door you should think about how prevent that you just press all the books.”

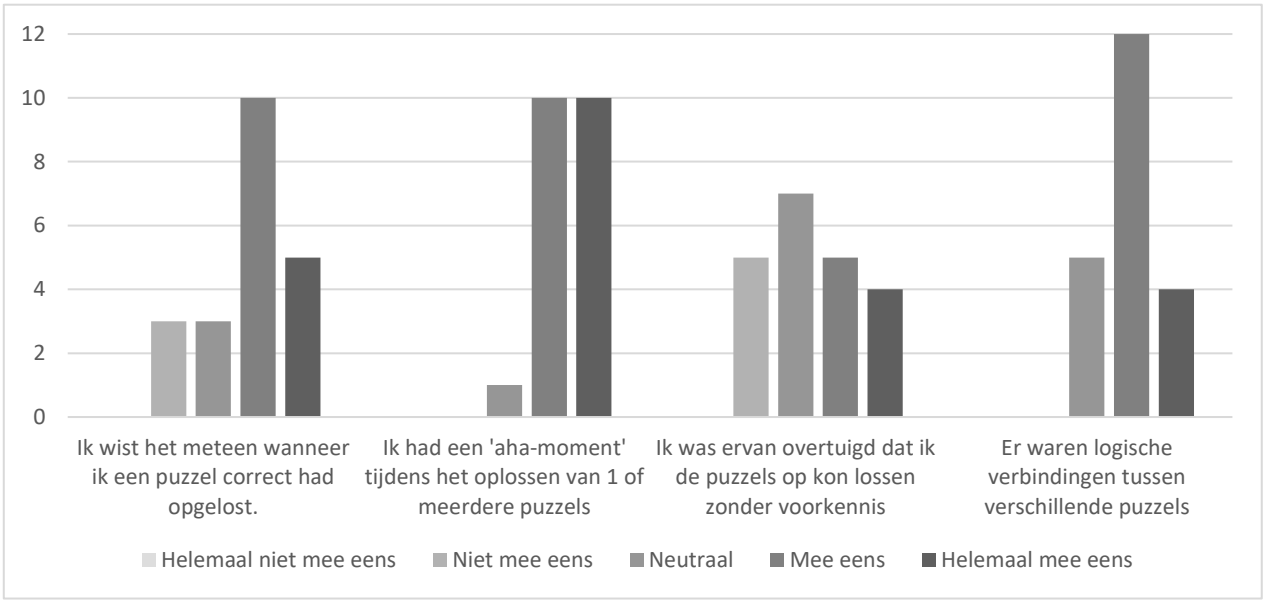
#3 “Misschien niet helemaal duidelijk omdat het lofi is, maar de impact van het eindfilmpje valt een beetje tegen. Zou tof zijn als dat een indrukwekkend einde kan zijn!”

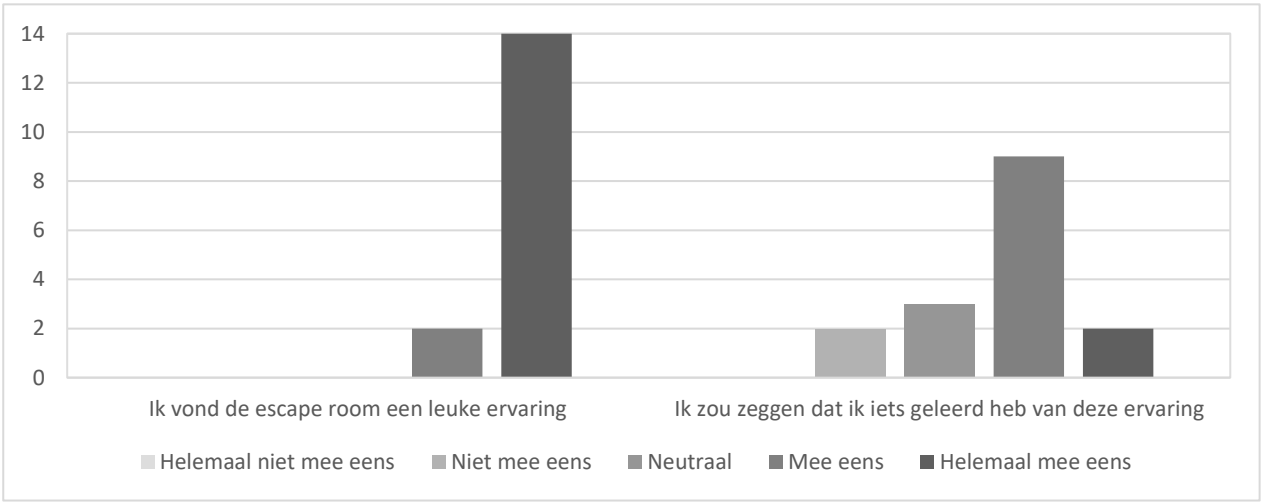
#4 “The last room was a bit short compared to the others. However, it was fun and educational.”

