Unlocking Experiential Learning:
Key Factors in Interactive Historical Storytelling

Master's Thesis in Computer Science and Engineering

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CHALMERS UNIVERSITY OF TECHNOLOGY
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Master's Thesis 2024
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Cover: Photo of the escape room used in the study.

Typeset in LaTeX
Gothenburg, Sweden 2024

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Abstract

This master's thesis investigates the integration of experiential learning with interactive historical storytelling through the medium of escape rooms. Conducted within the context of Karlsborg Fortress, a historical site in Sweden, this study explores the key factors that affect the conditions for effective experiential learning in an educational escape room setting. Leveraging theories from Interaction Design, Storytelling, Pedagogy, and Game Design, the research applies a Research through Design (RtD) approach to evaluate various interactive storytelling elements.

To conduct the study a historically accurate and engaging escape room was designed in collaboration with Kistone AB. The escape room immerses participants in the events of World War II, particularly the transfer of Sweden's gold reserve to Fort Knox. The design process was guided by the principles of design thinking in order to unveil knowledge in an unexplored area.

Through qualitative and quantitative evaluations, including thematic analysis and surveys, the thesis presents insights into the design and implementation of educational escape rooms. The findings highlight the key factors of Intensity, Familiarity and Group size. The study provides guidelines for future projects, aiming to bridge the gap between commercial escape room design and educational applications, thereby enhancing the impact of experiential learning in informal educational settings.

Keywords: Interaction Design, Experiential Learning, Research through Design, Interactive Storytelling, Educational Technology, Pedagogical Tools, Escape Rooms

Acknowledgements

Thank you Josef Wideström for excellent supervision and for believing in our project from the very start. You always steered us right when we lost direction.

We would also like to thank David Anthin and Niclas Ericsson at Kistone AB for all the time and input you have given us. Your commitment to providing everything from graphical material to professional insights has been vital for seeing this project through. Additionally, we want to thank Jarl Karlsson at Visit Karlsborg for welcoming us with open arms and giving us an amazing tour of Karlsborg Fortress.

Finally, we want to extend our gratitude to all the participants for our study and during the design process. Without your feedback and insights, this thesis would not have been possible.

Emil Bohman & Olle Anthin, Gothenburg, 2024-06-05

Contents

List of Figures

List of Tables

1

Introduction

Escape rooms have rapidly been established as a form of entertainment and a team-building tool worldwide. Players typically see themselves locked in a room and must solve a series of puzzles to escape the room and win the game within the time limit. There is a significant variation of settings and themes in escape rooms, ranging from trivial party games to complex challenges for escape room enthusiasts. However, the majority of these are developed for leisure. Some implementations cater to educational settings, but these mainly consist of escape room boxes that are fairly far from the full-scale commercial escape room. They are often designed to be used in the classroom or with a class of students in mind. Likewise, the research on educational escape room experiences revolves around these classroom solutions.

The design approach used when developing an escape room can heavily impact the user experience. The escape rooms made for classrooms focus on the pedagogical and cognitive aspects of design. The main focus is to be an educational platform, thus placing other aspects, such as game design and mechanics, in the background. However, the human factors and learning opportunities are emphasised and expanded upon. The escape rooms in the commercial space have different goals and, therefore, different design approaches. When the aim is to engage the players and create a fun, collaborative experience while running a profitable business, the focus is drawn to the phenomenological experience and streamlining the production. The design's engineering aspects are prioritised when escape rooms must be automated. The significant differences in approaches are reflected in the resulting escape rooms, varying from the stripped-down educational escape rooms that often come in a box to the spectacular commercial escape rooms encompassing a whole hangar.

Interaction Design has a potentially central role in exploring Experiential Learning, which in this project, takes the form of an educational escape room focusing on historical events. According to Rogers et al. (2019) Interaction Design means "Designing interactive products to support the way people communicate and interact in their everyday and working live". With this view as a design philosophy, the gap can be bridged between the engineering side of commercial escape rooms and the pedagogical side of educational escape rooms. The overarching term Interaction Design covers several fields, but at its core, it is about enhancing user experiences. In an educational experience, this viewpoint can be utilised to explore conditions for learning and ways to augment the user's experience.

Research in the field of design has undergone several minor paradigm shifts during

the 20th and 21st century (Hartson & Pyla, 2012). These paradigms each favour different design qualities and lead to different design solutions. Hartson and Pyla present three paradigms, the *Engineering and Human Factors*, *Cognitive Science*, and *Phenomenological* paradigm. The *Engineering and Human Factors* paradigm focuses on optimising human performance, the *Cognitive Science* paradigm treats the brain as an information processor, and the *Phenomenological* paradigm (or the design-thinking paradigm) focuses on the user experience (Harrison et al., 2007). These paradigms are not mutually exclusive and co-exist today. This contrasts with other natural science communities where paradigms are considered sequential and non-compatible. This thesis leans mainly on the third paradigm, stressing the importance of the interaction experience.

Another important field of research in the design community is the aptly named Research through Design (RtD). RtD strongly focuses on the design process and the knowledge that emerges from practising design. This approach results in a generative mindset and doesn't necessarily give one converging answer. Combining these two interaction design approaches allows for an exploratory process that can capture the human experience. Furthermore, the overall mindset is compatible with applying concrete design methods to specific processes. It imprints a holistic philosophy that guides the design choices and direction of the project. Since the design approaches of escape rooms seem to affect the finished product rather drastically, using RtD has the potential to result in novel educational escape rooms. The flexibility of the approach also enables a focus on pedagogy and game design, thus establishing a foundation for learning through escape rooms while still keeping its engaging elements.

Looking at the history of pedagogy, there has been a rise in the Experiential Learning approach during the 20th century. This field emphasises the importance of experience in learning, arguing that we need lived experiences to consolidate our knowledge. This branch of pedagogy has continued to expand during the 21st century, both as a research field and as a practice. With the help of new technologies, the possibilities for Experiential Learning are more significant than ever. Experiential Learning has been utilised and evaluated in applications similar to escape rooms. They have either been located in classrooms or use experiences that differ from escape rooms, such as scavenger hunts. The exhibitions implementing escape room elements such as gathering clues and solving puzzles have mostly been centred around natural sciences rather than history. However, there is great potential in using the storytelling aspects of escape rooms to immerse players in a historical setting. The cooperative aspects of escape rooms also help to create great conditions for learning (Qin et al., 1995). That said, there are some risks involved with implementing an Experiential Learning approach. The inherent hectic environment and focus on puzzles in escape rooms might distract from the educational purposes and lead to a less efficient learning platform. Therefore, the design could consider the whole experiential learning cycle, which includes debriefing and reflection, which might not be considered in traditional commercial escape rooms.

One of the earliest accounts of the word Museum used in English is by George Sandys (1578-1644) when visiting Alexandria (Simmons, 2016). Museums have a long history and have undergone many changes over the years, going from collections

of meaningful items to interactive educational institutions. Karlsborg Fortress is leaning into this newer paradigm, focusing on historical education with greater interactivity and immersion. This fits perfectly with the design of escape rooms and the Experiential Learning pedagogy.

Research Question

The emerging question is, "Can you combine Experiential Learning with escape rooms?". While combining the pedagogy of Experiential Learning and the commercial design of escape rooms, there is bound to be both friction and synergy. Therefore, we see potential in exploring and evaluating what factors cause these frictions and synergies that contribute to the conditions of an educational escape room. Many of these factors have been researched in an educational setting or as a commercial endeavour. The knowledge gap lies in the challenge of combining these disciplines, resulting in our research question being:

- *What are key factors in experiential learning for escape room storytelling of historical events?*

We intend to explore **Key Factors** for Experiential Learning. Specifically, key factors when designing an escape room for Experiential Learning. This will be achieved by evaluating different interactive storytelling elements in an “Escape Room Adventure" designed at Karlsborg Fortress. The project, which is being developed by Kistone AB (hereby mentioned as Kistone) in collaboration with Visit Karlsborg, has been described as an experience in the vein of an escape room but with a stronger focus on historical accuracy and the location where it takes place. At Kistone, David Anthin (storyteller, writer, and content producer) and Niclas Ericsson (technical producer) are the main contact persons for our project where David Anthin is the father of Olle Anthin. There is also a stronger emphasis on the storytelling aspects, and it is based on the actual World War II history of Karlsborg Fortress, which served as a military point responsible for moving Sweden’s gold reserve to Fort Knox. Thus, the design must adhere to the setting and story given by the stakeholders, Kistone and Visit Karlsborg, and be able to answer the research question. However, this also enables the project to include professional assets and scripts while giving a solid foundation to build upon. This raises the ecological validity and enables the focus to be on the key factors, not specific puzzle designs and producing supplementary material.

Background

This project is done in collaboration with Kistone, which specialises in interactive experiences and storytelling. They produce concepts and experience-based exhibitions, including everything from scenography to graphical and technical production. Previously, they have produced exhibitions for museums such as the Museum of Gothenburg, where they developed the anniversary exhibition for the birth of Gothenburg. Additionally, they have worked with foundations and within the public sector, e.g. the foundation for the world heritage Grimeton and the municipality of Kungs-

backa. The project has a foundation in historical storytelling with a focus on learning and immersion and consists of several interactive puzzles. Kistone's vision of a successful result is a history lesson disguised as an escape room. They wish for the participants to exit the experience with new, engaging, and accurate information about the history of Karlsborg Fortress while being entertained. Kistone highly values the fact that the escape room portrays historical events accurately. The escape room is planned to be completed and opened to the public in the Autumn of 2024.

Escape rooms are relatively well developed from an industrial standpoint, but academic research still needs to be done. It is also very uncommon with full-scale escape rooms developed for academic purposes. Therefore, we see a knowledge gap that our project could fill. In contrast, the fields of Experiential Learning and Interactive Storytelling are well-researched. The application of the theories and methods within those fields has a focus on academic education. This project could complement the research mentioned earlier by delving deeper into which specific factors enable successful projects in these fields, as earlier research does not define them in this specific context. We will also be able to test established theories in a novel context and refine what works in historical education. The project utilises Interactive Storytelling, acting as a structure within which the experiential education acts. The work we contribute with could be used in various fields, such as classroom education, museums and tourist attractions. Our work could also be used in research where immersion, learning and Interactive Storytelling are considered.

There are various environments where similar endeavours have been tried and studied. A study researching quest-driven exploration in science centres (Wideström et al., 2023) discovered that having interactive tasks got visitors engaged in the scientific content of the centre. The study also showcased that "Social interaction is an important dimension of informal learning in the science centre context". To further substantiate the claim that education in informal settings (outside of the classroom) is fruitful Falk and Dierking (2010) state that "A growing body of evidence supports the contention that the public learns science in settings and situations outside of school.". They give further arguments to show that these experiences play a vital role in society's acquisition of knowledge, and the playful aspect of it is vital for its attraction and efficacy.

The Fortress of Karlsborg

Karlsborg Fortress is a colossal architectural undertaking constructed during the 19th century to serve as the nation's backup capital during times of unrest. The construction time for the fortress on the Vanäs Peninsula was planned for ten years but ended up taking a staggering 90 years.

Figure 1.1: The Fortress of Karlsborg ("Karlsborgs fästning", n.d.).

Karlsborg Fortress in the Past

After Sweden lost Finland to Russia in the war of 1808-09, the Swedish capital Stockholm, was situated on the border leaving it more vulnerable than ever.

The Swedish defence discussions intensified, eventually leading to the formulation of a central defence plan. Baltzar von Platen, the construction engineer of Göta Canal, pushed the idea of constructing fortresses in the heart of the country. This strategic move aimed to provide the Swedish army with additional time for mobilisation. Simultaneously, plans were made to relocate the royal family, government officials, and the gold reserve to safer locations within the country in the event of war.

Given its proximity to Göta Canal, the choice of location for the fortress was natural. In 1819, Carl XVI Johan decided to build the fortress on Vanäs Peninsula along the western shore of Lake Vättern.

Karlsborg Fortress Today

Today, the fortress offers a family-friendly destination where the local community thrives within its historic walls. Visitors can explore shops, cafes, the museum, and the elegant Garrison Church or join a guided tour. Options include the Historical Adventure Tour, The Gold Rush experience, and soon, the new escape room. The National Property Board (Statens Fastighetsverk) currently owns the fortress.

Purpose of the thesis

This thesis focuses on the key factors that impact the learning conditions of escape rooms and does not intend to determine the best methods for learning and acquiring knowledge. Measuring learning is out of the scope of this thesis and a problematic concept to evaluate. Additionally, we utilise already established theories and methods that have been examined independently. Nevertheless, applying these theories in a

new context could give rise to new interaction effects in terms of learning, which could be studied in the future.

The evaluations in this thesis will not be applied on a finished escape room due to limitations in scope. That said, this will enable changing parameters, e.g. location, setting and linearity, which would not be possible in an existing escape room. The prototypes will be comparatively low-fidelity, which might impact the immersion and holistic experience. This will be negated by the fact that we are comparing different factors on the same premises, which opens up the possibility of changing designs quickly. There is potential for future studies to examine different high-fidelity escape rooms and compare the results with this thesis.

Scope and Limitations

The desired outcome of the thesis is to answer the research question and provide valuable research to future projects looking to develop educational escape rooms in the commercial space. However, some limitations result in us needing to narrow the scope.

Fidelity

The fidelity of the finished escape room will be lower than that of a professional commercial escape room. This is partly due to the time limitation set on the project. The escape room design has to be accomplished in conjunction with researching, conducting the study, analysing, and writing the thesis. Additionally, we lack the necessary proficiency to produce all the parts that an escape room encompasses, e.g. electric circuits and props. Some of the material from the production of the escape room in Karlsborg Fortress can be used, but the development is still in its early stages, so these will also be of lower fidelity. Finally, the study will not be able to be conducted in Karlsborg due to the necessary travel and difficulty in recruiting participants on location. However, the aim is to produce a scaled-down escape room that will still produce similar behaviours and experiences so that the insights can be generalised to finished escape rooms and educational experiences.

Key factors

Since the study will last upwards of an hour for each group, this part of the project will be fairly time-consuming. Therefore, the number of key factors to be studied can not be too large since the number of groups needed would exceed the time allotted for the study. The aim is to allow for indications of other potential key factors to be studied in future research while focusing the analysis on the pre-selected ones.

Stakeholders

Throughout this project, we are working with several different stakeholders. These include but are not limited to, Kistone, Chalmers University of Technology, and Visit Karlsborg. Our primary stakeholders are Chalmers University of Technology

and Kistone. The desired outcome of the thesis overlaps to a certain degree with the stakeholders' goals, but challenges still arise where they do not. Chalmers wants us to break new ground in the specific research area we are exploring, while Kistone wants to get valuable information for their current and upcoming exhibitions. The solution is to find a scope that fits well with the research question while providing valuable information for Kistone. By situating the project in a theoretical interdisciplinary context and utilising relevant methods that combine research and design, we aim to bridge the gap between the stakeholders.

2

Theory

This interdisciplinary project draws inspiration from Interaction Design, Pedagogy, Storytelling and Game Design specialisations. At the core lies Interaction Design, and this chapter begins with a few of the disciplines within Interaction Design that are relevant to the project. The subsequent section covers theories of experience-based learning, which are introduced and explained. This section explores the history of Experiential Learning, moving onto modern approaches such as Kolb's Learning Style Inventory (Kolb, 2014) and the Experience Pyramid Model (Tarssanen & Räisänen, 2009). Finally, research specific to escape rooms and Storytelling is presented. This research is primarily focused on educational escape rooms in a classroom setting.

2.1 Interaction Design

Interaction Design can be described as "...the design of interactive products and services in which a designer's focus goes beyond the item in development to include the way users will interact with it." (Interaction Design Foundation - IxDF, 2016). They also describe Interaction Design's position within the User Experience Design (UX design) field, being an integral part of UX design but narrowing the focus to the interactive experience. Below are some theoretical foundations that have informed the methodology and structure of the overarching project and the individual parts. UX design functions as a baseline for the project, providing a user-focused mindset and necessary tools for evaluation and design. Design Thinking is, in this instance, used as a complementary perspective to UX design, acting as a more focused lens through which to view the design process. To describe the project's problem space, the understanding of Wicked Problems is used. Tangible Interaction is a field within Interaction Design primarily focusing on physical representations of digital information. This provides the necessary methods and theory for designing the tangible elements of the experience. Finally, the theories within User-centred Design contribute a solid connection to potential users and guide design decisions. These different theoretical fields span overarching philosophies and more detailed design tools. More theories could be included, but these cover the essential perspectives while keeping within the project's scope and avoiding a fragmented theoretical background.

2.1.1 User Experience Design

As mentioned previously, Interaction Design is part of the bigger field of UX design. According to Norman and Nielsen (2024), UX design can be condensed into meeting the user's needs. However, they expand upon this concept by explaining that a successful user experience includes a coherent mix of an experience's aspects, including all the disciplines involved. This facilitates a joyous user experience while going beyond the explicit needs of the user. UX design can be further defined by differentiating it from the related term Usability. Hassenzahl (2006) point out three areas of difference that Hassenzahl et al. (2006) further explain. In contrast to Usability, UX design considers a wider range of aspects, including hedonic and pragmatic qualities. Furthermore, UX design considers subjective experiences instead of objective observations and measurements, as in Usability testing. Finally, while Usability focuses on negative barriers, UX design focuses on positive outcomes. This is accomplished by addressing both dissatisfiers and satisfiers to evoke positive emotion and create value for the user.

2.1.2 Design Thinking

Design Thinking can be described as "a mindset in which the product concept and design for emotional impact and the user experience are dominant. It is an approach for creating a product to evoke a user experience that includes emotional impact, aesthetics, and social- and value-oriented interaction." (Hartson & Pyla, 2012). Hartson and Pyla expand this notion by highlighting the "social and cultural aspects of interaction" as well as addressing the notion of the embodied nature of interaction which situates it in the physical world and involve our whole bodies. Additionally, they list several aspects of Design Thinking, including being immersive, integrating different perspectives, human-centred, market-oriented, and attentive to the product.

2.1.3 Ideation

Hartson and Pyla (2012) describe the Ideation process as "...applied design thinking". They focus on the necessity of a free iterative Ideation process utilising a non-formal evaluation exploring a plethora of ideas. They divide this process into idea creation and critiquing, and they must be kept separate. During the idea creation, the focus lies on uninhibited brainstorming, free from inhibitions; the critiquing must come later so as not to stifle creativity.

Performing Ideation requires spatial considerations where the workspaces should enable individual and group work (Hartson & Pyla, 2012). Optimally, this space should be dedicated and specialised for Ideation. Furthermore, they claim that sketching is essential to Ideation by supporting the communication. It also serves as a rich form of documentation (Nilsson & Ottersten, 2018).

2.1.4 Wicked problems

Design is a diverse and flexible field that has long evaded definition and strict definitions. This has been reflected in the development of Design Thinking as Buchanan (1992) describes it "...we have seen design grow from a *trade activity* to a *segmented profession* to a *field for technical research* and to what now should be recognised as a new *liberal art of technological culture*.". Buchanan continues describing modern design practices as connecting art and science, applying them to modern technological challenges. Additionally, he broadens the term technology to mean physical products and a "discipline of systemic thinking". Thus, it expands what technology means for designers, including the process of designing and the emerging reasoning and arguments produced in that process. This argumentation includes everything produced and expressed, from planning to prototyping.

Although the different design disciplines are diverse, they share a common ground in their attempt to work with Wicked Problems. Rittel and Webber (1973) first described Wicked Problems as a "class of social system problems which are ill-formulated, where the information is confusing, where there are many clients and decision makers with conflicting values, and where the ramifications in the whole system are thoroughly confusing.". Buchanan (1992) elaborates on this concept by describing that the problems designers face have a fundamental indeterminacy that results in limitless conditions. He claims that Wicked Problems are integral to design because the design has a scope that possibly applies universally to any human experience.

2.1.5 Tangible Interaction

Tangible User Interfaces (TUIs) combine physical and digital interfaces to create novel interaction mediums, allowing for physical representations of digital information (Shaer & Hornecker, 2009). These systems have also been used for educational purposes supported by research on engaging several senses in developing children (O'Malley & Fraser, 2004, as cited in Shaer & Hornecker, 2009). The interfaces can be complete learning environments or a part of more prominent educational entertainment institutions such as museums. A framework called The Child Tangible Interaction framework (Antle, 2007) lists five conditions where systems can aid in learning based on research on child development. These are spaces for action, perceptual, behavioural, semantic mappings and "spaces for friends", which aids collaboration. Shaer and Hornecker (2009) also highlight Storytelling as an application for TUIs, stating that "Storytelling applications build on traditional toys and play environments or books, and augment these.".

Shaer and Hornecker (2009) bring up several concepts, e.g. affordances, constraints, and mapping, that take advantage of the physical nature of TUIs. These can be used to leverage certain cognitive functions to enhance the functionality and intuitiveness of an interface. Additionally, they bring up the importance of embodiment for Tangible Interaction. The fact that we exist and act in the physical world affects our cognition and understanding of the world. Thus, TUIs can manifest and represent digital phenomena and create a connection between the physical and the digital.

Another advantage of using TUIs is the distributed cognition that they allow for. "Actions such as pointing at objects, changing their arrangement, turning them, occluding them, annotating, and counting all recruit external elements (which are not inside the mind) to decrease the mental load." (Shaer & Hornecker, 2009). Physical props can also be perceived more easily, allowing for mental shortcuts that circumvent logical deductions.

"The evaluation methods used to study tangible user interfaces are similar to those used within HCI." (Shaer & Hornecker, 2009). Thus, a wide variety of evaluation methods can be used. For comparing different TUIs, comparative studies are a viable option. These can be conducted with both quantitative and qualitative methods. Qualitative methods can also be used in tandem with interaction analysis of video, which is well suited for evaluation of TUIs (Shaer & Hornecker, 2009). Shaer and Hornbacher point out that qualitative observation affords an open mind and is suitable for field studies with fewer participants. Additionally, they describe that observational studies of TUIs can range from taking notes of participant behaviour to detailed transcriptions of video material.