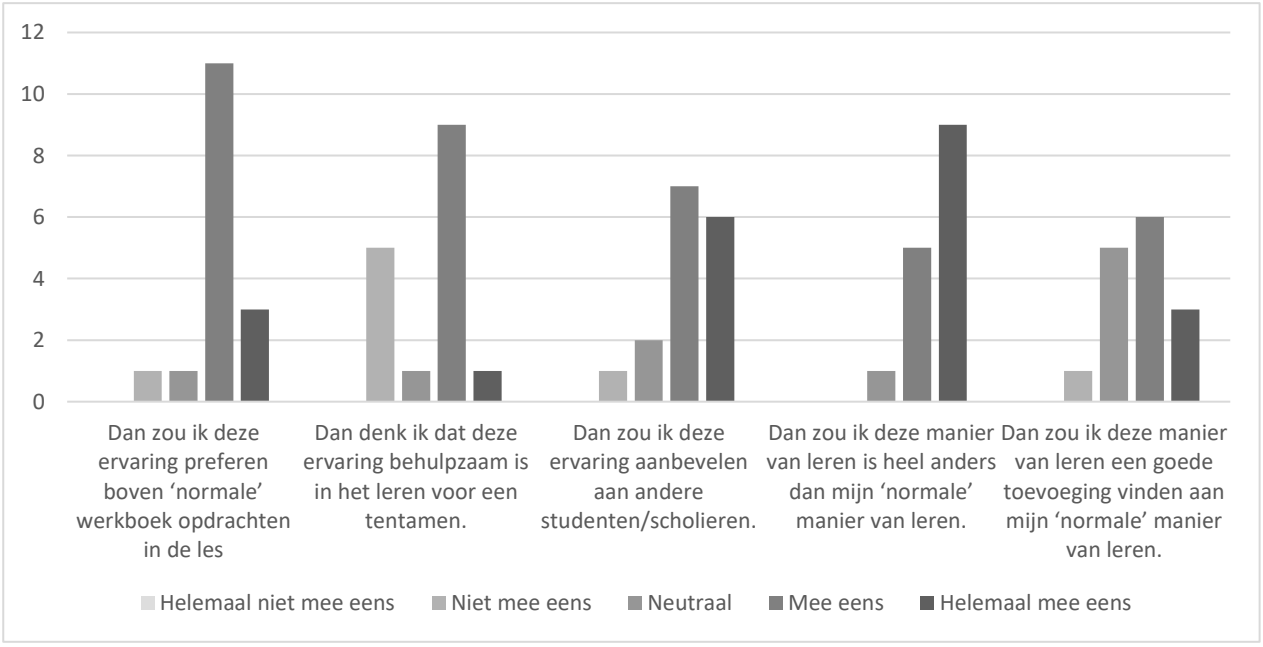
#5 “The choice for deploying the bomb or not felt rather abrupt. Overall, it was a very fun experience, good job!”

#6 “Leuk!”

APPENDIX E – RESULTS HIFI TESTING







APPENDIX F – CONSENT APPROVAL

Submission proposal Bachelor thesis

E **ethics-comm-ewi@utwente.nl <ethics-comm-ewi@utwente.nl>**
27-5-2019 13:16

Aan: l.c.vandenelzen@student.utwente.nl

Dear Linde,

Your request is checked by the Ethical Committee EWI and there are no problems. We will give a positive advice to the Dean.

For references you can use the number: RP 2019-44.

Success.

Best regards,
Jeanette Rebel-de Boer, J.A. (EWI)

Jeanette Rebel-de Boer
Secretary Chair DACS/ST
Secretary Ethics Committee EWI
Zilverling, room 5120
P.O.Box 217 / 7500 AE Enschede
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APPENDIX G – CONSENT FORM

INFORMED CONSENT FORMULIER

Naam van het onderzoeksproject
Escaperoom Koude Oorlog in samenwerking met het Palthehuis Museum, Oldenzaal.

Doel van het onderzoek
Dit onderzoek wordt geleid door drie studenten die bezig zijn met hun bachelor opdracht voor Creative Technology aan de Universiteit Twente. U bent van harte uitgenodigd om deel te nemen aan dit onderzoek. Het doel van dit onderzoek is om meer te weten te komen over hoe deze escaperoom zich in de praktijk uit.

Gang van zaken tijdens het onderzoek
Uw kind neemt deel aan een usertest waarin gevraagd wordt intuïtief de escaperoom te voltooien. Daarna worden er in de vorm van een enquête enkele vragen gesteld over de ervaringen in de escaperoom. Een voorbeeld van een typische vraag die zal worden gesteld: “Heb je iets geleerd van deze escaperoom?”.

Toestemming van ten minste één ouder of zorggever is verplicht tenzij uw kind ouder is dan 18 jaar.

Potentiële ongemakken, risico’s
- Er zijn geen fysieke, juridische of economische risico's verbonden aan deelname aan deze studie. Uw kind hoeft geen vragen te beantwoorden die hij/zij niet wilt beantwoorden. De deelname is vrijwillig en uw kind kan deelname op elk gewenst moment stoppen en de escaperoom verlaten.

Vergoeding
Uw kind ontvangt voor deelname aan dit onderzoek geen vergoeding. Door deel te nemen aan dit onderzoek zal uw kind meer inzicht krijgen in het design-proces van een escaperoom. Het bredere doel van dit onderzoek is het verbeteren van de escaperoom zodat het op een later tijdstip echt in werking kan worden gebracht.

Vertrouwelijkheid van gegevens
Uw privacy en de privacy van uw kind is en blijft maximaal beschermd. Er wordt op geen enkele wijze vertrouwelijke informatie of persoonsgegevens van of over u of uw kind naar buiten gebracht, waardoor niemand u of uw kind zal kunnen herkennen.

Voordat onze onderzoeksgegevens naar buiten gebracht worden, worden alle gegevens **anoniem** gemaakt. Enkele eenvoudige voorbeelden hiervan:

- uw naam wordt vervangen door anonieme, op zichzelf betekenisloze combinatie van getallen.

- uw woonplaats wordt niet gebruikt, maar de provincie waarin u woont.

Bij de start van ons onderzoek krijgt de naam van uw kind direct een **pseudoniem**; de naam wordt gepseudonimiseerd ofwel ‘versleuteld’. Op deze manier kan wel worden onderzocht wat er in het gesprek wordt aangegeven, maar weten de getrainde onderzoekers niet wie het is. De onderzoeksleider is zelf verantwoordelijk voor dit pseudoniem en de sleutel en zal de gegevens niet delen met anderen.

In een presentatie zullen of anonieme gegevens of pseudoniemen worden gebruikt. De audio-opnamen, formulieren en andere documenten die in het kader van deze studie worden gemaakt of verzameld, worden opgeslagen op een beveiligde locatie bij de Universiteit Twente en op de beveiligde (versleutelde) computers van de onderzoekers.

Vrijwilligheid
Deelname aan dit onderzoek is geheel vrijwillig. Uw kind kan als deelnemer de medewerking aan het onderzoek ten allen tijde stoppen, of weigeren dat zijn/haar gegevens voor het onderzoek mogen worden gebruikt, zonder opgaaf van redenen.

Dit betekent dat als je voorafgaand aan het onderzoek besluit om af te zien van deelname aan dit onderzoek, dat dit op geen enkele wijze gevolgen voor jou zal hebben. Tevens kun je tot 10 werkdagen (bedenktijd) na het interview alsnog de toestemming intrekken die je hebt gegeven om gebruik te maken van jouw gegevens.

In deze gevallen zullen jouw gegevens uit onze bestanden worden verwijderd en vernietigd.