2.1.6 User Centred Design

The User-centred Design process can be described as a set of tools to acquire a rich understanding of the user's needs ("What is User Centered Design (UCD)?", 2024). Through an iterative process, the user is placed in focus, and the designs are developed from the knowledge gained about the user. The iterative process consists of four phases: *Understand context of use*, *Specify user requirements*, *Design solutions*, and *Evaluate against requirements*. The first phase, *Specify user requirements*, involves obtaining knowledge about the user and the use context. In the next phase, *Design solutions*, the needs and requirements of the user are specified, and these two phases inform the upcoming design phase and centre the development around the user. During the third phase, *Design solutions*, several design solutions are produced that consider the context of use and the user's requirements in varying ways. Finally, the designs are evaluated against the requirements specified earlier in the fourth phase, *Evaluate against requirements*. This determines how successful the design is in conjunction with how well it suits the actual use. This process is iterated upon until a satisfactory result has been reached.

Gulliksen et al. (2003) expands upon this concept with six key principles for user-centred systems design. These principles overlap with the phases mentioned above while providing additional guidance. The first principle is *The users' work practices control the development*. This amounts to an early focus on the user's needs and an understanding of multiple facets of the user, e.g. work tasks and cognitive behaviour. The second principle, *Active user participation*, entails considering the user in every project step. The considered users should be both work domain experts and end-users. *Early prototyping*, the third principle, is important to understand the user early and ensure evaluation before the design is finished. The fourth principle, *Continuous iteration*, can be seen as complementary to early prototyping. The information gained from evaluating prototypes should inform the next iteration, and iterations should

occur as often as needed. The fifth principle, *Multidisciplinary design teams*, is fairly self-explanatory, but extra emphasis is put on the need for a usability designer. The sixth and final principle, *Integrated design*, involves developing all parts of the system or design in parallel.

2.2 Experiential Learning

Experiential Learning consists of various educational divisions, which have a few key factors in common. It has different definitions depending on the application and school of research. Still, it can generally be summarised as an educational framework where students cooperate to learn from experiences based on the real world. The process is heavily emphasised, and knowledge is constantly in flux based on our experiences. Furthermore, (Tate and Keeton (1978) as cited in Kolb, 2014) define Experiential Learning as "Learning in which the learner is directly in touch with the realities being studied. It is contrasted with the learner who only reads about, hears about, or writes about these realities but never comes into contact with them as part of the learning process." The concept of experiential education draws together the work of several notable 20th-century scholars who were valued for their theories of human learning and development (Kolb, 2014). The term was coined by John Dewey (Dewey, 1938 as cited in Kolb, 2014) and has since been associated with some controversy. The framework has been criticised for being difficult to assess quantitatively and problematic for using locations other than the classroom (Weinstein, 2023). In response to the description of Experiential Learning as misleading and full of bias (Kolb, 2014) states that "What the above cost/benefit analyses of experiential and academic knowledge fail to consider are the biases and limitations of generalised academic knowledge. Judgments and decisions based on "objective" knowledge can also be incorrect and unreliable because of unjustified assumptions in the analysis of data, professional tunnel vision that reinforces an availability heuristic in judgment..."

2.2.1 Learning Style Inventory

Kolb (2014) has developed an approach to Experiential Learning and an instrument for applying it stemming from earlier theories in the field and different academic professions. This instrument is called the Learning Style Inventory (LSI). The approach can be described as a cycle where “Concrete Experience”, “Reflective Observation”, “Abstract Conceptualisation”, and “Active Experimentation” feed into each other in a spiral, which can be seen in Figure 2.1.

The Experiential Learning theory was analysed qualitatively by Hickcox (1991). This study focused on the theoretical background and the application of the theory. Hickcox’s study showed that "A majority (61.7%) of the studies examined found that Kolb’s theory and LSI were useful in five academic areas: accounting and business education, the helping professions, medical professions, postsecondary education, and teacher education."(Hickcox, 1991).

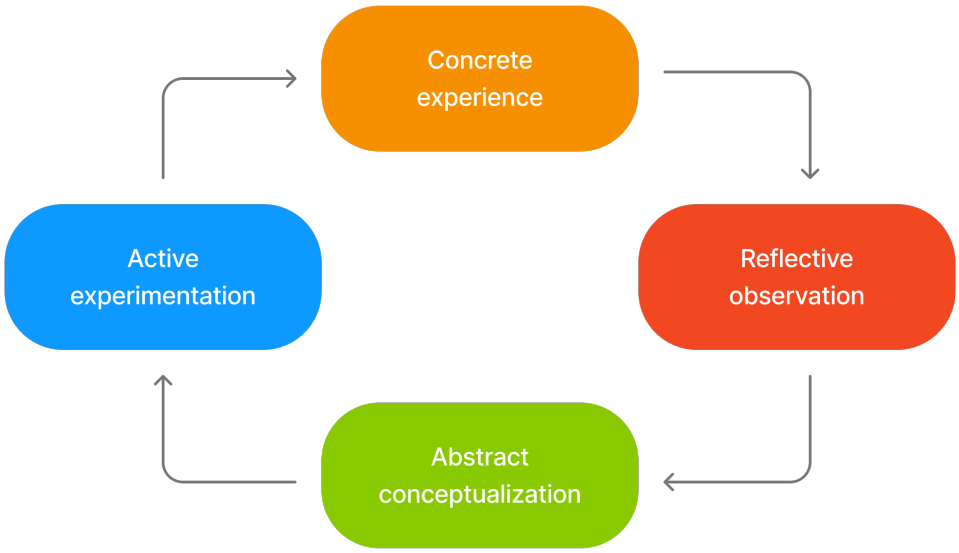

Figure 2.1: The experiential learning cycle (Kolb, 2014).

2.2.2 Debriefing

Baker et al. (1997) emphasise the importance of debriefing in educational experiences. They also argue that the conversation after an experience can transform it into learning, but the context and structure are key for a successful debriefing. Unfortunately, this area is heavily under-researched. The conversation also further strengthens the collective aspects of Experiential Learning, expanding the knowledge gained and distributing it to the group, making the whole greater than the sum of the parts. Through their research, they interviewed participants about memorable conversations and what aspects stood out in those conversations. From these interviews, they compiled six themes that can act as contextual considerations for creating meaningful conversations. Below follows these themes (Baker et al., 1997):

1. *Making an effort.* When participants in a conversation are making an effort to understand, be understood, and speak to be heard, as well as swallowing some things along the way, they make a fundamental contribution to creating a receptive space. Making an effort does not mean avoiding the differences (as seen in #4 below, where confronting growth-promoting conflict is encouraged). It does mean considering how and what to say, being led by anticipating what can be more readily and fully heard by the listener(s). The receptive space is not created without effort, especially with intensely emotional and historically laden differences.

2. *Creating a safe space.* The sense of safety that comes with acceptance, respect, recognition, flexibility, openness, and patience is paramount. In a safe space, individuals try to minimise or avoid judgment, blame, fear, ill intent, power plays, exclusion, rudeness, and coercion.

3. *Moderating the energy.* Being aware of modulating the energy and providing space for listening and reflecting while not suppressing participation deserves

serious attention. If the pace is too fast or slow, it interferes with people staying engaged and taking in (i.e. hearing) what is being said.

4. *Confronting conflict in ways that are growth promoting.* Explicitly supporting the exploration and confrontation of differences while being proactive and creative is vital to learning. Building common ground and making a safe and receptive space for confrontation is crucial for the conversation's success.

5. *Engaging with the head and the heart.* A more receptive space is created for conversation across differences when people are using their heads (the cognitive) integrated with using their hearts (the affective), as well as when both aspects are valued and encouraged.

6. *Valuing the reflective listening as highly as the active speaking.* Conversations require being active and reflective, proactive and reactive, even though typically, at least in Western cultures, action is generally more highly valued than reflection and receptivity (Baker et al., 1997). Nachmanovitch, 1990 refers to these two necessary phenomena as the "Creative and the Receptive, making and sensing...a resonant pair, matching and answering each other."

Inquiry and Scaffolding

In his early work, Dewey (Dewey, 1910 as cited in Hickman, 1997) stresses the positive effect that inquiry has on learning. This inquiry can drive the exploration of educational material and involves an active learning process. A study on how to encourage inquiries in mathematical learning Pareto et al. (2023) found that "Regarding scaffolding, the game hints and feedback seemed essential to inject inspiration for inquiry, as was the scaffolding provided by other group members.". This exemplifies the importance of the guiding structures included in an educational experience. Additionally, it reinforces the results from a previous meta-study that showed the positive effects of collaboration when problem-solving (Qin et al., 1995).

2.2.3 The Experience Pyramid Model

Heikkinen and Shumeyko (2016) emphasise creating a meaningful and memorable experience. They proceed to highlight that the most significant challenge when creating the ultimate experience is that the meaningfulness of the experience is highly subjective, and the developer has no control over many contributing factors.

There are, however, several ways of impacting the participant's experience. One way of helping to answer the challenging question of what makes a meaningful experience and to help create something that stands out is the Experience Pyramid Model (Figure 2.2).

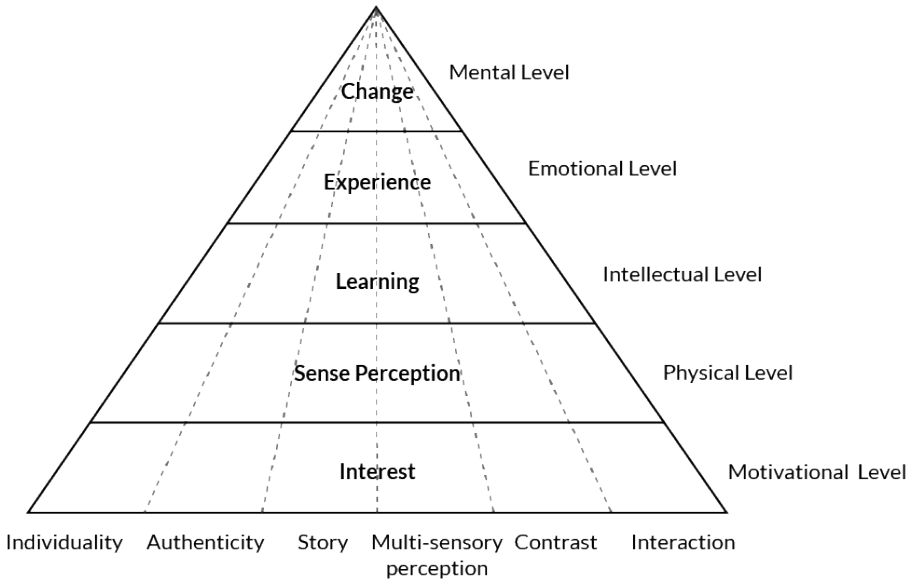

Figure 2.2: Experience Pyramid Model (Plomp et al., 2010).

Tarssanen and Räisänen (2009), the creators of the Experience Pyramid Model divide the model into two dimensions or perspectives. The horizontal axis represents the six elements affecting the customer experience.

Individuality

Individuality means uniqueness, a product or service offering distinct features not found elsewhere. It involves a participant-centred approach and adaptability to customise the product based on individual preferences. The challenge is to design easily customisable products while managing associated costs.

Authenticity

Authenticity points to a product's credibility, reflecting on its existing lifestyle and culture. Bruner (1994) suggests that authenticity is subjective and determined by the customer's perception of credibility and what is genuine. There is no universal authenticity; it is always defined from someone's perspective. A product should align with local culture to be considered a natural part of the producer's local identity. Each representation of a culture alters our perception of the original ((Bruner, 1994)).

Story

A product's narrative is closely connected to its authenticity. Implementing product elements into a cohesive story creates a compelling experience and adds social significance. A credible story provides participants with a strong reason to engage. Tarssanen and Räisänen (2009) exemplifies the story's importance by writing "Customers are not taken ice fishing just for the fun of it, rather, the customer is convinced of why it is important to learn the skill of ice fishing."

Multi-sensory perception

Multi-sensory perception entails that all sensory perceptions are carefully designed to strengthen the chosen theme and to support immersion. The participant's experience may suffer from too many or annoying sensory perceptions.

Contrast

Contrast is, from the participant's viewpoint, a deviation from their everyday life. The experience needs to offer something new, exotic, and out of the ordinary, allowing the participant to experience novelty and uniqueness. Encountering new and extraordinary aspects in a different environment provides the customer with a fresh perspective on themselves.

Interaction

Interaction is about effective communication among service providers, participants, and creators of the experience. Having a community and emphasising shared experiences is crucial. While meaningful solo experiences exist, shared ones elevate social status and create a sense of belonging.

The vertical axis of the Experience Pyramid Model illustrates how the participant's experience is constructed from interest and conscious processing. An ideal product has all the above-described elements involved at each level of the experience. The vertical axle consists of five different levels of experience.

Motivational

The participant's interest is sparked at the motivational level, where expectations for the product are shaped with the help of marketing strategies. It is crucial to involve as many fundamental elements of the meaningful experience as possible at this stage. The marketing of the experience should be authentic, multi-sensory, interactive, and emphasise contrast.

Physical

At the physical level, participants get a feel for the experience through their senses, providing awareness of the surroundings. A good experience ensures a comfortable and safe experience, addressing basic needs and minimising physical risks. Extreme experiences with inherent danger are exceptions (Tarssanen & Räisänen, 2009). The physical level is where the product's technical quality is tested.

Intellectual

On the intellectual level, we process sensory stimuli, engaging in learning, thinking, applying knowledge and forming opinions. This level is where we form our satisfaction with the product, according to LaSalle and Britton (2003). A good experience on the intellectual level offers a learning opportunity, providing the chance to acquire new knowledge and development both consciously and unconsciously.

Emotional

The emotional level is where the meaningful experience is likely to manifest. Individual emotional reactions are challenging to predict and control. However, when the essential elements for a meaningful experience are well-addressed earlier on the motivational, physical, and intellectual levels, the likelihood of the participant having a positive emotional experience is high.

Mental

On the mental level, a positive and impactful emotional experience has the potential to trigger personal growth, leading to changes in the participant's physical state or lifestyle. Tarssanen and Räisänen (2009) exemplifies these kinds of changes by stating that "An individual earlier rather un-courageous may consider them-self quite brave after having skydived with a parachute, the materialist discovers new values from a wilderness trek, or a couch potato is bitten by an exercise bug."

The Experience Pyramid Model can create a wide array of experiences, from customer experiences to artistic concepts. The model has also been applied to escape rooms. Heikkinen and Shumeyko (2016) states, "The Pyramid does not bring anything new to designing escape rooms per se, but it makes the process more streamlined and organised, providing a structured base for creating a wholesome, engaging experience.". In this context, it has been thoroughly tested from an entertaining perspective, leaving out the educational aspects.

2.3 Escape Room Research

Escape rooms for entertaining and educational purposes have been exponentially researched since their beginnings in 2007 (Garwood, 2020). However, the focus of the research has been explicitly on entertainment or education, leaving a knowledge gap concerning educational escape rooms in commercial settings.

2.3.1 An Emerging Educational Approach

Since its early use cases in 2007, escape rooms have grown in popularity at an exponential pace and have become a common activity all over the world. Alongside the increase in popularity of escape rooms, educational escape rooms have become more prevalent. Even though the educational approach of using escape rooms is much more common now than a few years ago, it is still a new concept, and its potential has yet to be explored extensively.

Although educational escape rooms have been introduced into many more classrooms over the last few years, they are often implemented with compromises. From the relevant 68 articles collected in the systematic review by Fotaris and Mastoras (2019), 76,5 % of the educational breakout rooms were physical. However, only 44.2 % of these were an actual escape room. The rest were either a breakout box or some form of a tabletop game (Fotaris & Mastoras, 2019). They can still provide a motivating

and educationally beneficial experience when designed appropriately. However, they do lose a large chunk of immersion, limiting their full educational potential (Clarke et al., 2017).

2.3.2 Aspects of Educational Escape Rooms

Fotaris and Mastoras (2019) list tendencies, affordances and challenges as areas where there are opportunities to make discoveries and confirm earlier hypotheses. Within these areas, they continue listing the aspects: **Fields of Education**, **Target Audience**, **Game Type**, **Location**, **Time Limit** and **Team Size** as factors that can affect the learning outcome of educational escape rooms (Fotaris & Mastoras, 2019). Below are their findings extracted from the selected studies of these aspects.

Fields of Education

To help explore the educational escape room's domain, Fotaris and Mastoras (2019) used a classification system based on the broad educational fields outlined by the International Standard Classification of Education (ISCED) proposed by UNESCO (2015). The data gathered reveals that most educational escape rooms focus on subjects within the broad field of Health and Welfare (29.4%), emphasising Nursing and Medicine. Natural sciences, Mathematics, and Statistics comprise the second largest category at 22.1%, with Chemistry emerging as the dominant topic in this domain. Social sciences, Journalism, and Information cover 19.1% of the studies.

Target Audience

The most common target audience in the studies was higher education students 72.1%, with secondary education students comprising 11.8%, primary education students at 7.3%, the general public at 7.3%, and staff members at 1.5%. This distribution could potentially be explained by the superior resources and research-focused staff typically found in universities compared to schools. However, the increasing enthusiasm among schoolteachers, as evidenced by the widespread adoption of educational escape rooms, suggests a shifting trend in the future.

Game Type

Since their inception, escape rooms have been designed to operate within physical, digital, or mixed realities. The majority of escape rooms are physical, adding up to 76.5% of the selected studies, and can be attributed to the cost-effectiveness of props (e.g. locks, boxes, paper-based puzzles) and quicker development times. 13.2% was hybrid escape rooms, incorporating physical elements and virtual components containing puzzle clues. A smaller portion, 10.6%, are entirely digital games. While physical escape rooms currently dominate, there is an anticipated rise in the popularity of hybrid escape rooms utilising augmented/virtual reality as these technologies mature.

Location

Fotaris and Mastoras (2019) findings indicate that a significant majority, 78.9% of educational escape games occurred in classrooms or labs. This logistical trend may directly result from the spatial constraints commonly encountered in educational settings, as escape rooms often have dedicated and permanent spaces. Conducting classroom escape games also eliminates students' need to travel to a separate location to participate. The second and third most common locations are library buildings and hospital rooms. A connection can be identified with earlier observations about the popularity of escape rooms centred around Library orientation, Nursing, and Medicine.

Time Limit

Out of the 68 studies Fotaris and Mastoras, 2019 reviewed, 52 provided details regarding the time limits set for the escape rooms. The majority of the educational escape rooms had time limits of 15-120 minutes to complete the game, excluding any additional time allocated for briefing and debriefing activities.

A significant portion, 78.8%, of the escape rooms had a duration of one hour or less, aligning with prior research findings (López-Pernas et al., 2019). Among these, 36.5% followed the common 60-minute time limit seen in commercial escape rooms. This duration suits a reasonable number of puzzles and encourages participant teamwork.

Games with a duration of 75-120 minutes were less common (17.3%) due to logistical challenges and the potential for the participants to experience fatigue. However, a longer duration allows tutors to incorporate more meaningful challenges requiring additional time and effort.

Team Size

Regarding the number of participants in escape rooms, team sizes in all studies varied from 2 to 14 players. Fotaris and Mastoras (2019) findings show that the majority of teams consisted of 5 players (27.5%) or more. Compared to the average team size of 4.58 people in commercial escape rooms Nicholson, 2015, educational escape rooms tend to feature larger teams. This is primarily a consequence of constraints related to classroom size, time limitations, and available facilities, as mentioned earlier when discussing location.

2.3.3 Advantages & Challenges of Educational Escape Rooms

All 68 articles covered in the systematic review by Fotaris and Mastoras (2019) reported at least one advantage over traditional educational methods, but most showed more. Almost half (41.2 %) of the educational escape rooms showed an increase in promoting teamwork and collaboration. The level of enjoyment was also increased in many cases (38.3 %). Other reported advantages were increased motivation and learning gain, as the participants found learning through play more interesting. Finally, some cognitive advantages identified in several studies were improved critical thinking, problem-solving and creativity.

48 of the 68 articles reported one or more identified challenges with the educational escape room. One big challenge was poor evaluation. Many studies lacked a control group or another viable evaluation method. This led to many of the insights being collected through the participant's perception of the educational escape room and the teachings it strives to deliver. Another challenge identified within several studies was time commitment. The creation and iteration of an educational escape room is a high-resource activity, making it less optimal when the room is not planned to be used many times. Some studies highlighted that balancing the lack of space and required group size was challenging. The large groups also proved to be a logistical challenge as it took more work for the instructors to keep all the members engaged with the task. This balance proves to be even more challenging as many studies found that educational escape rooms are often bigger as they often contain larger groups, and dividing the participants into many small groups would prove to be a logistical challenge (Adams et al., 2018).

2.4 Storytelling

Storytelling as a way of passing on knowledge is a cross-cultural phenomenon and is an integral part of our learning, starting before we can express our own thoughts (Alterio, 2002). Alterio claims that "Storytelling is an ideal teaching and learning tool..." with several positive effects, e.g. encouraging cooperative activity, linking theory to practice, and revealing multiple perspectives. However, Alterio also conveys that Storytelling requires careful consideration, such as what form of Storytelling (oral, written, visual, or physical) should be used and what forms of support are required, among others. Furthermore, Caminotti and Gray (2012) showcase the effectiveness of Storytelling for adult learning. They highlight the need for engagement and interest within the adult learner, which storytelling can help facilitate.