Als je tijdens het onderzoek, na de bedenktijd van 10 werkdagen, besluit om jouw medewerking te staken, zal dat eveneens op geen enkele wijze gevolgen voor je hebben. Echter: de gegevens die u hebt verstrekt tot aan het moment waarop uw deelname stopt, zal in het onderzoek gebruikt worden, inclusief de bescherming van uw privacy zoals hierboven beschreven. Er worden uiteraard geen nieuwe gegevens verzameld of gebruikt.

Als u besluit om te stoppen met deelname aan het onderzoek, of als u vragen of klachten heeft, of uw bezorgdheid kenbaar wilt maken, of een vorm van schade of ongemak vanwege het onderzoek, neemt u dan aub contact op met een van de onderzoeksleiders:

Linde van den Elzen	l.c.vandenelzen@student.utwente.nl
Famke van Meurs	f.f.m.vanmeurs@student.utwente.nl
Chantal Vriens	c.vriens@student.utwente.nl

Toestemmings-verklaring
Met uw ondertekening van dit document geeft u toestemming dat uw kind meedoet aan het onderzoek; dat u goed bent geïnformeerd over het onderzoek, de manier waarop de onderzoeksgegevens worden verzameld, gebruikt en behandeld en welke eventuele risico's uw kind zou kunnen lopen door te participeren in dit onderzoek.

Indien u vragen had, geeft u bij ondertekening aan dat u deze vragen heeft kunnen stellen en dat deze vragen helder en duidelijk zijn beantwoord. U geeft aan dat u vrijwillig akkoord gaat met uw deelname aan dit onderzoek. U ontvangt een kopie van dit ondertekende toestemmingsformulier.

Ik ga akkoord met deelname aan een usertest geleid door Famke, Chantal en Linde. Het doel van dit document is om de voorwaarden van mijn deelname aan het project vast te leggen.

1. Ik kreeg voldoende informatie over dit onderzoeksproject. Het doel van mijn deelname als ouder in dit project is voor mij helder uitgelegd en ik weet wat dit voor mij betekent.

2. De deelname van mijn kind in dit project is vrijwillig. Er is geen expliciete of impliciete dwang voor mij of mijn kind om aan dit onderzoek deel te nemen.

3. De deelname van mijn kind houdt in dat hij/zij deelneemt aan een onderzoek en voor en achteraf wordt geïnterviewd door middel van het invullen van een enquête en interview vragen. De escape room ervaring zal maximaal 50 minuten duren, het beantwoorden van verdere onderzoek circa 10 minuten vooraf en circa 25 minuten achteraf.

Ik geef de onderzoekers toestemming om tijdens het interview opnames (geluid / beeld) te maken en schriftelijke notities te nemen. Het is mij duidelijk dat, als ik toch bezwaar heb met een of meer punten zoals hierboven benoemd, ik op elk moment de deelname van mijn kind, zonder opgaaf van reden, kan stoppen.

4. Ik heb van de onderzoeksleider de uitdrukkelijke garantie gekregen dat de onderzoeksleider er zorg voor draagt dat mijn kind niet te identificeren is in door het onderzoek naar buiten gebrachte gegevens, rapporten of artikelen. Mijn privacy en dat van mijn kind is gewaarborgd als deelnemer aan dit onderzoek.

5. Ik heb de garantie gekregen dat dit onderzoeksproject is beoordeeld en goedgekeurd door de ethische commissie van de EWI Ethics Committee. Voor bezwaren met betrekking tot de opzet en of uitvoering van het onderzoek kan ik me wenden tot de Secretaris van de Ethische Commissie van de faculteit Elektrotechniek, Wiskunde en Informatica op de Universiteit Twente via ethics-comm-ewi@utwente.nl.

6. Ik heb dit formulier gelezen en begrepen. Al mijn vragen zijn naar mijn tevredenheid beantwoord en ik ben vrijwillig akkoord met deelname aan dit onderzoek.

7. Ik heb een kopie ontvangen van dit toestemmingsformulier dat ook ondertekend is door de interviewer.

8. Ik geef bij deze mijn voorkeuren aan met betrekking op beeld- en audiomateriaal:

- Beeld- en audiomateriaal mag anoniem gebruikt worden in het verdere proces
- Beeld- en audiomateriaal mag gemaakt worden maar niet gepubliceerd
- Beeld- en audiomateriaal mag niet gemaakt worden

_____	_____	_____
Naam deelnemer	Handtekening	Datum
_____	_____	_____
Naam Onderzoeker	Handtekening	Datum

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