Breakthroughs in the media of communication have enabled the development of Interactive Storytelling. Pavlik (2017) calls this experiential media and claims that this new media can "...enable content creators to design stories for users as participants in immersive, multi-sensory and interactive first-person narratives". He argues that "Experiential media bring the possibility of a transformation of media content from storytelling to story experiencing.". This can change the user's role from a passive bystander to an active participant experiencing the story from a first-person perspective.

The Storytelling aspect of escape rooms can help create memorable learning experiences (Nicholson, 2018). The advantage of this participatory Storytelling is that the participants can affect the story through their choices. Nicholson (2018) claims that escape rooms that utilise Storytelling for learning "...can inspire learners to seek more knowledge, help them reflect upon how the learning connects to their own lives, and help them develop their intrinsic motivation to learn and explore more instead of just responding to the extrinsic motivation of grades.

3

Method

The thesis utilises various methods, from foundational to instrumental. The methodology relies heavily on Design Research, Research through Design, and Experiential Learning. These permeate the whole thesis, and more specific methods are used for detailed planning and designing. The specific methods include qualitative and quantitative evaluation methods and the Double Diamond design process.

3.1 Design Research

Initially, a robust theoretical foundation has to be established. This can be accomplished by conducting a literature study that maps the current research landscape and practices of Experiential Learning, Interactive Storytelling, and escape rooms. This is a complex task due to the sheer breadth of these fields. To tackle this potential problem, the strategy being used is first to attain a general understanding of the separate fields. This is done by reading the most prominent and cited authors combined with the most recent research on each subject. The goal is to provide the necessary knowledge concerning epistemology views and potential applications of those fields to this project.

Afterwards, the overlapping literature is researched. The research aims to provide insights into the field of escape rooms and activity-based education, informing about the methods and instruments currently in use. The knowledge gained from this informs of potential overlaps and unexplored areas. Valuable knowledge of how to structure the experience in a way that adheres to the guidelines of the respective field while still being able to change key factors that can influence the result is also attained. In conjunction with collaborating with industry professionals, Kistone enables a solid connection to established practices but might require more innovation. However, even though the separate fields have a long history of dedicated research, their combination is still novel and lacking in terms of studies and research. This gives rise to opportunities for new innovative research within experiential escape rooms while making it less likely to omit essential theories. The extensive research conducted in this project also provides an opportunity to discover gaps and potential for innovative research. However, the small amount of research in the area might result in a lack of guidance to inform the design. To reduce this risk, case studies of similar projects which share several of the focus areas of this study are studied. Additionally, this helps bridge the gap between theoretical insights and practical

application in the design of escape room experiences.

This initial literature study can be seen as part of a Design Research practice. The emphasis on a robust theoretical foundation is intended to inform the rest of the design process, allowing the design to focus on the user and the key factors. This reflects the goal of examining the current ways of design while suggesting important key factors to address and how they impact the conditions for learning. An alternative approach to design research could be to use a form of Participatory Design ("What is participatory design?", 2024), which could result in a more user-centred design. However, since the project aims to provide insights and guidelines, the main focus is not creating the best escape room. Users will still be involved to ensure that the design lives up to a certain standard and that the analysis is heavily based on the user's experiences.

3.2 Research through Design

Research through Design (RtD) is an approach that focuses on the process of designing as a way of gaining new knowledge. As Gaver (2012) puts it, "Whenever practitioners describe their influences, discuss the rationales for design decisions, and articulate their assessment of what they have made and its importance, they engage in the form of implicit conceptual work by highlighting important issues, dimensions of similarity, and criteria for choices and success. To the extent these conceptual statements are articulated in general terms and applied to multiple examples, they become recognisable as theories in their own right.". Using RtD for this thesis can help give new insights concerning design practices used today. It also aids in applying theories and perspectives from other disciplines to design. Gaver describes this borrowing of theories as a way to produce and explain designs, thus "translating" them to design practices.

This project is not meant to produce one solution suitable for this specific instance but rather to provide new knowledge to future actors in the same field. This aligns with the description of RtD by Gaver (2012) as a discipline that doesn't converge but generates new suggestive worlds. RtD also embraces the complexity of design projects formulated by Gaver as "... the myriad of factors that remain untheorised yet crucial to a project's success". We believe this is a suitable method to test the key factors in different steps by prototyping interactive systems to discover potential interactions between them. Additionally, RtD can help bridge the gap between the different disciplines involved in the project. The method applies to our complex research question, where RtD can help create a more comprehensive understanding. The method Action Research could be used, which is regularly utilised in research within education (George, 2024). This method has some advantages, such as quick adaptability and direct solutions; however, this project aims to create a generalised result that can be used in several applications. The use of Action Research would also focus less on the design process, which is an integral part of this project.

Several prototypes will be created to test different systems and alterations in those systems. Therefore, the specific artefacts will have relatively low fidelity in most

cases. That said, we might be able to use some of the prototypes developed by Kistone, which will have higher fidelity. The design of the prototypes depends on the key factors being evaluated. If we were to evaluate the importance of linearity, we would only construct basic building blocks, and the same would be true for evaluating group size. These prototypes would be used in user studies to study user engagement. Testing whether location is a key factor for experiential learning would require one part of the experiment to take part at the museum, while testing the duration of the experience might not. This iterative process is accomplished within the Design Thinking framework.

3.3 Design Thinking

The Design Thinking theory includes a set of stages that guide practitioners through the design process. According to Dam (2023), these consist of **Empathize**, **Define**, **Ideate**, **Prototype**, and **Test**. This method is suitable since it is effective when undertaking unexplored areas that contain properties of wicked problems. It also involves considering the user's needs, technological feasibility and viability, which fits this project's scope. A method such as Systems Thinking could be applied to a more well-known problem where a holistic analysis of a complex system is needed (Goodman, 2016).

3.3.1 Empathize

The first stage involves deeply understanding the users and the problem at hand. This can be done by consulting experts or performing observations. The information gained from this stage is fundamental to the next stage.

3.3.2 Define

The next stage utilises the information from the first stage by processing and organising the findings. The analysis then informs the problem statement. The analysis should be conducted with a strong focus on the human perspective. The problem statement is central for giving an initial intuition about potential solutions and key features needed.

3.3.3 Ideate

The third stage consists of idea generation. Combining the understanding of the user gained in the Empathize stage and the problem statement formulated in the Define stage builds a foundation for generating ideas that involve different perspectives while staying centred around the human experience. The brainstorming techniques used for this stage are not predefined and can be chosen to fit the developers and the problem.

3.3.4 Prototype

This stage aims to quickly produce solutions to the problems defined in previous stages. The prototypes are tested to find improvements or possibilities for new designs. This also provides knowledge about the user's interactions and behaviour.

3.3.5 Test

Finally, a product with higher fidelity is tested with the improvements identified in the previous prototype stage. This can lead to a redefinition of the problem statements and new iterations of previous stages. The aim is to hone the understanding of both the design and the users.

3.4 Double Diamond

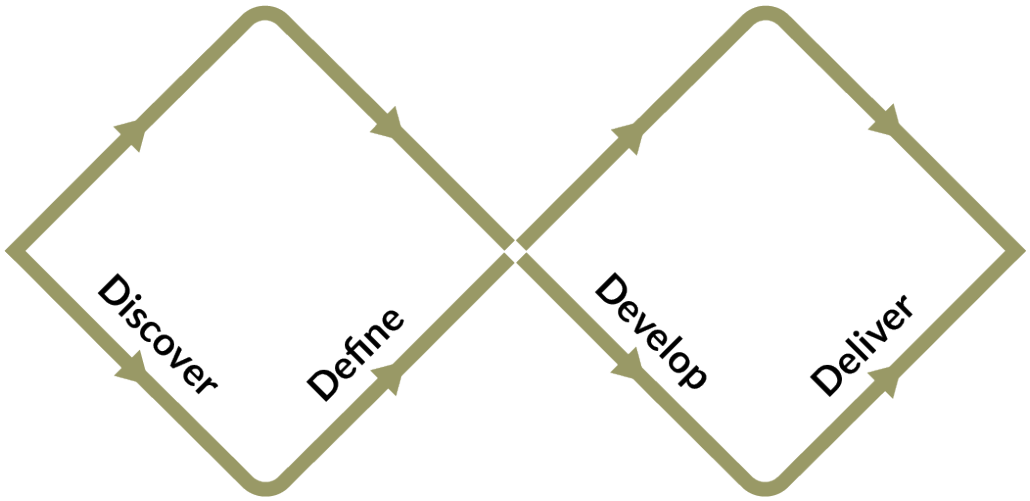

Figure 3.1: A graphical representation of the double diamond process (Council, n.d.).

"The Double Diamond is a visual representation of the design and innovation process." (Council, n.d.) and can be seen in Figure 3.1. This representation of the general design process can also be utilised as guidelines for projects in a wide range of fields, and divergent and convergent thinking can be applied. In the first divergent phase, *Discover*, designers spend time understanding the problem from the perspective of directly affected people. Following this is the converging phase of *Define*, in which designers use the knowledge gathered to define the challenge. Moving on to the second diamond, the diverging phase, *Develop*, consists of producing different solutions to the defined problem. Finally, in the convergent phase *Deliver*, the different designs are tested, distilled and reworked into the working solutions. This iterative process can involve moving back and forth between phases. A process such as the Design Sprint ("The design sprint", n.d.) could be used, but it involves a more rigorous structure. The schedule for this project requires collaborating with stakeholders and stretches over a longer time period than the design sprint affords. The Design Sprint

also has a smaller scope focusing on definitive solutions. Double Diamond fulfils the criteria of this project better, thus making it a natural fit for this project.

3.5 Evaluation

The information needed to answer the questions in this thesis heavily relies on evaluating the identified key factors. This requires objective evaluation using quantitative data gathering methods and subjective evaluation using qualitative data gathering methods. The data collected using these methods are analysed to extract relevant information and provide a clearer picture of the challenges and key factors that must be prioritised.

3.5.1 Qualitative evaluation

A qualitative evaluation, such as conducting an interview or doing observations, can be performed to determine the importance of each factor. It can give insight into the participant's experience and measure the impact of a factor's change. Furthermore, it can reveal interactions between key factors and conditional consequences, for example, that group size strongly affects the time needed to complete an escape room.

Pilot study

A pilot study can be defined as a small sample study created to be used before conducting a study of a larger scale (Jairath et al., 2000). The purpose of the pilot study is to ensure that the structure and methods used within the study are working as intended. Pilot studies allow for iteration on larger scale studies, resulting in a higher chance of a successful study.

Interview

Interviews are an example of a qualitative data collection method. By asking questions and, more importantly, listening to users' opinions and comments, a better and deeper understanding of the user experience is created. Interviews can also be conducted with experts in a particular field to better understand the user experience.

There are three basic interview structures: unstructured, semi-structured, and structured. Unstructured interviews start from a "blank slate" and allow the interviewee to control the conversation. Semi-structured interviews have a script where the same questions are asked in the same order to everyone interviewed, but follow-up questions are based on the answers provided rather than on a script. A structured interview is entirely based on a script where all questions are asked in the same sequence, and all follow-up questions are outlined in the script ("Intervjuguide", n.d.). For this project, a semi-structured interview was used to allow for richer data suitable for the experience's complexity.

Expert users have extensive interaction knowledge, task expertise, and domain-specific

knowledge related to a particular system (Shluzas et al., 2013). They leverage this knowledge to accomplish goals or tasks effectively. On the other hand, novice users are described as individuals who lack familiarity with a specific system, possess limited interaction experience, and demonstrate a less proficient ability to acquire and apply knowledge for achieving interaction goals and tasks in the specific system. This project involves interviewing experienced developers of interactive exhibitions, which is necessary to fill gaps in knowledge.

Group Interview & Focus Group

Group interviews and focus groups are frequently used interchangeably, referring to structured discussions involving a chosen group of individuals to highlight collective perspectives on a research topic. Group interviews collect diverse opinions within a group setting, often featuring interactions between the interviewer and the group members. The distinctive aspect of focus groups lies in their interactivity, where the group's opinions are equally important as individual opinions. Additionally, a focus group can develop its dynamic, taking on a life of its own, which may not have been planned or initiated by the researcher. This approach is suitable for the nature of the escape room and the goal of reflecting the collective experience.

3.5.2 Quantitative evaluation

A quantitative evaluation can determine whether there are differences between conditions. If a factor is to be deemed important, it needs to have some effect on the experience. That effect can be measured quantitatively by measuring completion time and the number of wrong answers or with a post-experience survey measuring, e.g., engagement and difficulty.

Survey

A questionnaire can be used as a versatile tool that can be applied to various kinds of research. It is considered good practice to conduct a pilot study or pretest of the questionnaire with a small sample of respondents before using it on a larger target group. This helps identify areas of confusion, detect errors, and estimate the average time each respondent might take to complete the questionnaire. A meticulously crafted and precisely designed questionnaire is instrumental in ensuring the collection of reliable information (Roopa & Rani, 2012).

3.5.3 Thematic Analysis

According to Braun and Clarke (2006), "Thematic analysis is a method for identifying, analysing and reporting patterns (themes) within data.". They also state that Thematic Analysis is broadly used as a flexible qualitative method that can be used to discover a range of rich aspects of the research topic. A more systematic approach can be used, such as Framework Analysis (Stewart, 2024). However, this method assumes predefined themes, which does not support the structure of this project. Instead, the adaptable Thematic Analysis method deeply analyses the experiences.

Braun and Clarke (2006) defines six different phases of thematic analysis, which are:

1. Familiarizing yourself with your data
2. Generating initial codes
3. Searching for themes
4. Reviewing themes
5. Defining and naming themes
6. Producing the report

The first phase, *Familiarizing yourself with your data*, consists of one or several read-troughs of the data (Braun & Clarke, 2006). This should be done actively and attentively to gain a nuanced understanding and to start picking out potential codes and themes. This phase could also include transcribing the data. In the second phase, *Generating initial codes*, the researcher thoroughly examines the data, identifying any interesting features. The codes should condense the data item into its most basic representation. The third phase, *Searching for themes*, involves clustering codes that relate to each other. This results in preliminary themes that are still subject to change and reordering. The fourth phase, *Reviewing themes*, has several steps. First, the individual codes are reviewed, resulting in themes being removed, reorganised or codes being moved to different themes. This is followed by a review with the whole data set in mind. The themes and the overall thematic map should be looked at with the data set to ensure they accurately represent the data. This might result in new codes and themes being added or repurposed. In the fifth phase, *Defining and naming themes*, the themes are refined to their core meaning and given a concise name. Finally, the story of the data is told through an analytic narrative in the last phase, *Producing the report*. Examples in the form of data extracts should be used to support the themes.

4

Process

The project was structured according to the Design Thinking Process (Dam, 2023), see 3.3. However, the thesis aimed to produce knowledge about users and educational historical escape rooms instead of resulting in a design project. Thus, only the first three steps, *Empathize*, *Define*, and *Ideate*, were utilised. While designing the escape room, the Double Diamond framework was used, including continuous iterations paired with evaluations with both users and within the team (3.4). The earlier parts of the process comprised conceptual work utilising the *Discover* part of the Double Diamond process. This stage meant understanding the project's scope and narrowing it to fit the research question. The developers of the final escape room, Kistone, were frequently consulted to provide expert insights and feedback on the concept. After developing an overarching structure, the next stage consisted of designing puzzles and connecting them. In accordance with the second and third parts of the Double Diamond process, *Define* and *Develop*, the insights from the first stage were utilised to inform the ideation process and the design of the escape room. Several low-fidelity prototypes were produced to test puzzle mechanics as well as visual elements to hone in on an appropriate style. These prototypes were tested on potential users to gauge the difficulty level and general impressions. Finally, the low-fidelity prototypes that showed the most promise were refined and developed into higher-fidelity prototypes. This was performed following the fourth part of the double diamond process, *Deliver*. The final aesthetic and supplementary material was also finished to create a holistic experience. The finished escape room was then user-tested.

4.1 Planning

A time plan was put together to accomplish all the steps necessary for the project, see Figure 4.1. The aim was to conduct the Design Research phase during January and the first half of February 2024. The first two weeks would consist of a literature study, researching relevant literature, and interviewing relevant stakeholders. The remaining time would be used to apply the new knowledge to plan the study and determine the design process. Meanwhile, the writing of the appropriate parts of the thesis was planned to have begun. The iterative Research through Design phase was planned to run from the second half of February to the middle of April. The study and prototypes were planned to be iterated, constructed and conducted during this phase. Finally, the data would be analysed and evaluated, and the report finalised from the middle of April until the middle of May at the end of the thesis period. For

the construction of the escape room, the plan was to use material contributed by Kistone. This could provide an opportunity to focus on the theoretical and structural aspects of the study. However, it could also introduce a risk if the fidelity of the material were too low or if the material could not be provided on time. The plan was mostly followed, with some study dates being pushed back due to Easter.

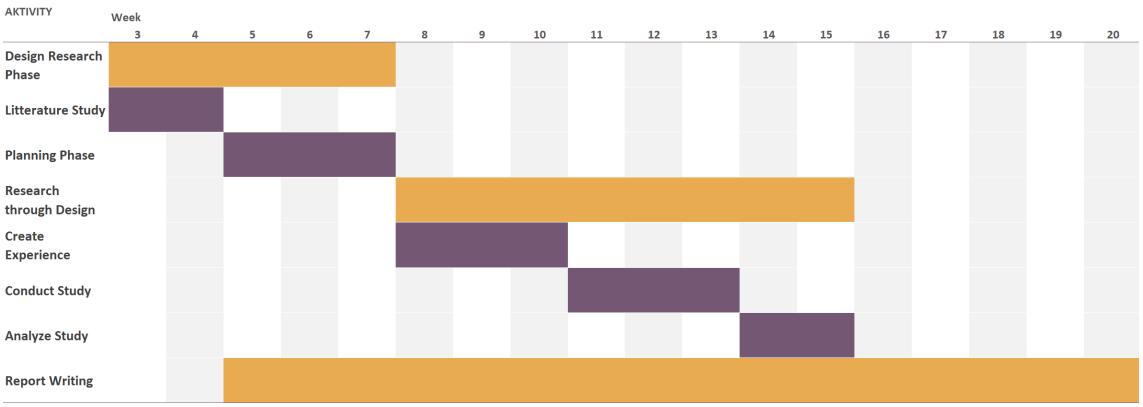

Figure 4.1: Project Time Plan.

4.2 Research phase

The first step of the Design Thinking process is *Empathize*, where the researcher aims to gain knowledge about the users and the problems that they face. This step started in the research phase with a literature study and stakeholder interviews.

4.2.1 Literature study

The first step to gaining a deep understanding of the users and the problem space was to conduct a literature study. During this time, a corpus was gathered with articles covering relevant research fields. The literature pertaining design methodology informed the decision to adopt a Research through Design approach since it was suitable for generating new knowledge instead of a complete design concept. Additionally, the Design Thinking methodology determined the structure of the progress, dividing it into the phases mentioned above. The theory and methodology of Experiential Learning helped build a theoretical groundwork while reinforcing the usability of experience-based learning outside the classroom. Further research into pedagogy highlighted the importance of debriefing and inquiry, which supported the analysis of the results. Additionally, the requirement for supportive scaffolding became apparent and implemented as a factor. Finally, the research on escape rooms and Storytelling provided necessary guidance in designing the escape room used in the study. It also became evident that there was a lack of research on commercial educational escape rooms focusing on historical learning. However, commercial and educational escape rooms have been studied separately, giving some insight into what factors and difficulties could be studied.

4.2.2 Interviews with Stakeholders

As part of the *Empathize* phase, an interview with Kistone was conducted. The interview provided information regarding their previous exhibitions, which could be applied to this project. The goals and guidelines for the escape room at Karlsborg Fortress were also discussed. They aimed to create an escape room for up to twelve people of all ages. However, this was scaled down in the study for practical purposes. That said, group size remained a factor to be tested. Kistone strongly emphasised the historical perspective and that their story was grounded in the location's history. This aspect was later reflected in questions asked during the interview. They also expressed interest in exploring different scaffolding and linearity systems since they want all users to experience the whole story. Finally, digital material and puzzle designs were shared, which were later used in the project.

This was followed by a visit to Karlsborg Fortress, where the location of the planned escape room was shown, and a deeper understanding of the concept could be acquired. The limitations and the goals of the project were also further established. Visit Karlsborg explained their aim to broaden the range of tourist attractions in Karlsborg while also serving as an educational environment.

4.3 Factors

Before the study was developed, an investigation was conducted to determine suitable factors to test in the escape room. Through the investigation, it was concluded that some factors fit the project better than others. The factors to be applied were based on the previous literature study in combination with input from Kistone. Bringing insights from both the academic groundwork that had been done and Kistone's requested areas provided us with the opportunity to aim for a result that could both be used for a general educational escape room as well as providing highly valuable data to Kistone and their current endeavour at Karlsborg Fortress. The second phase of choosing factors was to see which factors were viable for testing in the project and how. The factors that were to be chosen needed to be applicable in all types of groups and also to be easily altered to test differently on different groups. The chosen factors are explained in the following sections.

4.3.1 Intensity

The intensity of the experience was divided into high and low intensity and was altered through three different implementations. The first implementation was the background music, where the low-intensity factor was achieved by a calm soundtrack in contrast to the high-intensity variant with high-octane music at a higher volume. The high-intensity variant also included an air raid alarm. In the introduction, the participants were informed that at the sound of the alarm, they had to get as close to the ground as possible until it was over. The air raid alarm sounded two times during the experience, once in the beginning after five minutes and once in the end two minutes after the last puzzle was started. The final implementation featured a siren light that increased the intensity visually.

4.3.2 Familiarity

The familiarity factor points to whether the participants knew each other beforehand or not. The groups were either classified as unfamiliar or familiar. For a group to be classified as familiar, the whole group had to be familiar beforehand. This means that if a group of four consisted of two pairs of familiar participants, it was still classified as unfamiliar if the pairs were unfamiliar. This resulted in the unfamiliar groups consisting of participants who did not know anyone before the experience and a mix of familiar and unfamiliar people.

4.3.3 Guidance

A common theme between the literature and Kistone was the implementation of guidance. Guidance can be crucial in creating the right conditions for learning and acting as a scaffolding for the experience. Kistone also saw it as a challenge since they wanted to convey a complete story to every participant, regardless of how well they did on the puzzles. Therefore, a form of guidance called forced progression was implemented. This meant that if a group did not finish a puzzle in the set time, they would hear an announcement declaring that they had failed but an alternative solution had been found, and they could move on to the next puzzle. This factor could thus only be tested on groups that did not finish a puzzle in time. The time limits were set to six minutes for the first puzzle and seven for the second and third.

4.3.4 Group Size

The final predetermined factor tested was group size. The different groups were divided into three, four or five participants. Just as intensity and familiarity, group size was determined before the escape room started in the study's planning phase. The group sizes in the escape room at Karlsborg Fortress are planned to be over ten people, but since this is a scaled-down version (in terms of room size, time, and complexity), the smaller groups tested were deemed appropriate. The difference in group size between the groups was argued to still be substantial enough to show any potential effects.

4.4 Creation of the Escape Room

After the key factors had been decided upon, the design process for creating the escape room was initiated. The development followed an iterative process based on the Double Diamond model. During the process, parameters from stakeholders, the literature study, and the key factors informed the focus of the first diamond. Different design solutions to puzzles were tested during the second diamond, and established escape room knowledge was used as inspiration. This resulted in a finished escape room adhering to the guidelines given by stakeholders, with the possibility of testing the identified key factors.

4.4.1 Discover

The previous literature and stakeholder research was utilised in brainstorming to achieve a clearer picture of the problem space. The research on escape rooms, Storytelling, and Experiential Learning resulted in potential technical tools and insight into parameters that could affect the conditions for learning. The resources and knowledge from stakeholders provided guidance towards established practices, graphic material for clues, and ideas for puzzles to implement. To come up with puzzles that would fit the escape room, the initial inspiration was Kistone's escape room, which was during development. Finally, the potential key factors framed the ideation and created a lens through which the other information was viewed. This resulted in several clusters of notes used in the next stage.

4.4.2 Define

During this stage, the insights gained from the *Discover* stage were used to define the challenges and parameters the escape room had to act within. To be able to ideate and create the escape room while still evaluating and analysing the factors used within the escape room in the set time frame, an experience of 20 minutes was decided upon. Within the time frame, three different puzzles were to be implemented. From here, puzzles were identified with several criteria in mind. The puzzles needed to be simple enough for us to design within a shorter time frame, they needed to be similar to the puzzles that were common in traditional escape rooms, and they also needed to fit into the shortened experience and its storytelling. Three puzzles were chosen from Kistone AB's planned escape room. The three puzzles did, however, still need to be altered to fit in with the defined prerequisites.

4.4.3 Develop

Once the foundation had been set and the goal had been made clear, the different parts of the escape room got broken up and focused on individually. The parts were each individual puzzle, the story and environmental assets. Several prototypes were produced for the different puzzles to evaluate mechanics and the complete puzzles. The story emerged from the selected puzzles since Kistone had provided an early script draft with puzzles connected to different parts of the story. This was, however, slightly rewritten to fit into a shorter time frame with fewer puzzles. The script was then recorded by the designers in a podcast studio and edited into separate voice lines that could be played at specified intervals. A computer program, shown in Figure 4.2, was developed in Python to allow easy control over the sounds played and switching between high and low intensity. Finally, several environmental assets were designed to fit the puzzles and the story.

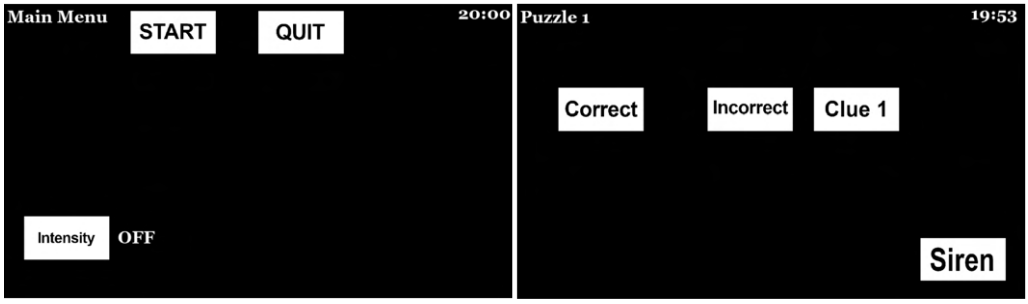

Figure 4.2: Program to Control the Escape Room.

4.4.4 Deliver

During this stage, the different prototypes were evaluated by both users and the team to determine which would work best. This process involved moving from lower fidelity prototypes of isolated game mechanics to a complete higher fidelity escape room. This iterative process required several ideas to be reworked or redone. Initially, a low-fidelity version of the puzzles was tested with the help of the project supervisor, which led to the identification of several areas of improvement. A pilot study was also performed on a group (n=4) to get more concrete feedback, which led to minor changes implemented before performing the study on the rest of the participants.

4.4.5 Iterate

With the insights from the designer's conclusions in combination with comments from the low-fidelity tests and the feedback from the pilot study, several changes and iterations were made to both the puzzles and the experience. The changes were made in two ways: alterations or additions to existing solutions or new concepts weighed against the current solution. The process took the shape of an iterative loop where the new information, in combination with earlier insights from the *Discover*, *Define*, *Develop*, and *Deliver* stages, played a significant role.

The first puzzle, the Morse Code Puzzle, had an audio file that played the word "Petsamo" in Morse code. The participant's task was to decipher the Morse code. From the initial testing, it was pointed out that it was far too hard to decipher the Morse code within six minutes. A sound of a cassette tape being removed and a rewind sound was incorporated into the audio file to indicate when the sound replayed. However, the participants still needed help understanding where the Morse code started. The solution was to slow down the speed of the Morse code and add a silent part at the start of the audio file. This proved to have a positive effect, but the difficulty level for the set time frame was still too high. Another iteration was made where a more extended silence was added between the letters, and the silent part at the beginning was extended. Figure 4.3 shows a visual representation of the iterations.

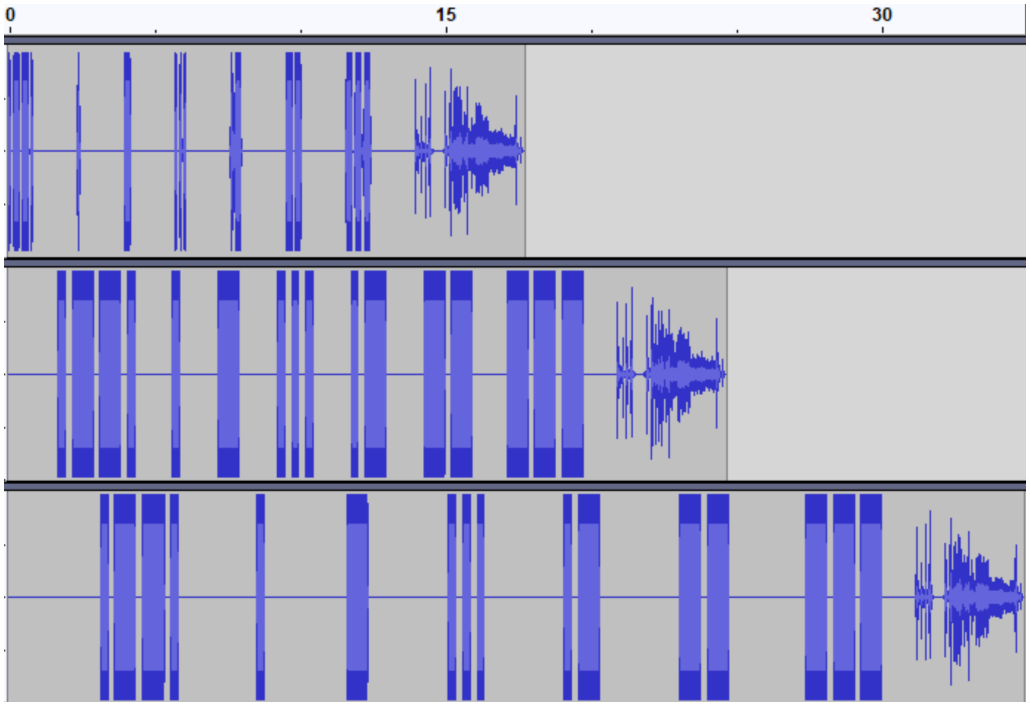

Figure 4.3: Morse Code Iterations.

One part of the second puzzle was deciphering in which order five different military divisions were mentioned in a telegram. The military divisions were *Gothenburg Garrison*, *Air Corps*, *Army Corps*, *Marine Corps* and *Electronic Corps*. The Train Puzzle was designed to be the most challenging puzzle, but after initial testing, it proved too hard since the telegram was not legible and explicit enough. The problem was that the text and information in the telegram were not distinguishable enough, leading to the attention of the participants not being drawn to it. The font was made more prominent and bolder to draw more attention to the telegram. The testing also highlighted that seeing a particular order of the military divisions in the telegram was difficult. The solution to make the order more obvious was to divide the different military divisions so that each had its own sentence. A comparison between the initial telegram and the updated one can be seen in figure 4.4. The telegram was also placed on top of the other puzzle props to draw the participant's attention further.

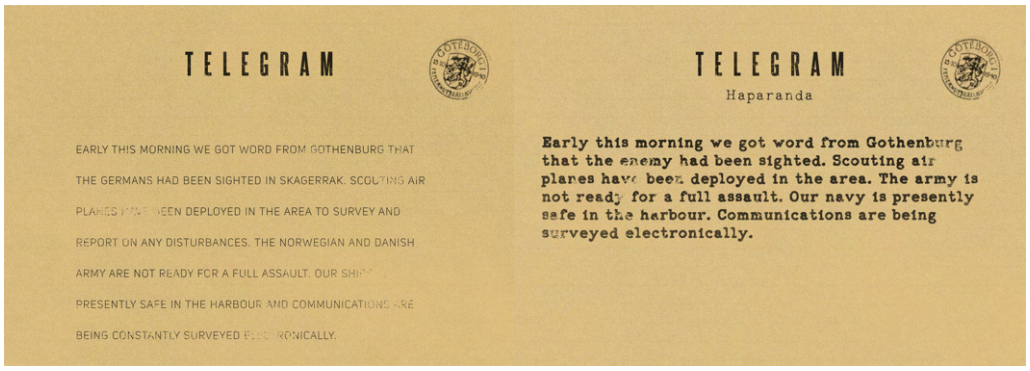

Figure 4.4: Telegram Iterations.

For the third puzzle, the Mafia Puzzle, the participants were to make connections between mugshots of mafia members and criminal records. This puzzle proved to work as intended except for one clue that read *"Don't let the young age fool you, this killer can jive with the best of them."*. Here, the intention was for the participants to make the connection that this was the youngest mafia member. Still, the participants understood it as to be one of the younger mafia members. To make the intention of the information more obvious, the sentence was changed to *"Don't let the* ***youngest one*** *fool you, this killer can jive with the best of them."*. The final version of the altered criminal record can be seen in Figure 4.5.

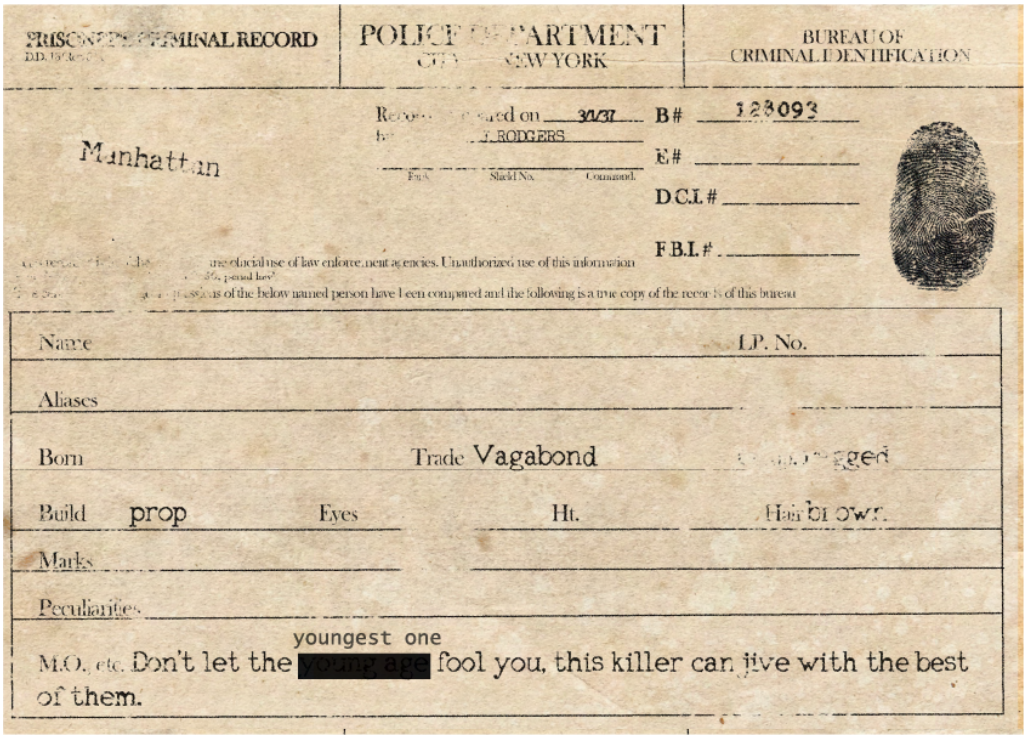

Figure 4.5: Criminal Record Manhattan.

The participants were given a telephone switchboard to keep track of the mafia members and their corresponding districts, which can be seen in Figure 4.6. Initially, during the planning phase, the telephone switchboard was planned to be of a higher fidelity. The planned version was to use sensors in the outlets of the telephone switchboard to sense whether the participants had placed the "knobs" in the correct position. In the *Develop* stage of the process, however, it became clear that it would not be possible to build and program the needed components to make the concept viable in the given time frame. Instead a purely physical telephone switchboard was made that was intended to be a representation of a telephone switchboard.

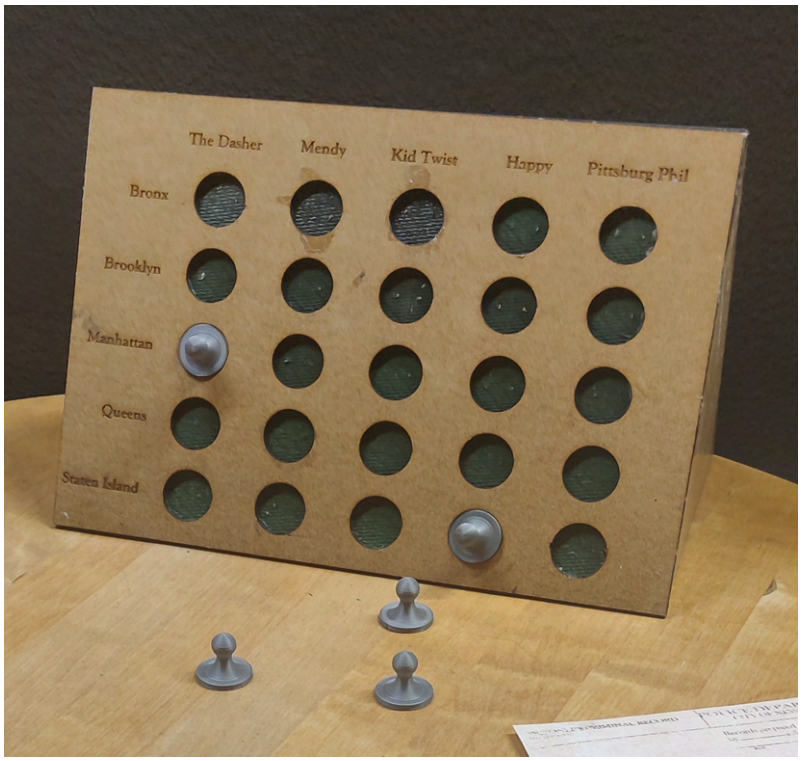

Figure 4.6: Telephone Switchboard.

The escape room experience consisted of three puzzles, so the participants had to deliver three answers. The participants were informed during the initial briefing that the answers were to be delivered using a phone placed in the room, which can be seen in Figure 4.7. During the pilot study, a sense of confusion emerged among the participants who had forgotten how the answers should be delivered. This resulted in a change in the introduction and briefing, where the emphasis on how to deliver the answers was greater.

Figure 4.7: Telephone.

4.5 Escape Room Study

A shorter escape room experience was designed to understand better how different factors affect the experience within an educational escape room with a historical focus. The experience was highly inspired by the escape room being developed by Kistone at Karlsborg Fortress, but instead of the intended hour-long experience, a shortened version that lasted 20 minutes was designed.

4.5.1 Recruitment

The participants were recruited using convenience sampling. This was used to gauge potential users in an efficient manner. The participants were all students from different programs at the Chalmers University of Technology and the University of Gothenburg. This was deemed a suitable target group for this study since the stakeholders had identified students as one of their target audiences. Additionally, the number of participants was expected to be fairly low, and a narrower target group could lower the variation of participants. Additionally, a homogeneous target group puts a stronger emphasis on the effects of the key factors rather than a variety in the target group's preferences. The study was marketed through a poster, which can be seen in Figure 4.8. Participants could sign up through an online form, and they were assigned groups depending on their availability.

Figure 4.8: Recruitment Poster.

4.5.2 Creation of Groups

The groups were assigned factors beforehand to ensure a variety of combinations of factors. To keep track of what factors were used on which group while at the same time keeping them anonymous, the groups were named after their factors. The naming depended on whether the group had *High* or *Low* intensity (H/L), if the other participants were *Known* or *Unknown* (K/U), if the group *Finished* or did *Not Finish* (F/N) the majority of the puzzles, and how big the *Group Size* was (3/4/5). With the 45 participants, eleven groups were put together with the following combination of factors:

- 2x HKF4
- 2x HKF5
- HKN3
- HKN4
- HUF5
- LKF3
- LUN3
- LUN5
- LUF4

The factors assigned to which groups were initially decided by when the participants were able to participate and later on by which factors needed more test samples. This allowed the study to get a larger quantity of participants initially and later fill in the gaps of lesser-used factors.

4.5.3 Collecting Data

The sound was recorded during the group interviews after the escape room experience and later transcribed into text form. The participants were anonymous and had aliases, but their group affiliation was kept. All groups were filmed during the escape room, and the video was saved and used for complimentary analysis. Finally, the data from the surveys were in the form of ratings on a ten-degree scale, which were saved and then made anonymous except for the group affiliation.

4.6 Analysis

The observations and data collected from the user studies were analysed from a user experience perspective. The majority of the analysis was conducted qualitatively with Thematic Analysis to achieve phenomenological discoveries, see 3.5.3. The aim was to discern what factors impact the experience, whether there are any interactions between factors, and whether any complimentary guidelines could be deduced. The survey was summarised and analysed for any discernible patterns.

4.6.1 Thematic Analysis

The qualitative analysis was conducted using the Thematic Analysis method. The steps included are described chronologically, but some were revisited during the process to expand certain themes and clarify key factors.

Familiarizing with the Data

The first step was to transcribe the audio recordings from the group interviews. This was accomplished using transcription software, which produced a first draft. This was then reviewed to check the validity of the transcription and gain a deeper understanding of the data. The text files were then further cleaned up for easier coding. Finally, the transcripts were read thoroughly to build an apprehension of the interviews and recognise potential codes and themes.

Generating Codes

This step involved systematically reviewing each interview transcript and identifying interesting features related to the key features and complementary insights. These features were then coded concisely to represent the core of the statement. Finally, the codes were transferred from the transcripts to digital Post-it notes.

Searching for Themes

Once all of the features had been coded, they were sorted based on their relevancy to each other. From this preliminary sorting, themes were created. Several themes were changed during the process, and codes were rearranged multiple times.

Reviewing the Themes

The first step in reviewing the themes was examining each individual code to determine its relevancy in its respective theme. Then, the themes were approached holistically, evaluating whether the thematic map and the individual themes reflected the complete data set. These two steps resulted in further reorganisation and some themes' removal (and creation).

Defining and Naming the Themes

The next step involved crystallising what each theme was saying. The process consisted of finding the most common thread among the codes while not removing the nuance of the differing opinions. Based on this, they were also named.

Producing the Report

Finally, the refined themes were analysed in terms of the research question to convey the data's message appropriately. It also became apparent that some themes worked in conjunction, which informed the structure of the analysis. Data extracts were also selected to exemplify the narrative of the analysis.

4.6.2 Survey

After each group had finished the escape room experience, a survey was sent out, and the participants were asked to answer nine questions. The questions were:

- Have you been to an escape room before? *(No, Once or twice, Yes more than three times, Yes more than eight times)*
- How difficult did you think the Escape Room was? *(1-10)*
- How intense did you think the Escape Room was? *(1-10)*
- How fun did you think the Escape Room was? *(1-10)*
- How much did you contribute to the solutions? *(1-10)*
- How comfortable did you feel contributing? *(1-10)*
- How engaged were you by the story? *(1-10)*
- What amount of participants do you think would have been most suitable for this experience? *(1-8)*
- Do you consent that your data is being stored in accordance with GDPR? *(I consent)*

The questions were formulated to be anonymous and part of a quantitative evaluation. However, the answers were categorised by the factors applied to the participants during the experience. This was done to compare the different experiences and to see if and how the factor's effects differed. A total of 44 surveys were submitted, resulting in a response rate of 97.8%.

When the answers were collected, several graphs were made to compare the factors' effects on the experience. Examples of graphs are high and low intensity, familiar and unfamiliar groups and different group sizes. Later, the groups were also compared against each other with the different questions in mind, resulting in an overview of outliers within the different questions. The results from the quantitative evaluation and its analysis were mainly used to strengthen the insights from the qualitative evaluation. However, some conclusions could be drawn from the quantitative evaluation as well.

4.7 Conclusion

The analysis resulted in conclusions in two categories: *Key Factors* and *Other Guidelines*. A factor was considered a key factor if a clear thematic pattern was associated with the factor. This means that if groups with one level of a factor, e.g. high intensity, expressed similar qualitative opinions while the other level did not, it was deemed to play a key role. Several thematic differences between levels of a factor were interpreted as a stronger indication of a key factor.

The general guidelines were deduced by extracting themes where a majority of the groups expressed an opinion or experience with no discernible pattern regarding their factors. Additionally, some interesting thoughts expressed by the participants did not relate to the research question for this thesis. However, they could still be helpful and informative when designing experiential learning experiences and were thus documented and presented.

5

Results

This chapter contains the design of the finished escape room (see Section 5.1), the identified key factors (see Section 5.2), the results from the Thematic Analysis (see Section 5.3), further observations from the video material (see Section 5.4), the results from the survey (see Section 5.5), implications of the results (see Section 5.6), and general guidelines (see Section 5.7). The thematic analysis presents the themes that emerged from the group interviews and the key factor's effect on the participant's experience. The video observations give further context to the participants' perspectives while also showcasing patterns in behaviour. Finally, the survey shows differences and similarities between the groups on several parameters, e.g. intensity and difficulty.

5.1 The Escape Room Experience

Below is an outline of the setup and flow of the escape room experience in which the study occurred. The puzzles are described, and the intentions behind the experience are explained. Furthermore, the storytelling and guidance principles, in combination with the desired atmosphere, are presented. To see all the material used in the escape room see Appendix A.

Introduction
The participants gathered close to the escape room's location. They were then guided to a table where they signed a consent form and got a brief explanation of what they would do and how long it was expected to take.

Briefing
After the introduction, the participants were told to stand outside the escape room. Here, the experience begun, indicated by a voice line by a narrator explaining the story, the setting, and the first objective. The participants were then let into the room, and the time started.

The puzzles
The experience was divided into three puzzles: a Morse Code Puzzle, a Train Puzzle, and a New York Mafia Puzzle. The puzzles were designed to differ from each other in both difficulty and interaction. They are closely connected to the story, aiming to create a more immersive experience. Figure 5.1 shows the floor plan with the

different puzzle components.

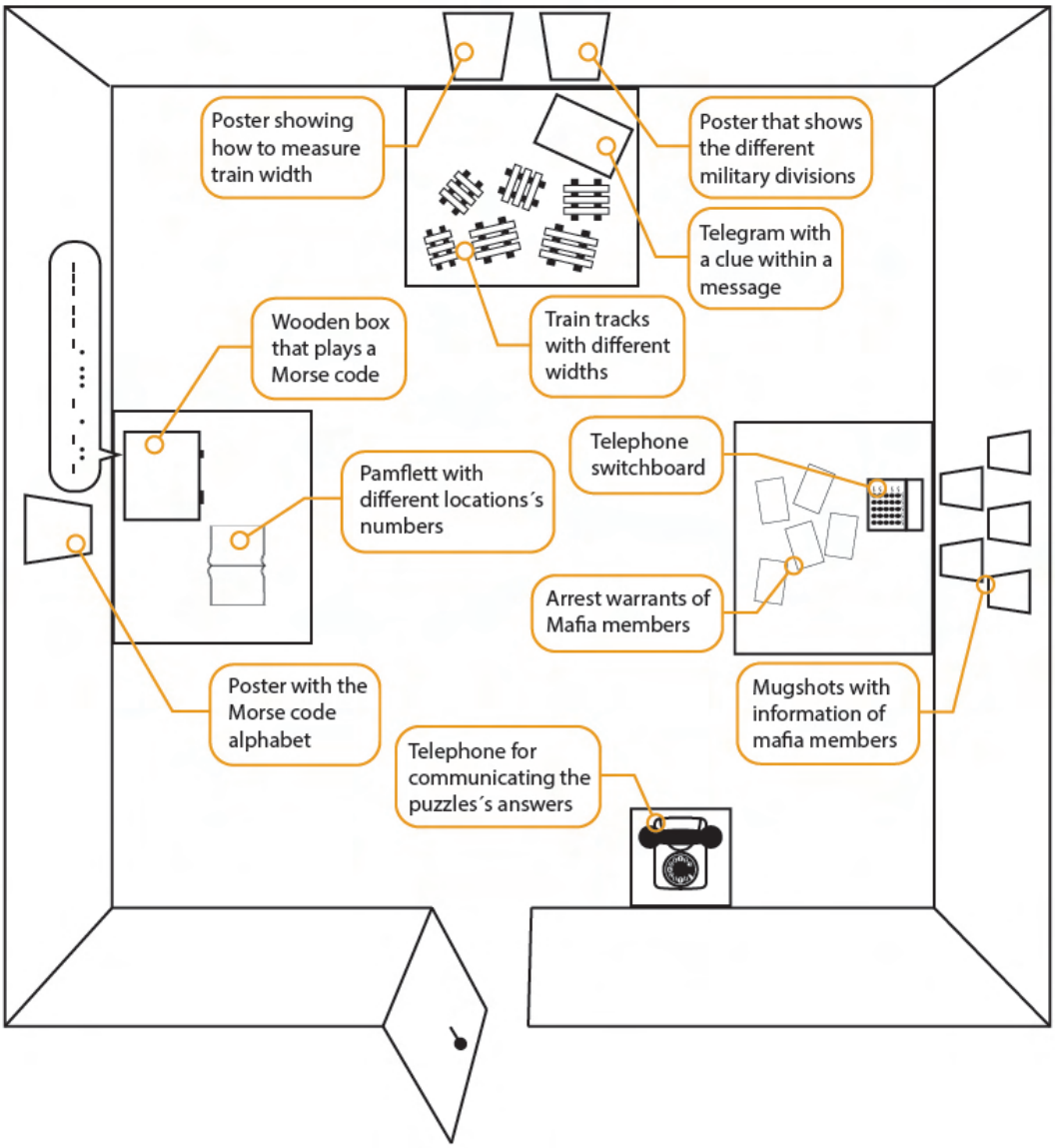

Figure 5.1: Floor plan of the escape room.

The first puzzle, the Morse Code Puzzle, was the easiest to get the group of participants to participate immediately. The puzzle consisted of a speaker disguised as an old wooden machine, a booklet of train stations, a poster of the Morse alphabet, a notepad, and a pen, as seen in Figure 5.2.

Figure 5.2: Puzzle 1, The Morse Code Puzzle.

The puzzle started immediately when the participants entered the escape room through the sound of the Morse code coming from the wooden box on a table. In front of the box were a notepad and a pen so the participants could write down the Morse code. To help translate the Morse code, the participants had a Morse code alphabet on a poster on the wall behind the puzzle. Besides the notepad, a booklet containing different train stations and their corresponding station number was located on the table. Of these stations, one matched the Morse code message, and when the corresponding station number was found, it was to be delivered by contacting the researchers by the phone in the room.

The second puzzle, which is called the Train Puzzle, was the most complicated. It consisted of six tracks, five jigsaw puzzle pieces, a poster with military divisions, a poster with instructions on how to measure track width, a telegram, and a ruler, as can be seen in Figure 5.3.

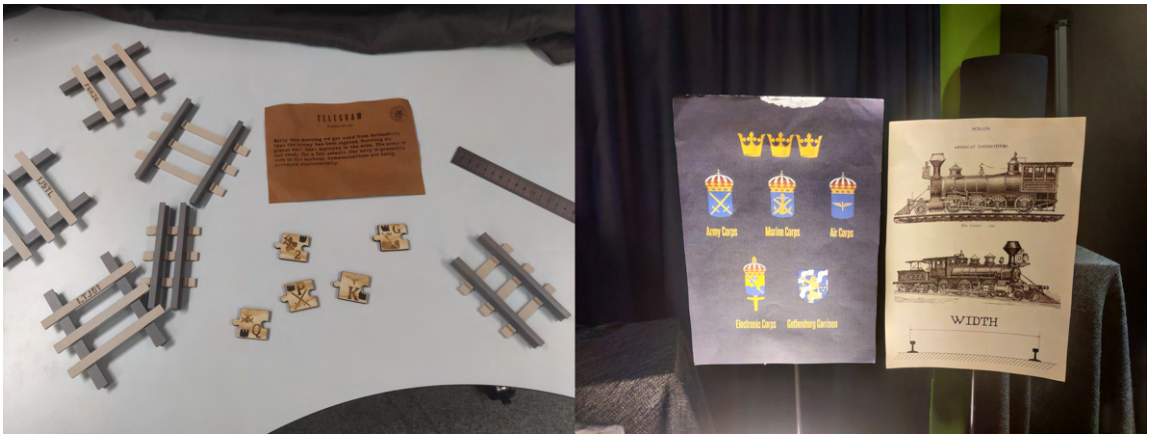

Figure 5.3: Puzzle 2, The Train Puzzle.

The goal was to figure out the correct difference in track width by solving a jigsaw puzzle. Here, the participants were presented with six different train tracks of varying width and different combinations of letters and numbers marked on them. To find out which tracks to compare, the participants had to decipher a telegram that was located on the table. The telegram contained five sentences, each mentioning a military division, and the order in which they were mentioned was the correct order. Beside the tracks, five jigsaw pieces with the same shape but different markings were placed. Each jigsaw puzzle piece had a military division marked on both sides, which was the same, and a number or a letter on each side, which was not the same. A black crown was marked on one side of the jigsaw pieces to show which side was up. When the jigsaw pieces had been placed in the correct order and with the right side up, a combination of letters and numbers could be identified on each side of the pieces. To help the participants identify which marking corresponds to which military division, a poster was placed on the wall in front of the puzzle showing the different military divisions and their names. Next to the military poster, a poster showing where to measure the tracks was placed, but in reality, the tracks could be measured in many ways as the difference remains the same. When the correct tracks had been identified, measured and compared, the width difference was delivered by contacting us through the phone. Figure 5.4 shows the whole flow for solving the puzzle.

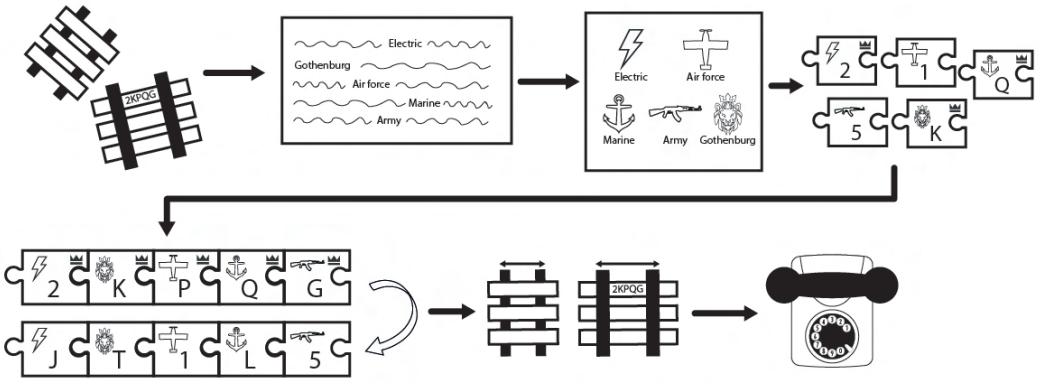

Figure 5.4: Flow of the Train Puzzle.

The third and final puzzle, which we called the Mafia Puzzle, was between the two other puzzles in difficulty. It consisted of five mugshots, five criminal records, and a telephone switchboard, as shown in Figure 5.5.

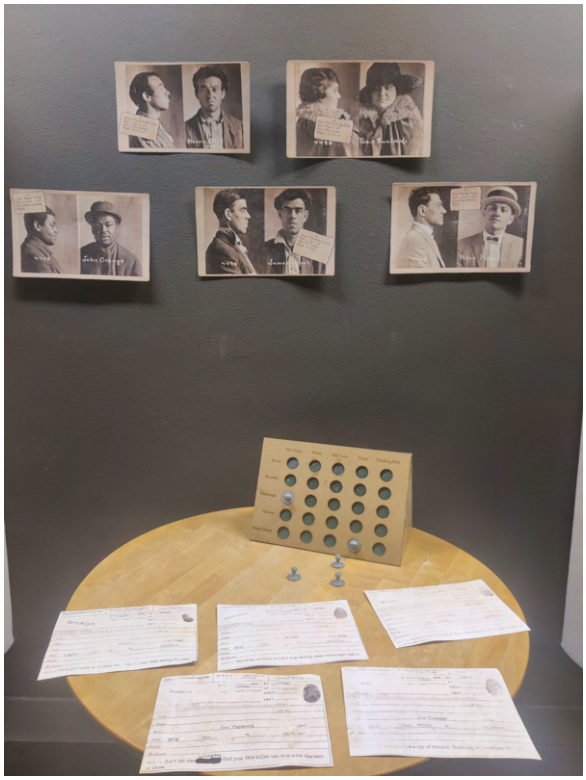

Figure 5.5: Puzzle 3, The Mafia Puzzle.

The objective of the third and final puzzle was to connect the correct mafia member to the correct district on the telephone switchboard. On the table, the participants were presented with five criminal records, one for each mafia member. The criminal records had information about the mafia members, for example, "This one could not stop smiling", what district it was connected to and some other general information to fill out the space and make the relevant information less obvious. The name was, however, not written on the criminal record. Information such as name, alias and height was written on the mugshots of each mafia member. For example, the name John "Happy" Orange. The participants were asked to find connections between the mugshots and the criminal records. Some criminal records fit more than one mafia member, so the participants had to find some mafia members before others to rule them out. When all mafia members had been connected to the correct district the participants delivered the solution through the phone.

When the third puzzle was completed, the escape room ended. The participants were then led out of the room to a table nearby, where they were asked to sit down. Here, the participants were offered buns, candy and soft drinks. After a small chat about how to solve any eventual puzzles that the group did not solve, a group interview was initiated. We acted as mediators while following a script consisting of questions with room to probe further or to talk about what the participants brought up, making it

a semi-constructed interview. The questions touched upon the general experience as well as more detailed questions about, e.g. collaboration and intensity.

Story
Throughout the experience, the voice of a narrator named Captain Prytz was played to act as a medium to tell the story, progress the experience and provide hints. During the briefing, the participants were informed that they were in a command centre during the early stages of World War II. The narrator explained that the pressure from Germany had risen and that Sweden's gold reserve was being transported from Karlsborg Fortress to Fort Knox in the United States of America. The narrator then proceeded to inform the group that the situation in Norway and Denmark was too volatile and that the gold needed to be transported by train on a different route. If the group were assigned the high-intensity factor, the narrator also explained that air raids could sound during the experience and that the participants, in that case, needed to get as close to the ground as possible. The first task was then presented by the narrator, who informed the group that the train conductor in the city of Skövde needed to be informed of the next location and its location code. The experience then begins with a Morse code that starts playing.

When the answer to the first puzzle has been provided or the time has run out, the Finnish voice of a train operator from the city of Haparanda starts playing. The voice explains that there is a problem with the difference in the width of the Swedish and Finnish train tracks. The voice tells the participants that they need the difference in track width to proceed with the transportation of the gold.

After the width difference has been communicated or the time has run out, Captain Prytz is once again back, explaining that the gold is now to be shipped by boat to the harbour in New York City. The narrator then proceeds to explain that there is an ongoing war within the Mafia families in New York City. To secure safe passage, the participants need to connect informants from the Mafia families to the correct districts of New York City.

When the participants have provided the correct information or the time has run out, Captain Prytz returns with a final message. He congratulates the participants on transporting all or some of the gold, depending on how well they solved the puzzles. Then, the experience is concluded.

Hints
Throughout the experience, Captain Prytz also offered hints in the form of voice messages. Each puzzle had a set time limit. The first puzzle had a limit of six minutes, while the second and third puzzles had a time limit of seven minutes, adding up to 20 minutes for the experience. Each puzzle had two hints played after two and four minutes. These hints were formulated in a way that connected to the story while giving hints to the participants, allowing them to progress if they got stuck. If the participants could not complete the puzzle during the set time frame, Captain Prytz informed them that they had lost a bit of the gold but not to worry as the journey went on.

5.2 Key Factors

		Factors		
		Intensity	**Familiarity**	**Group Size**
Area of Effect	**Division**		Familiar groups divided less	Smaller groups divided less
	Inactivity			Larger groups was more inactive
	Linearity			Smaller groups appreciated linearity
	Desired Intensity		Unfamiliar groups expressed an extra level of desire for higher intensity	
	Attitude towards Difficulty		Familiar groups expressed a more positive attitude towards a higher difficulty	
	Roles		Familiar groups had more defined roles	
	Collaboration	Low intensity groups felt more comfortable contributing	Unfamiliar groups were hesitant for longer	Smaller groups were more comfortable contributing
	Communication	High intensity groups have a higher intensity communication	Unfamiliar groups were more formal	
	Experienced Intensity		Unknown groups experienced less intensity	Smaller groups experienced less intensity
	Experienced Difficulty	Low intensity groups experienced less difficulty		
	Enjoyment	High intensity groups had more fun		

Table 5.1: Matrix of key factor effects.

As shown in Table 5.1, three factors resulted in thematic effects.

The key factor Intensity affected **Collaboration**, **Communication**, **Experienced Intensity**, and **Enjoyment**.

The groups with a low-intensity experience felt more comfortable contributing than those with a high-intensity experience. They also experienced the escape room as less difficult. The high-intensity groups experienced a higher degree of enjoyment. Finally, the tone of the communication followed the key factor intensity, i.e., high-intensity groups had high-intensity communication, and low-intensity groups had low-intensity communication.

The key factor Familiarity affected **Division**, **Desired Intensity**, **Attitude towards Difficulty**, **Roles**, **Collaboration**, **Communication**, and **Experienced Intensity**.

The desire for a higher-intensity experience was more prevalent in the groups who were unfamiliar with each other. They also experienced the escape room as less intense than those who were familiar with each other. Additionally, unfamiliar groups

displayed hesitance in the escape room and communicated more formally. Familiar groups were more positive towards a higher difficulty. Furthermore, they displayed more well-defined roles than the unfamiliar groups.

The key factor Group size affected **Division**, **Engagement**, **Linearity**, **Collaboration**, and **Experienced Intensity**.

Participants in the larger groups experienced more inactivity than those in the smaller groups. The smaller groups appreciated the linearity of the experience more. They also experienced the escape room as less intense. Finally, the smaller groups were more comfortable contributing.

The fourth key factor, Guidance, was excluded due to the nature of its implementation. Forced progression was not applied randomly across groups; instead, it was implemented in all groups, but only those who failed a puzzle experienced it. Thus, conclusions could not be drawn about whether this form of guidance had an effect or if the act of failing led to qualitative differences. Nevertheless, some analysis could still be done on the opinion on this form of guidance.

5.3 Thematic Analysis

45 students participated in the qualitative evaluation. They were divided into eleven groups with different combinations of the key factors. Each group could have a variation of four different factors: low or high intensity, familiar or unfamiliar group, forced or not forced progression and finally, group size, which ranged from three to five participants. After a group had completed the escape room, a group interview was conducted. The interviews were then transcribed, and then initial codes were generated. Then, the codes were sorted into themes, followed by a refinement of the themes. A thematic analysis was performed to gather insights. Video material from the escape room experiences supported the thematic analysis. For more information and material from the analysis see Appendix B.

5.3.1 Group Dynamics

In the following sections, themes concerning group dynamics will be presented. Group dynamics is further divided into the themes **Group Size**, **Division**, **Inclusion and Engagement**, and **Familiarity**. The key factors of **Group Size** and **Familiarity** had the biggest impact on group dynamics and are both represented as a separate theme where opinions regarding these key factors are presented.

Group Size

All groups except one preferred a group size of three. A larger group size (four and five) resulted in a perceived good exchange of ideas and the possibility of doing different tasks simultaneously.

> "The group size was good. We could exchange ideas and cooperate."

However, it also resulted in a perceived difficulty when focusing on the puzzles and communicating.

> "With many people, there are too many thoughts at the same time. It makes it hard to immerse yourself in the puzzle."

Division

The key factor of familiarity caused differences in division, where unfamiliar groups divided more.

> "We divided naturally and just went for it."

The key factor of group size caused differences in division, where larger groups divided more.

> "When it got crowded on one puzzle, I moved to another one."

There was no discernible pattern in opinions on division concerning the factors. The overall attitude towards division was slightly positive, while some expressed a negative attitude because they wanted to follow the whole process.

Inclusion and Engagement

The key factor of group size caused a difference in the number of negative experiences of not having anything to do, where the larger groups had more negative accounts.

> "Being five meant that someone was always a bit on the outside and could not participate."

The other key factors did not impact this, and all groups expressed that they had the most fun collaborating and working well together.

Familiarity

Most unfamiliar groups expressed that the key factor of familiarity did not impact their experience. At the same time, a few said they felt slightly hesitant to speak their mind or ask for help.

> "If we knew each other I might have dared to ask for more help or speak my mind."

Some participants saw an advantage in being unknown since they could focus on the task. The familiar groups said that they felt comfortable in the group.

> "Maybe being unfamiliar led to a better collaboration. Because we didn't like, talk about other stuff. We were very focused on just solving the tasks."

5.3.2 Guidance

Independent of the key factors, there was a strong negative opinion of the implemented form of guidance, which was forced progression. The groups that experienced forced progression had negative emotions associated with failing when they had nearly solved a puzzle.

> "It felt bad when the voice gave the solution when you felt you had solved it to 95%."

The key factor of group size affected the appreciation for the linearity of the experience; the smaller groups enjoyed it while the larger groups did not. The groups that did not experience forced progression still had negative emotions similar to those of the forced progression group. However, these emotions were instead directed at clues presented at a bad time. The groups that did not experience forced progression had an overall more positive attitude towards the linearity of the escape room.

> "We got lost in the beginning and then it was good to have a guiding voice and it got easier when we realised that it was one table at the time."

5.3.3 Intensity

The groups with high intensity appreciated the level of intensity, and the groups with low intensity wanted a higher level of intensity.

> "The intensity was fun, everyone was hyped and on their toes."

> "I didn't feel that much pressure. Because of the theme it would have been fun to feel more stressed."

The key factor of unfamiliar groups and no forced progression caused a higher desire for high intensity.

> "It would have been fun to experience more intensity even if it would have gone worse."

5.3.4 Difficulty

The key factor of familiar groups and forced progression caused a more positive attitude towards high difficulty.

> "I thought it was nice that it was so difficult."

The groups that experienced forced progression had a higher number of opinions regarding the difficulty level.

5.3.5 Storytelling

There was no single key factor that affected the experience of the story and the ability to comprehend it. Participants had an overall positive impression of the story with a few negative opinions. Some groups remarked on the fact that they lost the story at times due to all the information presented.

> "I lost the story a bit. I knew the premise of it but it was so much new information and I didn't hear all of it. I picked up what to do in the puzzles but didn't really follow the whole story of the money. That said it was a fun story."

Several groups appreciated the experiential nature of the learning experience and felt motivated to learn more afterwards.

> "Good educational practice to learn by experiencing."

> "For educational purposes, it's important with debriefing."

5.4 Video Observations

The following sections will present complementary observations from the video footage. This analysis also included finding instances that corroborated or conflicted with the experiences expressed in the interviews. Those instances are not presented in this section but were rather used as a complement in the previous thematic analysis.

5.4.1 Roles

Depending on the key factors, there were some discernible differences in the approach to roles in the different groups. The familiar groups had a leader figure more often than the unfamiliar groups. They also had defined roles more often. Additionally, the low-intensity groups mixed who was most active more frequently than the high-intensity groups.

5.4.2 Collaboration

All groups started off a bit hesitant, but they became more vocal and assertive as time went on. However, this hesitance was a bit stronger in unfamiliar groups and held on for a bit longer in general.

5.4.3 Communication

Communication between the different groups varied. The unfamiliar groups were a bit more polite, while the familiar groups were more direct and effective. However, the familiar groups also had a more sociable tone, sometimes joking around, thus distracting from the puzzles at hand. The intensity also impacted the communication, where groups mirrored the high or low intensity.

5.4.4 Storytelling

Independent of key factors, the groups gather together when information is being played. However, they pay less attention and focus on the puzzles later in the experience, leading to some groups missing information.

5.5 Survey

The survey results, summarised in Table 5.2, provide many insights into how the key factors affect the experience. Conclusions can be made from differences between the factors and occurrences where the participant's experience was not affected by a factor. Below is an overview of the results where the effects of the factors **Intensity**, **Familiarity**, **Forced Progression**, **Group Size** and **Escape room Habit** on the participant's experience are shown. The general conclusions drawn from the surveys are that intensity and group size had a more significant impact, familiarity had a minor impact, and escape room habit had close to no impact. As mentioned earlier in the report, forced progression showed challenges when being analysed. It was not a predetermined factor but something that occurred if the participants did not complete a puzzle.

	Intensity		Familiarity		Forced Progression	
	Low	High	Unknown	Known	Not Forced	Forced
Difficulity	4,5	6,1	4,9	5,9	3,7	6,5
Intensity	3,5	6,8	4,6	6,4	3,7	6,8
Fun	6,9	8,0	7,1	8,0	7,5	7,7
Contribution	6,0	6,0	6,3	5,9	6,3	5,9
Comfortable	8,9	7,9	8,1	8,3	8,3	8,2
Story engagement	6,4	7,1	7,2	6,7	6,1	7,3
Desired Group Size	2,9	3,2	3,1	3,2	3,0	3,2
	Group Size			Escape Room Habit		
	3	4	5	< 3	> 3	
Difficulity	5,3	5,5	5,7	5,8	4,8	
Intensity	3,9	6,2	6,2	5,9	5,1	
Fun	7,8	7,7	7,5	7,7	7,5	
Contribution	6,3	6,1	5,8	6,1	5,9	
Comfortable	9,0	8,6	7,6	8,3	7,9	
Story engagement	6,3	6,7	7,3	6,8	7,1	
Desired Group Size	2,8	3,3	3,1	3,2	2,8	

Table 5.2: Table of all Factors.

5.5.1 Intensity

From the survey results, it can be shown that participants with the high-intensity factor, on average, found the experience to be double as intense as the participants with the low-intensity factor, showing that our changes in intensity had the desired effect. Groups with the high-intensity factor experienced the escape room more difficult than those with the lower intensity factor. They also had a more enjoyable experience, finding the escape room more fun. However, the groups with low intensity felt more comfortable contributing to the puzzle's solutions, but both high and low-intensity groups felt that they contributed equally much. The results can be seen represented in Figure 5.6.

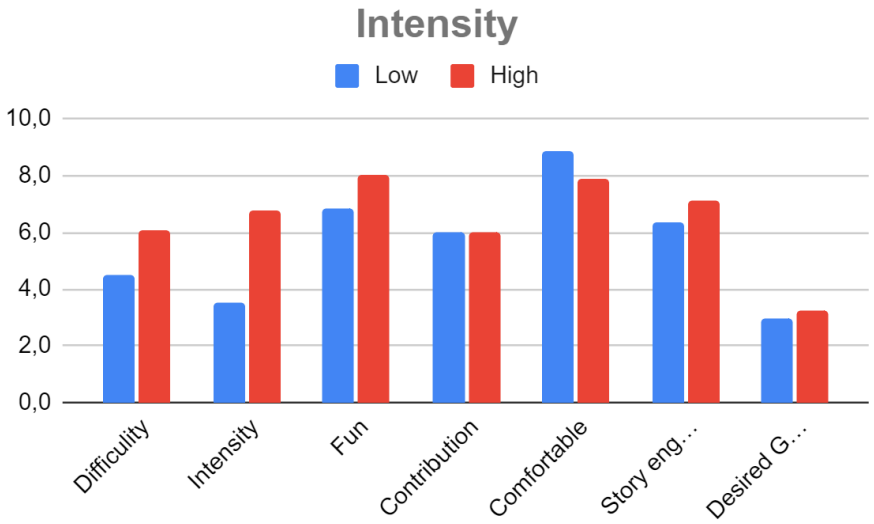

Figure 5.6: Graph of Intensity Factor.

5.5.2 Familiarity

Many aspects of the experience were not affected by whether the groups were familiar beforehand or not. However, the survey showed that familiar groups found the experience more intense, difficult, and fun than unfamiliar groups, following the same pattern as the intensity factor but with lesser differences, as seen in Figure 5.7.

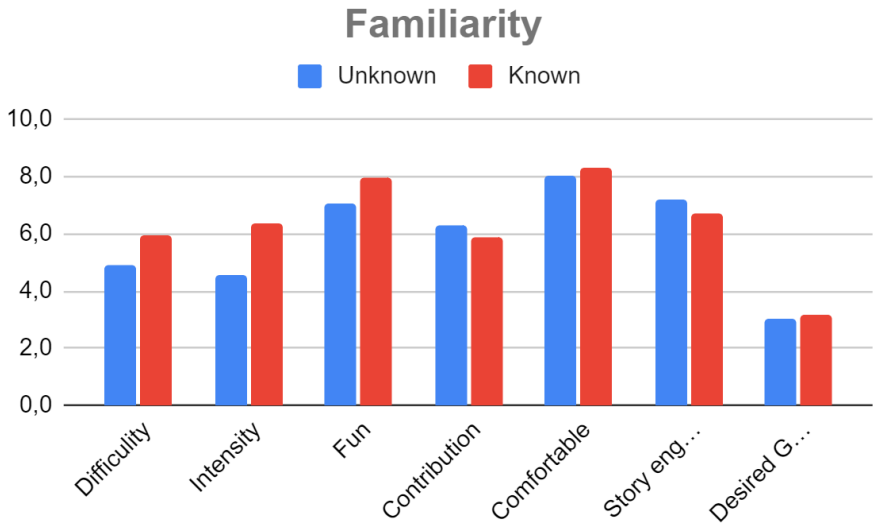

Figure 5.7: Graph of Familiarity Factor.

5.5.3 Group Size

The survey showed several differences in how the participants experienced the escape room depending on their group size. The groups of three participants found the experience to be a lot less intense than the groups with four or five participants.

A connection between the number of group participants and contribution could be found. Groups with more participants felt less comfortable contributing and experienced that they contributed less to the puzzle solutions. The groups with more participants did, however, feel more engaged by the story. From the survey results, the enjoyment of the experience was not affected by group size, as no difference in how fun the participants found the experience could be identified. The effects of group size can be seen in Figure 5.8.

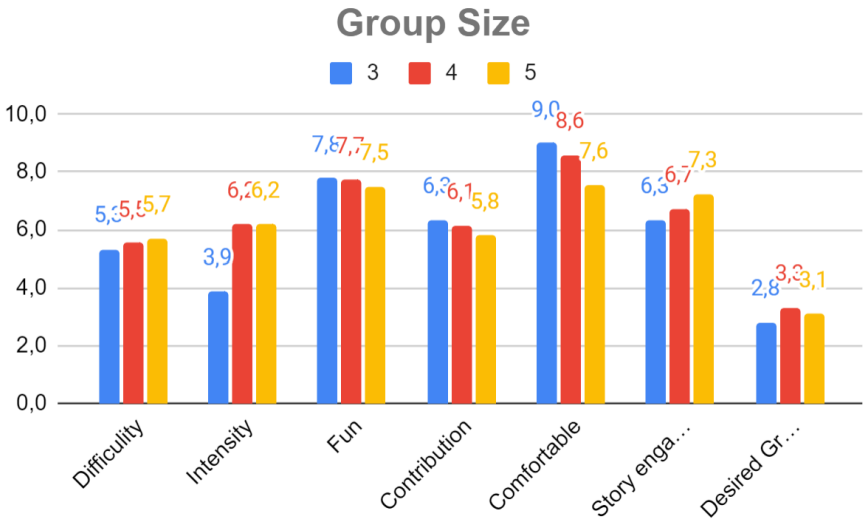

Figure 5.8: Graph of Group Size Factor.

5.5.4 Escape Room Habit

One of the survey questions asked was how familiar the participants were with escape rooms beforehand. The results show that there do not seem to be any significant differences between participants with and without earlier experiences. A minor insight was that experienced participants found the experience to be a bit less intense and difficult than participants with no or lesser experience, see Figure 5.9.

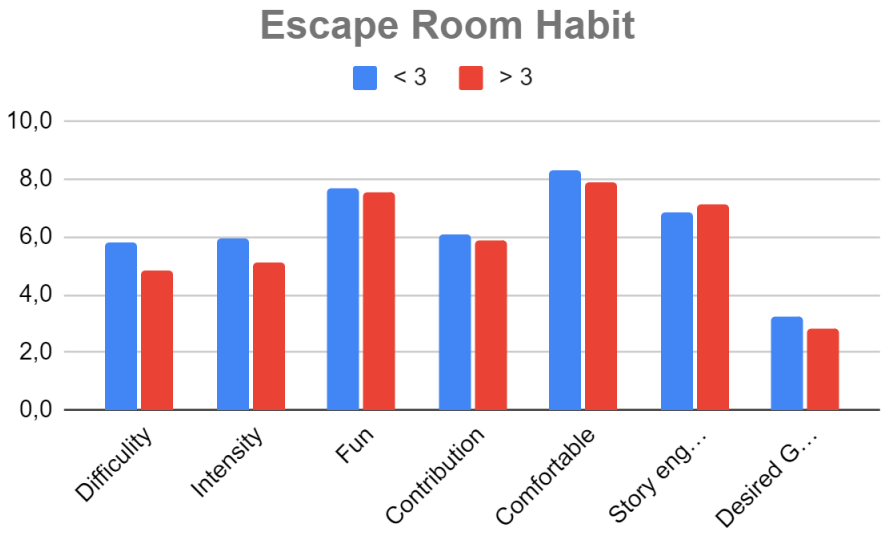

Figure 5.9: Graph of Escape Room Habit.

5.5.5 Individual Groups

When looking at individual groups, it is hard to draw conclusions with high validity as the sample size for each group is relatively small (n=3-10). It is, therefore, more beneficial to identify similarities between the groups. The desired group size was very close to three for all groups and participants. The enjoyment of the experience was also consistent for all groups except the **HKN3** group, who found the experience extra enjoyable. Figure 5.10 shows the results for all groups.

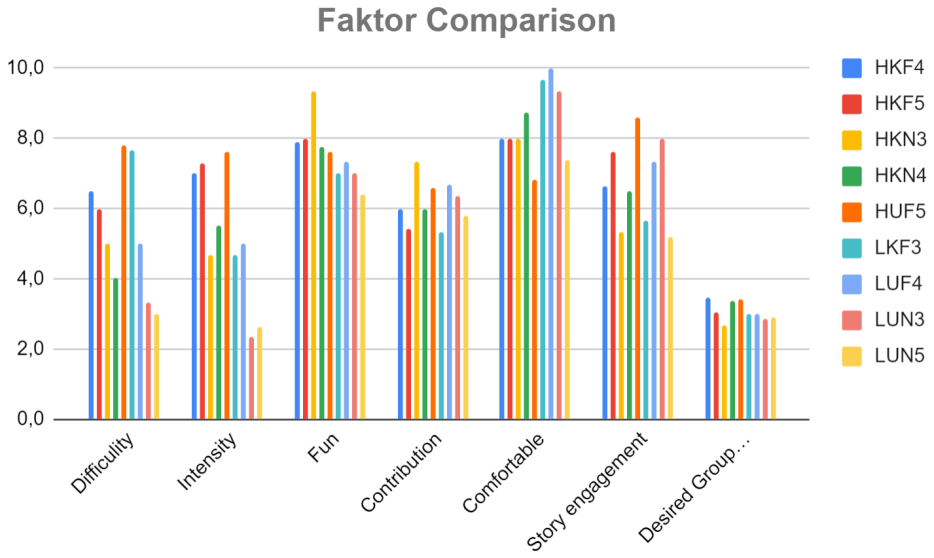

Figure 5.10: Graph of All Factors.

5.6 Implications of the Results

This section will present the implications of the themes and experiences. This has resulted in recommendations and knowledge concerning Experiential Learning experiences. The findings have been packaged so researchers and developers can use this knowledge to build on these concepts and test them in high-fidelity environments.

5.6.1 Group Dynamics

The key factor of group size affects group dynamics, where larger groups had more negative experiences concerning being unable to contribute. Since opinions regarding dividing the groups were varied and not connected to a specific key factor, puzzles should be designed with the ability to be solved with fewer or more people. The opportunity to solve puzzles in parallel and find hidden clues could also be given. However, this is contradicted by the expressed wish for teamwork and collaboration. The larger groups expressed varying opinions about their group size with advantages and disadvantages. However, most groups preferred a group size of three, which could be addressed by the previous solution or by limiting the group sizes to smaller groups.

The key factor of familiarity in the groups affected the group dynamic, but unfamiliarity did not negatively affect their experience in general. Furthermore, the differences between familiar and unfamiliar groups decreased over time and by solving puzzles together, which means that a longer and teamwork-focused escape room could be beneficial. This is also strengthened by the fact that all groups value collaboration and teamwork.

5.6.2 Guidance

The opinions regarding forced progression were unanimously negative. Those who did not experience forced progression also expressed negative opinions about untimely clues that give away too much. However, some still appreciated the clearness of a linear escape room. A disruptive and unresponsive clue and failure system gave negative results when enforcing linearity. With this in mind, a less forced guidance system could be beneficial. Some groups suggested asking or paying for clues, which could be one solution. However, some groups also mentioned that if they had to ask for clues, they would forget that possibility or be too stubborn to utilise it. A possible improvement is to have a greater variety of clues that trigger in a more thoughtful way instead of at specific time intervals. This balance should be considered when developing Experiential Learning experiences since the aim for all users to complete the experience is more prevalent, especially for historical experiences. Regardless, the forced failure should be avoided. An alternative could be to give very obvious clues. The participants also disliked having to leave a puzzle behind, so the opportunity to solve it even after the story moves on could be beneficial.

5.6.3 Intensity

The participants consistently appreciated a higher-intensity experience. The only negative sentiments were associated with the limited time of the escape room and not the key factor intensity. The key factor of familiarity affected the desire for a higher intensity, whereas unfamiliar groups with low intensity wished for it more frequently. As mentioned before, the group dynamics and the communication of the unfamiliar groups differed from the familiar groups, where they were more hesitant and withdrawn. Therefore, a higher intensity could create excitement and compensate for the lack of casual conversations. The groups that did not experience forced progression, thus completing the escape room with no failed puzzles, also wanted higher intensity. This shows that if the puzzles have a lower difficulty or the participants perceive them as such, there is more room for intense environmental elements. Finally, the smaller groups expressed that they thought the experience was less intense, affording more intense elements.

5.6.4 Difficulty

Opinions regarding difficulty were mainly tied to the key factors of familiarity and forced progression. The familiar groups expressed more positive sentiment towards a greater difficulty, showing a more significant wish to be challenged or less shame associated with failing. The groups who experienced forced progression, thus failing at least one puzzle, expressed more emotions regarding the difficulty level. Therefore, the reflection on difficulty can be avoided by making the escape room easier or having different forms of failure.

5.6.5 Storytelling

The opinions and emotions expressed regarding the story of the experience were similar depending on the key factors. The overall impression was positive regarding the format as an educational platform and the specific story told during this experience. This can be interpreted as an indication that educational escape rooms provide good conditions for learning history. The argument for an engaging and collaborative escape room could still be made even though the different key factors did not affect the Storytelling experience. It is also worth considering that some participants felt distracted from the story by the amount of information presented and the puzzles. A way to circumvent this is to make less complex puzzles requiring less information or to locate most of the story elements before or after the escape room.

5.7 Guidelines

During the Thematic Analysis, valuable insights were collected that did not directly fit into the factors or other categories but could still be used to create a good educational escape room in the commercial sector or as guidelines to create good conditions for learning. Some insights were more targeted at creating a good escape room experience, which is challenging to connect to our factors but is highly valuable

for Kistone's escape room as well as other upcoming, similar endeavours to be created with similar prerequisites.

5.7.1 General structure

The participants expressed gratitude for the intuitiveness of the first puzzle. They appreciated that the sound from the Morse code sounded in the beginning, clearly indicating where to start the experience. The lower difficulty and straightforwardness of the first puzzle were also appreciated, as they helped the groups get engaged with the experience quickly and created a high motivation within the group from the start.

The experience was created with an apparent linearity, with the puzzles divided into different stations. Each station had its own table to divide the puzzle, making it easier to know what props were connected to each puzzle. The participants had different opinions on this approach. Some expressed that they found it positive that knowing which items to interact with and investigate was easy. Many participants did, however, express a desire to have more spread-out clues mixed between the stations, and some participants did not comprehend that the stations were divided initially and found it confusing.

Some of the materials and decorations in the escape room were not related to the solutions of the puzzles but instead were implemented to create the desired aesthetic or to make it more complicated to locate the correct information. This was received positively by the participants, who expressed a sense of pride in being clever enough not to get sidetracked. Examples of this were propaganda posters and illustrations in the booklet of train station location codes.

Rather than hiding things in the escape room, making it more of a treasure hunt, the escape room and its puzzles were designed to be solved by listening to the narrator and using the props to create connections and find the solution. The participants also received this positively, emphasising listening to the voice and using a more hands-on approach to solving the puzzles.

The escape room had a set limit of 20 minutes, where six minutes were allocated for the first puzzle, and the second and third each had seven minutes allocated. The elapsed time was, however, not visualised in any way for the participants, who instead had to guess how much time had passed and how much time there was left. This was something many participants highlighted in the group interview as something negative. The participants expressed that it created stress and feelings of anxiety, not knowing if they had to rush or if they had time to take a calmer approach. We could also identify that even when the participants had mere seconds left of a puzzle and had a guess, they still often waited to be sure of their answer, as they did not know that the time limit was about to expire.

- Situate the easiest puzzle first to ease the players into the experience.
- If the puzzles in the escape room have separate stations make sure to convey that explicitly.

- Use a narrator in conjunction with puzzles without hidden elements.
- Give feedback concerning the time left of the whole escape room. Additionally, also give feedback if there are any sub-sections that are time sensitive.

5.7.2 Presentation of Information

Information was delivered to the participants in the escape room through a narrator's voice played on a speaker. The narrator was present primarily at the beginning of the briefing part of the experience, but also when hints were given, when a puzzle had been solved or if the time limit was reached for a puzzle. Additionally, to provide information, the narrator's intent was also to be a large part of the storytelling, leading to the voice messages being quite long to fit in with the story and make the experience more immersive. The first voice message, earlier referred to as the briefing, was especially long before the participants entered the escape room. This intro proved too long as many participants pointed out that it was hard to focus for that long and that it was unclear where the briefing ended, and the information for the first puzzle started. This led to the participants not listening to the story to understand the premises but instead listening for clues and information that could be used to solve the puzzle. This was true even though the majority of the initial briefing did not contain any information about the solution to the puzzle and only contained the premise for the story to be told. The same was highlighted about the hints and the messages in between puzzles, where the participants highlighted that the length of the voice messages made it hard to know what information was relevant and what was solely story-related.

- If an introduction is included in the experience, make sure to convey if the intro contains any clues or not.
- If a voice over is utilized keep the message as short as possible and find other ways to convey the story e.g. details in the environment and an introduction.

5.7.3 Atmosphere

During the creation of the escape room, a lot of work was put into creating an exciting atmosphere closely connected to the story. This was done through story and time-accurate decorations, props and narration. Many participants took a liking to the atmosphere and the story. It was brought up during the group interview that the participants found it refreshing with a story connected to World War II that was not focused on the conflict between Germany and the USA but instead had a more uncommon perspective. In the same regard the participants also found it exciting and fun that the story was about Sweden. The participants also expressed that they expected this feeling to be even more present if the experience occurred at Karlsborg Fortress.

- Design with attention to the atmosphere. This can be enhanced by situating the experience in an athmospheric location with real connection to the story being told.

5.7.4 Specific Suggestions

During the interviews, the participants shared many suggestions for improvements or alternate approaches. Even though the suggestions often were specific to the experience we created, the core ideas of many of them can be applied to a greater extent.

The participants expressed a lot of ideas and suggestions on how to approach the guidance of the experience differently. In the experience we created, the hints were delivered after a set amount of time. Still, many participants expressed in the group interview that they may have wanted to acquire the hints manually. Many ways of doing this were shared, with the most common suggestions being that you either paid gold to receive a hint or used the phone in the room to get hints when desired.

> "Could have used gold to buy clues."

Many suggestions were connected to the gold, and a common suggestion was visualising how much gold was left throughout the experience. This was a good combination with the earlier suggestion that one would pay gold to receive hints. Connected to this, there was also an expressed desire to get a bonus if you were to complete a puzzle without using any hints, with this bonus being in addition to not losing any gold.

A participant's suggestion during the group interview, which we found interesting, was to develop the air raids further. The specific suggestion from the participant was to hide information under the tables, which could only be seen when lying on the floor during the air raids. Another suggestion received regarding the air raids was for the participants to take action to stop the raid instead of waiting it out.

- If a guidance system is to be implemented design it with some interactive elements.
- Utilize visualisation or representations to connect the players to the story.
- Avoid passive sections in the experience by including interactive elements at all times.

With the results drawn from the qualitative and quantitative analysis data, the last part of the thesis approaches. However, before a conclusion can be drawn, the processes used to derive this result need to be discussed. This and several other topics will be considered in the next chapter, Discussion.

6

Discussion

This chapter considers topics of discussion for this project. The main topics are the process of answering the research question, conditions for learning, generalisability, ethical considerations, and future work. Some topics have one or several subcategories that delve deeper into each topic and its nuances.

6.1 The Research Question

As a result of this project, several key factors were discovered in relation to the research question, *"What are key factors in experiential learning for escape room storytelling of historical events?"*. By conducting user tests, subsequent interviews, and a survey, we established that **Intensity**, **Familiarity**, and **Group Size** affect several areas, e.g., engagement, collaboration, and enjoyment. Additionally, the design process and analysis gave insights into general guidelines for designing experiential learning platforms, specifically educational escape rooms for historical events.

Although our project resulted in an escape room retelling the story of Karlsborg Fortress, we see potential in applying the knowledge to different types of experiences. The rigorous research for this project included Experiential Learning and storytelling, which does not exclusively apply to escape rooms. We would argue that the key factors also affect other interactive experiences, such as games, and even non-interactive experiences, such as theatre, to a certain extent. The findings could also be applied to other fields of education than history. Although Storytelling fits naturally with historical retelling, it can still be a powerful tool for natural sciences to create engagement and context.

Intensity

The participants who took part in the study had an overall positive attitude towards high intensity. This could be because the rest of the escape room did not vary when the intensity level did, and the elements introduced by a higher intensity level suited the experience. However, the opinions about the intensity level were not the only effect as the groups with a higher intensity level also had more intense communication and a more enjoyable experience, and they expressed that the difficulty was hard more frequently. The groups with lower intensity felt more comfortable contributing. The fact that the groups' communication reflected the intensity of their experience could

be utilised depending on the designer's goal. We believe that music has contributed to this fact especially.

One of the elements introduced with the higher intensity was an air raid alarm that forced the participants to lie down on the floor. This could have contributed to the enjoyment of the experience and is not only a factor of intensity but also an extra game mechanic. Thus, more than just the intensity might contribute to a more enjoyable experience. Still, it is interesting to note that although this was a distracting game mechanic that gave the participants less time to complete the puzzles, they still found it more enjoyable. Specific opinions about the air raids were also positive although some thought they were a bit too passive during it.

We also propose that the demographic of the test group might affect the overwhelmingly positive attitude towards a higher intensity. We only tested the escape room on young students (20-30 years old), who were shown to appreciate a higher level of intensity, but the results might differ if a wider selection of the whole population were included.

Familiarity

The participants did not have unanimous opinions about familiarity. They appreciated the familiarity or unfamiliarity of the group they were a part of. That said, the factor still impacted other areas, i.e., familiar groups divided less, expressed a more positive attitude towards a higher difficulty, and had more defined roles. The unfamiliar groups expressed a more pronounced desire for higher intensity, stayed hesitant longer, communicated more formally, and experienced the escape room as less intense.

The participants that were in unfamiliar groups were not all strangers. They were often familiar with at least one other participant. Still, we argue that this reflects commercial and educational escape rooms where groups might not know everyone but are familiar with some. The difference in division between familiar and unfamiliar participants could be seen within the groups as well as between them. If some participants were more familiar with each other in the familiar groups, they often stuck closer together. The fact that familiar groups appreciated a higher difficulty and had more defined roles could be because they felt more comfortable losing and taking a leadership role. The groups might also already have established roles that they fall into during the experience.

The unfamiliar groups' wish for a higher intensity could be because of their more formal communication and lack of joking. A higher intensity might alleviate the hesitant atmosphere. Since they experienced the escape room as less intense, there is also more room for intensifying elements.

Group Size

The interviews clarified that three participants were the optimal group size for our escape room. However, this does not mean that a smaller number of participants is always better, but rather that group size plays a vital role, and people have opinions on the factor. Participants not only had opinions on the group size but also that it

affected their division, engagement, collaboration, experienced intensity and thoughts about linearity. Therefore, we argue that no matter the group size you are designing for, the experience should be designed considering the group size.

To avoid the fact that people strongly preferred a smaller group in our escape room, we could have made two different versions of the escape room to cater for group size. This could have given a clearer picture of the effects of group size and removed the risk that an ill-fitted experience causes the differences. However, this would have shifted the comparison between differently designed escape rooms instead of differences in group configurations. Additionally, other comparisons might have become more obtuse since the experiences of different groups would have differed more. Finally, in actual escape rooms, the group sizes often vary proportionally to our experience, making it closer to reality, and the findings could more easily be applied to real-life scenarios.

Guidance

For the study, we implemented a form of guidance, forced progression, where groups that do not finish a puzzle in time are forced to move on to the next puzzle. After the study, we realised we couldn't analyse it as a factor the same way as we had done with the other factors. The groups were not randomly assigned forced or non-forced progression before the experience. However, guidance is still an important aspect to consider, and our findings show strong opinions regarding both the forced progression and clues that were given at pre-determined time intervals. Therefore, we chose to analyse guidance separately and see how groups that experienced failure reacted to our implementation of guidance.

The groups had many negative opinions of forced progression, and those who did not fail on a puzzle had some negative opinions regarding clues played when they were about to solve the corresponding part of the puzzle. One conclusion that could be drawn is that forced progression is a too harsh and unforgiving implementation of guidance. The fact that the participants had to leave a puzzle unsolved was received negatively, which could be counteracted by having the possibility to solve a puzzle retroactively even though the narrator has directed the players to the next puzzle. However, this becomes more difficult when the escape room is built around a linear story with consequences. The narrator also tried to soften the blow of failure by encouraging the players and telling them that failing at one puzzle is not a catastrophe as they can still complete the next one. This didn't significantly affect the participants, leading us to think an alternative approach might be necessary.

Overall, we believe that a more intelligent system needs to be in place in order to give the players appropriate clues at the right time. This would result in a more complex implementation, but we believe that it is worth it to reduce frustration. It is also worth noting that the participants only encountered forced progression when they failed. Therefore, it is reasonable to believe they would have negative emotions associated with the implementation. We believe it is challenging to design a system with similar functionality that doesn't have any negative connotations. It could have a positive effect of heightening the tension and highlighting the severity

of the situation. That said, it could still be worth exploring other options, such as giving obvious clues or providing the opportunity to go back to a previous puzzle. Including a timer to see when the group is about to fail could also help reduce some frustration by giving more clarity.

Unknown factors

Our literature study and stakeholder interviews identified four potential key factors: Intensity, Familiarity, Group Size and Guidance. However, we do not claim that these are the only ones. Other factors could emerge as key to the design process through further testing. We saw some signs that the medium of information could affect the experience. In our implementation, the story was told via voice-over, and the puzzles contained information in the form of visual posters, sound, tactile objects, and written notes. Including video and other forms of storytelling and information could affect the learning conditions.

We believe a true story is essential in an educational experience focused on history, so this is perhaps not a potential factor for this specific application. That said, we believe that other escape rooms and experience-based entertainment could benefit from using a true story. Most participants found this to be a strong positive and impactful.

Finally, we want to address the fact that our escape room was built with the potential key factors in mind. The design was purposefully made to be able to highlight any effects of the key factors. This could have affected the result by enhancing the differences. However, we also used puzzles and the overall structure from the escape room being designed for Karlsborg Fortress while also taking inspiration from established practices within the escape room field. Considering our study, these elements were not designed, which we claim gives ecological validity. We aimed to design an experience that did not affect the participant's behaviour while providing ample opportunity to study the proposed key factors.

6.2 Conditions for learning

The challenge of measuring learning has been present for a long time and has been researched many times. Caspersen et al. (2017) identifies these challenges as the need for ways to measure learning continuous to rise. With the knowledge of the difficulties of measuring learning, we decided early in the project to research conditions for learning rather than measure how much the participants learned.

An approach when looking at conditions for learning is Kolb's (2014) research on Experiential Learning. His approach and instrument for applying it have proved helpful in several academic areas (Hickcox, 1991) and can thus be argued to provide beneficial conditions for learning. His work is based on earlier established research (Dewey, 1938) that, while being criticised for difficulty being assessed quantitatively, still provides valuable tools and structure for experience-based learning. Using the learning cycle proposed by Kolb (2014), we would argue that the escape room

experience can be situated in the "Concrete Experience" phase, where the learners grasp for apprehension and acquire diverging knowledge. The learning process includes several other phases but the experience is a vital cog in the learning mechanism.

With the insights from extensive research by Kolb (2014) on Experiential Learning, it is interesting to discuss if we, through our escape room, did create conditions for learning. But before we can assess whether or not we did create conditions for learning, we need to establish what we wanted the participants to learn. Together with Kistone, we want the participants who experienced our escape room experience to leave with a better understanding of the events that took place in Karlsborg Fortress and the story of moving Sweden's gold reserve. Furthermore, the focus during the experience is not so much on remembering specific facts but on getting a general understanding of the happenings surrounding Karlsborg Fortress and creating a spark of interest for the participants. This synergises well with the views of Kolb (2014), who emphasises the lived experience and not the generalised academic knowledge in the form of 'objective' knowledge. Additionally, he argues that experiential learning has an important part to play in the goal of lifelong learning.

It is also important to look at what the stakeholders want to get out of the end result. Visit Karlsborg's primary goal is to prolong its tourism season and have an activity which is not dependent on the weather. Kistone wants to create a successful experience while telling the story of Karlsborg's history. Finally, together with Chalmers University of Technology, we as a project group want to break new ground in our research area and create valuable guidelines to be used in similar endeavours in the future. Balancing all these different approaches differentiates a solely educational escape room from one within the commercial sector. With an educational escape room within the commercial space, the enjoyment of the experience plays a heavier role as it is vital for creating conditions for learning and making the experience financially reliable.

Stress and Learning

A natural part of the escape room experience is the stress involved with completing puzzles and challenges within a given time limit. Furthermore, a narrative is often constructed and told to immerse the participants, which may escalate the stress and increase adrenaline further. With an increasing stress level comes both advantages and challenges. Joëls et al. (2006) have conducted a study researching how stress affects learning and how it works. They concluded that stress does affect the learning and memory processes. However, they found that it could have quite different effects, both positive and negative. Two of the main findings in the article highlighted the time frame and the repetitiveness of the stress as highly impactful. It was found that non-repetitive stress, which is closely linked in time and within the context, provided good results in terms of learning and memory processes. It was, for example, predicted that stress experienced within the context of a learning experience will induce focused attention and improve memory of relevant over irrelevant information. This could be a positive if the players deem the story and historical facts relevant. However, there is a risk that the participants deem it irrelevant and only focus on

the puzzle information. This stresses the importance of debriefing and the other learning cycle stages, as well as incorporating story elements into the puzzles.

Storytelling

One challenge that did arise when creating conditions for learning is to find a balance between creating an enjoyable experience and still making it educational. A question thoroughly discussed throughout the project is how close to the exact happenings of the true story you need to be. For example, our second puzzle was based on finding the correct difference in the width of the train tracks while, in reality, the width of the rails differed. We choose to differ from the real story here to create a better puzzle, as it would have been far too finicky to measure such minor differences as differences in rail width. One way to look at it is to determine if you want to tell a story that reflects the general happenings of moving the gold reserve or if you want to educate the participants about the exact happenings of the endeavour.

6.3 Generalisability

As established early in this thesis, the aim was to create knowledge and unveil key factors that do not only apply to this specific case but to a broader spectrum of learning experiences. In the instance of the key factor intensity, we discovered that it affected communication, which could be used in any collaborative experience. Depending on the desired effect, the designers could manipulate parameters such as music and lights to lower or raise the intensity of the users' communication. Even in a more simplistic experience, there are ways to increase or decrease the intensity, e.g. changing the time limit or the wording of the instructions. The same can be said for the experienced difficulty. If the goal is to create an experience that feels difficult, then the designers can increase the intensity and vice versa. The positive response to a high intensity might be less generalisable since the participants in the study might only represent part of the target audience. However, we believe the other effects can be applied to a broader audience.

The key factor of familiarity has several effects worth being aware of when designing for experiential learning. That said, it might not be possible to choose if the participants will know each other or not beforehand. In the scenario that the designers know beforehand that all the groups will be familiar or unfamiliar with the effects that pertain to that condition, and they can either counteract or enhance based on the desired outcome. In the scenario that the groups will be mixed between familiar and unfamiliar, the designers can be aware of the effects and either have different versions of the experience or try to strike a balance.

The effects of the key factor group size are somewhat dependent on the design of the experience. Therefore, the designers should adapt the knowledge provided for group size appropriately. However, we discovered a preference towards smaller groups, which means that if possible, it might be worth striving towards a lower amount of participants. An alternative is to design the experience to be less linear. Even though the strong preference for a group size of three might be applicable to all

experiences, we believe that the fact that participants had strong opinions on the group size is generalisable to other learning experiences.

Although guidance couldn't be determined to be a key factor due to our configuration of the experience, we still believe that it is worth taking into consideration in the design of a learning experience. We believe that having a form of guidance could prove helpful, and since the participants reacted negatively to forced progression, other forms should be explored. The configuration of guidance could take its form in a myriad of different ways, e.g. an AI-assisted tool or simple clue cards, meaning that the knowledge provided by this project could inform a variety of experiences.

6.4 Ethical considerations

This project was conducted as transparently as possible with regular considerations for ethical missteps that we could be making. The design of the experience was frequently anchored with potential users and stakeholders to ensure that they were in focus. While recruiting participants for the study, we tried to include as diverse a group of people as possible from different programs and schools. That said, the group consisted of students only at Chalmers University of Technology or the University of Gothenburg, a relatively narrow demographic. If the scope had been larger, we would have liked to test on a group that better represented the potential beneficiaries of experiential learning.

Before the study, we informed the participants of the data that would be gathered and as much about the experience as we could. In the later stages of the interviews, we also explained what factors we had tested on them to ensure transparency. However, we could not reveal this information earlier since it could have affected their interview responses. The collected data was also anonymised as early as possible in the process. The survey had no personal information other than group affiliation. The audio and video were anonymised in the transcription and only used sparingly afterwards to confirm what a participant was saying.

Accessibility

Escape rooms themselves raise some ethical questions that are worth considering. Many commercial escape rooms consist of cramped rooms and narrow passages. They might also include elements like flickering lights, colour puzzles and puzzles that require fine hand coordination. These factors could damage the accessibility of the escape room if not taken into consideration. It is important to be aware of this early in the design process and develop suitable puzzles and solutions. Alternatively, the escape rooms can be designed with alternative features, e.g. having the opportunity to disable flickering lights in a section when needed. Finally, the staff needs to be aware of potential issues, and the players must be informed of the escape room's characteristics and alternatives.

During our design process, we considered this and designed puzzles that would not require fine hand coordination or complex physical tasks. However, there were some

aspects that we missed taking into consideration. The high-intensity experience included a task where the participants had to get down on the floor. This could be difficult for a physically impaired person. This could have been avoided by having the low-intensity experience as an alternative, but even better would have been to design elements that are inclusive to all. Otherwise, you run the risk of designing a sub-par experience for some people. The same is true for the lighting in the high-intensity experience. The lights were fairly dim in this setup, and some text was more challenging to read. This could have been solved with spotlights or directed light on these segments.

Commercial Education

The focus on commercial forms of education can be put into question. If money and time should be invested into learning opportunities, shouldn't it be spent on an education system that everyone can access and doesn't include admission fees? However, as Falk and Dierking (2010) claims, "Supporting evidence for the important role that out-of-school experiences have on children's learning is emerging from a variety of fronts.". Furthermore, they stress the importance of programs that invest in education outside of school and that participation in these has increased, especially among lower-income youths. It is important to create a broad spectrum of education opportunities without disregarding the school system.

Therefore, we believe this is a valuable endeavour and a possibility for spreading knowledge to a broader audience. We also believe that ensuring these educational platforms are made available for everyone is important. This includes designing an accessible experience and making it affordable. It is, in part, up to designers and stakeholders to ensure that the educational and accessible aspects are not deprioritised in favour of profit and entertainment. We also believe that the public sector should support these projects and create good conditions for creating educational experiences.

World War II

The topic of our experience has been World War II, and when dealing with such a serious historical undergoing, it is crucial to treat it with respect. The war segment that the story covers is one of less tragedy than others, which lends some liberty to the tone of the experience. However, consideration for the severity of the historical events is still needed. There is a balance of creating an enjoyable experience while still conveying the horrors of war, which we had in mind during the design process. It is still important not to be afraid to cover these aspects of history so we can learn from them. Educational experiences could be a good alternative to other forms of education, ensuring that as many as possible receive the knowledge and take it to heart. The experience of acting out and influencing a historical event could increase the immersion and urgency. This could have both positive and negative effects. It could convey history in a more relatable manner, but it could also become too overwhelming and disturbing. This balance needs to be established with potential users and considered throughout the design process.

6.5 Future work

As mentioned earlier in the discussion, we believe that there is potential to build on the knowledge produced in this thesis by conducting further research. The areas we believe would be interesting to delve deeper into include the importance of having the experience connected to the location, the effect of briefing and debriefing, other potential key factors, and studying one factor at a time.

Location

From our interviews with Kistone and Visit Karlsborg, we gathered that one of their primary selling points and focuses was the importance of the location and its history. They wanted to ensure that the story being told was grounded in Karlsborg, and they postulated that this could have a significant impact. The interviews later echoed this with a positive attitude towards the connection to the location and a desire to visit Karlsborg. However, we could not conduct our study in Karlsborg, which would have been interesting. We believe the location's connection to the story being told could be studied, especially if this is only relevant to historical or educational experiences. This could also be paired with a higher fidelity study, which utilises the environments of a historical building instead of the studios used in our study.

Briefing and Debriefing

We believe further research on the effects of briefing and debriefing is important. The importance of both processes has been highlighted by both Kolb (2014) and Baker et al. (1997). However, these were outside of the scope of this project. We did include a form of briefing, but this was mainly to instruct the participants on the structure of the escape room and briefly explain the setting. Additionally, the participants asked some questions during the interview and discussed with each other, which served as a light form of debriefing. Both these components could be explored more extensively, perhaps showing video as a mode of briefing to increase the immersion and give a better understanding of what is to unfold before the experience so the participants can focus on the puzzles. The debriefing could be constructed to cement the experience's story further and provide additional information. Kistone has recognised these aspects, and they will be included in the final escape room. Therefore, this could be further researched through a study at Karlsborg Fortress.

Other key factors

As mentioned earlier, we believe there could be other key factors for Experiential Learning for interactive Storytelling of historical events. Finding these and showing their effect could be the subject of a future study. As a continuation of this study, we believe that guidance could be a potential factor to study, testing different ways of providing guidance or the absence of it. Additionally, we saw some indications that the form of Storytelling you design could impact the educational viability. It at least affects the experience, and exploring different ways of conveying the story and puzzle information could be fruitful. Finally, there might be factors that we have

not considered or that have not appeared in our project that might become apparent through an explorative study with a more explicit goal of finding any key factors instead of checking the validity of a few pre-selected ones.

One factor at the time

It could be worth researching each key factor separately to unveil more detailed knowledge about their effects. We see the potential to study a wider variety of group sizes to showcase the differences between larger groups of up to perhaps fifteen participants. With the sole focus on group size, you could also design different variants of the same experience to avoid the risk of one group size being optimal. This could potentially show how different designs of experiences, in terms of group size, affect the conditions for learning. Different types of intensity could also be studied. We implemented a physical task, with lights and music as elements of intensity, but you could also include, e.g., the physical design of the room and video. The familiarity could also be studied separately, but we believe that we covered the most commonly occurring configurations, as most players know at least one other person. However, all the factors could be restudied with more participants to provide an even more comprehensive understanding of the different key factors.

7

Conclusion

This project aimed to identify key factors in Experiential Learning for interactive Storytelling of historical events. Moreover, the exploration of potential key factors aimed to result in additional guidelines to consider when designing experiences for education. The project was done in collaboration with Kistone and Visit Karlsborg, which meant an additional design goal of adhering to the fundamentals of their project at Karlsborg Fortress. Through utilising the Research through Design approach, the purpose of the thesis was to create richer knowledge for future endeavours in designing experiential learning projects.

- *What are key factors in experiential learning for escape room storytelling of historical events?*

At the end of the project, three key factors and several general guidelines were identified. The key factors are Intensity, Familiarity, and Group size. The results include an explanation of how these affect the conditions and participants for educational experiences and instructions for how the general guidelines can be interpreted. Several areas of effect were identified for each factor that can be used in the design process to achieve the desired effect.

The intensity level affected engagement, communication, experienced intensity, and enjoyment thus making it a key factor. The low-intensity groups thought the experience was easier and communicated less intensely. This is not necessarily a positive or negative effect but an effect to consider depending on the goal of the design. However, the low-intensity groups collaborated more, which can be seen as an effect worth striving towards. Inversely, high-intensity groups had a higher level of enjoyment. Therefore, we recommend that if designing with a higher level of intensity, there should be additional focus on ways of collaborating.

Familiarity affected division, desired intensity, attitude towards difficulty, roles, collaboration, communication, experienced intensity, and desired intensity. The groups who were familiar with each other divided less and fell into more defined roles. The opinions regarding divisions were divided. However, the groups unanimously agreed that the aspects of teamwork were desirable, suggesting that division should be avoided. The unfamiliar groups experienced the escape room as less intense and desired a higher intensity. This could be manipulated according to the desired design outcome. Finally, the familiar groups expressed a more positive attitude towards a higher difficulty. This could be utilised if the player's familiarity can be guaranteed.

However, since it is hard to guarantee a consistent familiarity level, the design should be flexible and considerate of the effect of the factor. In the cases where familiarity is guaranteed, appropriate measures could be made to enhance or repress the effects of the key factor.

The final key factor, group size, was determined to be a key factor as it affected division, engagement, linearity, collaboration, and experienced intensity. Since the larger groups experienced more difficulty contributing, were less comfortable contributing, and were divided more, the design should either have parallel tasks that can be completed or have a specific group size enforced in mind. Making the experience less linear and providing the ability to split up could have drawbacks since the groups expressed an appreciation for teamwork and collaboration. With smaller groups, the linearity was more appreciated, and the perceived intensity was lower, which means that these aspects can be emphasised when designing for smaller groups. This points towards the advantages of designing for smaller groups, although what is considered small depends on the scope and size of the experience.

The insights were achieved by studying a down-scaled escape room using visual elements, story, structure, and puzzles from an upcoming escape room at Karlsborg Fortress that Kistone is developing. The escape room and the elements within were redesigned to enable the evaluation of the previously mentioned factors. The participants in the study were assigned different conditions of the factors (high or low intensity, familiar or unfamiliar, three to five participants in the group) which altered their experience. The following group interviews, video material, and survey were used to evaluate the effects of the different factors.

The results from this project provide several new findings that can contribute to the field of Experiential Learning and educational escape rooms. The intersection between commercial and educational escape rooms is fairly unexplored; thus, this work can bring knowledge to practitioners and researchers in the field. Using the key factors and the general guidelines, newcomers and experts in neighbouring fields can receive a good starting point and direction for designing Experiential Learning for interactive Storytelling of historical events. Hopefully, this can lead to a broader spectrum of educational platforms and a community inspired by new historical knowledge and memorable experiences.

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A

Escape Room

This appendix contains graphical material and physical props used in the escape room.

Puzzle 1 - Morse Code Puzzle

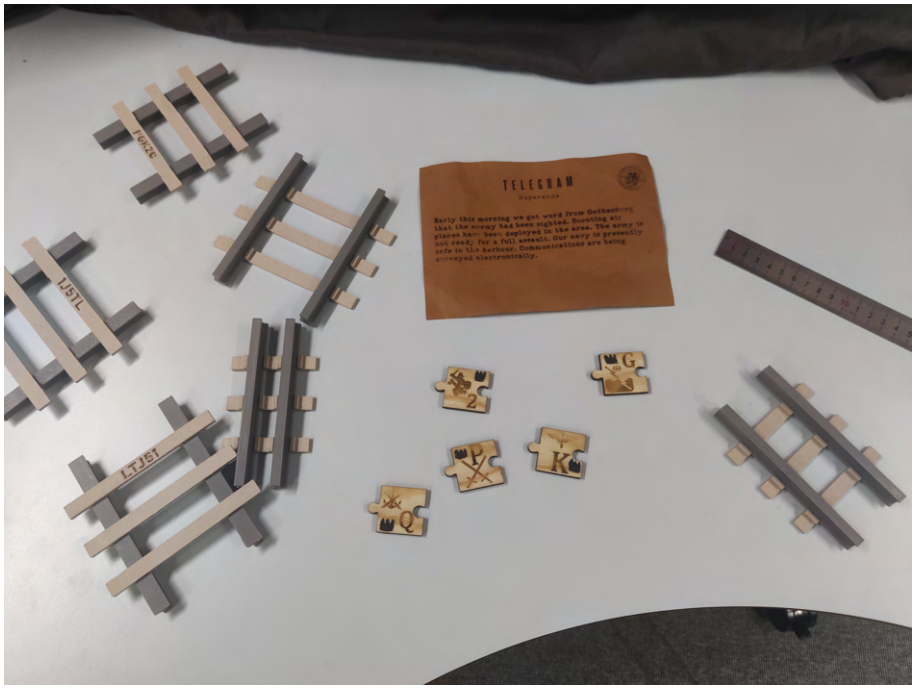

Figure A.1: Train Tracks and Puzzle Pieces.

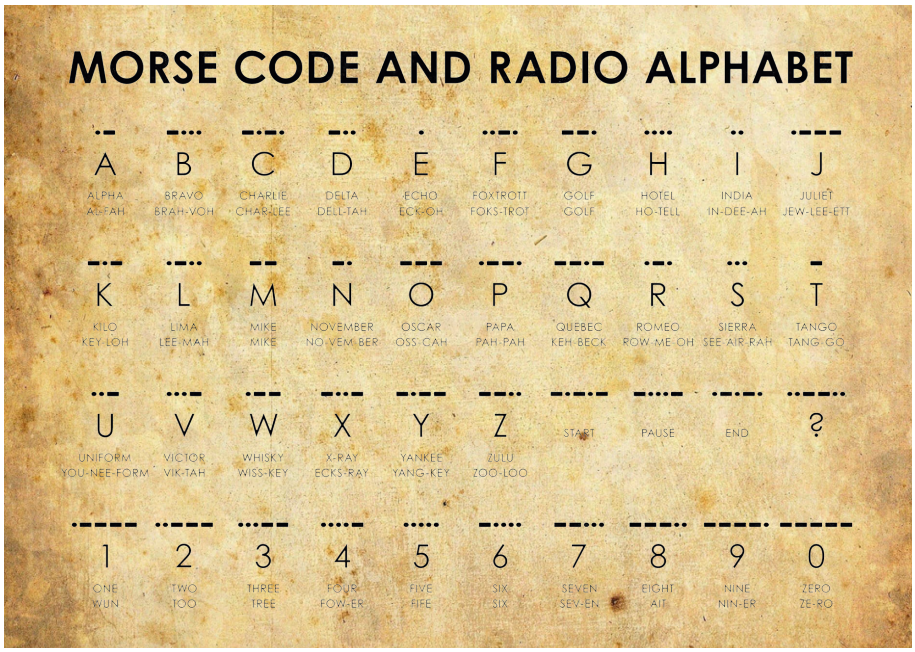

Figure A.2: Morse Code Alphabet Poster.

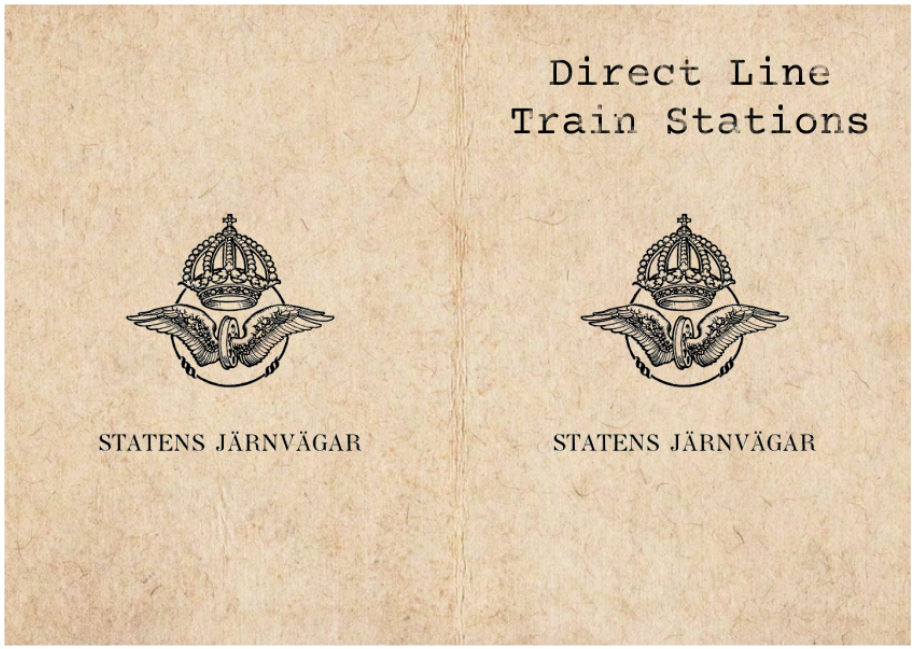

Figure A.3: Back and front of Train Station Booklet.

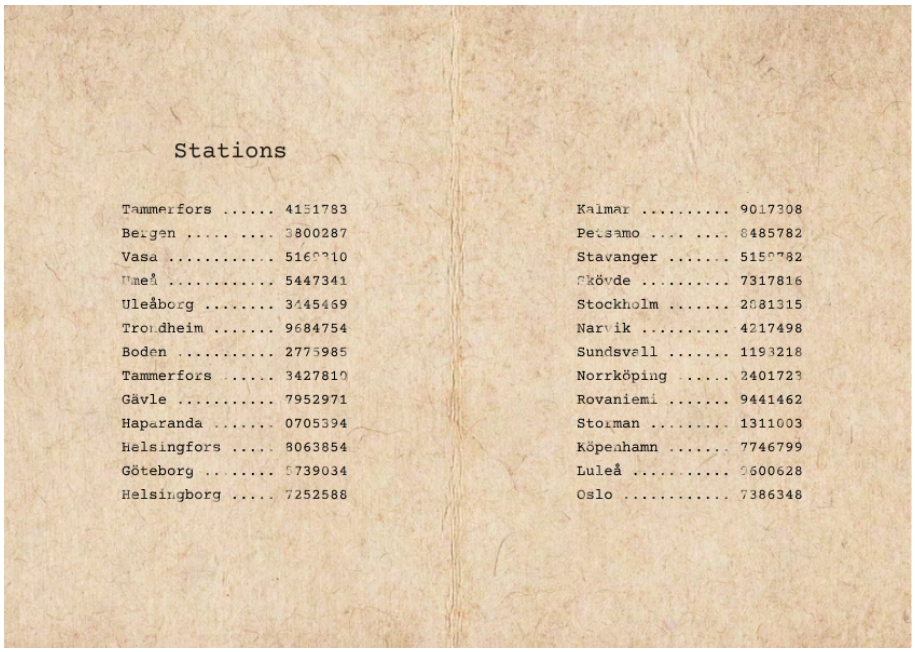

Figure A.4: Example of Booklet Pages.

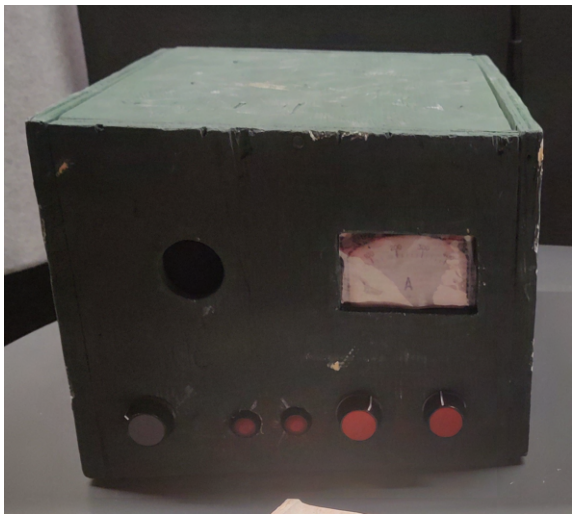

Figure A.5: Speaker disguised as Wooden Box.

Puzzle 2 - Train Puzzle

Figure A.6: Military Divisions Poster.

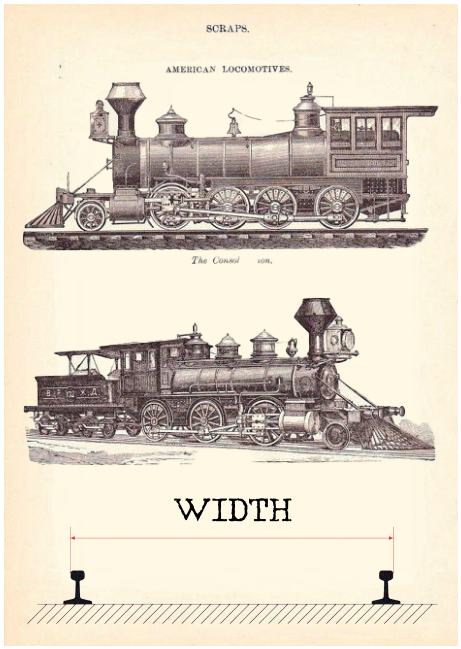

Figure A.7: Rail Width Poster.

Puzzle 3 - Mafia Puzzle

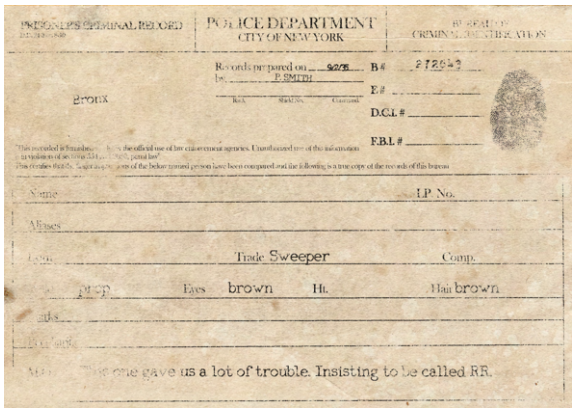

Figure A.8: Criminal Record Bronx.

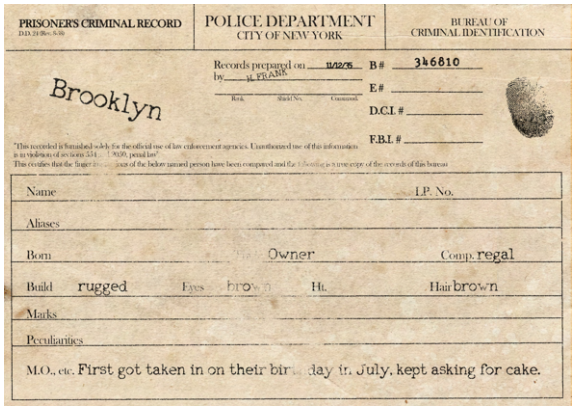

Figure A.9: Criminal Record Brooklyn.

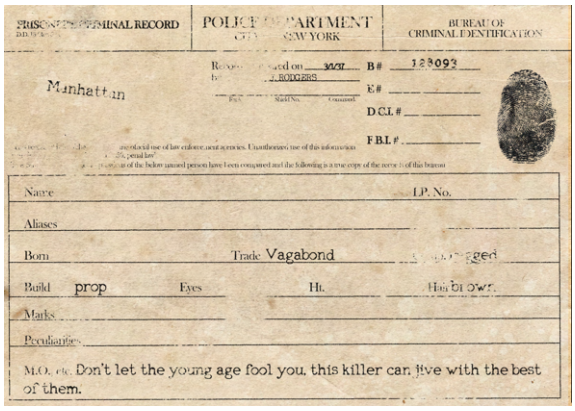

Figure A.10: Criminal Record Manhattan.

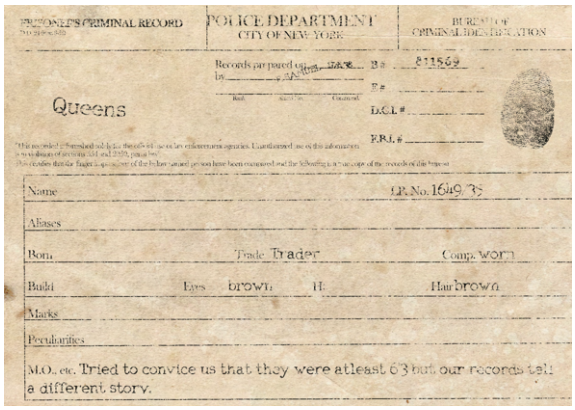
PRISONER'S CRIMINAL RECORD
POLICE DEPARTMENT
CITY OF NEW YORK
BUREAU OF CRIMINAL IDENTIFICATION
Queens
B# 811569
D.C.I.#
F.B.I.#
Name
I.P. No. 1619
Aliases
Born
Trade Trader
Comp. worn
Build
Eyes brown
Ht.
Hair brown
Marks
Peculiarities
M.O., etc. Tried to convice us that they were atleast 6'3 but our records tell a different story.

Figure A.11: Criminal Record Queens.

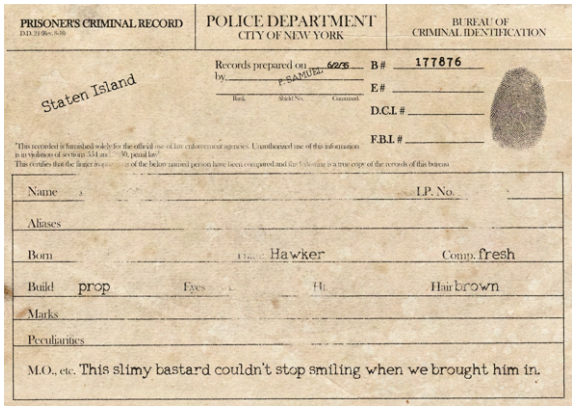
PRISONER'S CRIMINAL RECORD
POLICE DEPARTMENT
CITY OF NEW YORK
BUREAU OF CRIMINAL IDENTIFICATION
Staten Island
B# 177876
E#
D.C.I.#
F.B.I.#
Name
I.P. No.
Aliases
Born
Trade Hawker
Comp. fresh
Build prop
Eyes
Ht.
Hair brown
Marks
Peculiarities
M.O., etc. This slimy bastard couldn't stop smiling when we brought him in.

Figure A.12: Criminal Record Staten Island.

Figure A.13: Mugshot Morris "Pittsburgh Phil" Slick.

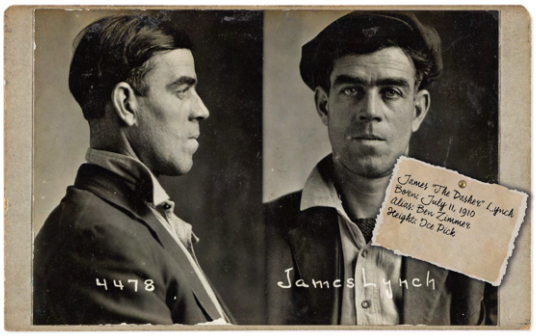

Figure A.14: Mugshot James "The Dasher" Lynch.

Figure A.15: Mugshot Peter "Mendy" Porgic.

Figure A.16: Mugshot John "Happy" Orange.

Figure A.17: Mugshot Rosie "Kid Twist" Gualiardi.

Transcript of the Narrator

Please note that the transcript and the story are highly inspired by Kistone's experience, which is in development. The story and its content are a work in progress.
INTRODUCTION 1 Welcome to Karlsborg Fortress. Captain Prytz, security chief here at the fortress, at your service. You have been specifically selected for this very important - and secret - mission. It is of the utmost importance that you cooperate and complete your task together.

INTRODUCTION 2 The times are truly turbulent with the ongoing war intensifying with each passing day. On the night between the 6th and 7th of September last year, just a few days after the outbreak of the war, a train carrying 71 tons of gold left Stockholm for transport to the Riksbank Section C in Karlsborg Fortress. A month later, a new shipment was sent, this time with 70 tons of gold.

INTRODUCTION 3 Concern for the security of the gold has increased with the intensification of the war. Therefore, in consultation with the other three central banks in the Nordic countries, we have decided to transport the gold to America and Fort Knox. The gold was supposed to be sent from Karlsborg to Bergen, then to England, and finally to America and Fort Knox but due to the German's recent attack on both Denmark and Norway you have to find a new way out of the country.

INTRODUCTION 4 The gold was loaded into the train cars destined for Bergen yesterday, and early this morning on April 9, 1940, the train left Karlsborg and is now stationed in Skövde. I will assist you throughout your mission and I will send a message about this new destination for the train. So listen carefully. You must immediately contact the train dispatcher in Skövde and inform them of the train's new final destination.

INTRODUCTION 5 - High Intensity We also know that the German Luftwaffe has Karlsborg Fortress as a target in their target catalog. Therefore, there is a high risk of air raid alarms at the fortress. When the air raid alarm sounds you have to take a low position as close to the floor as possible. Listen Carefully, end of transmission Now remember to listen carefully. End of transmission.

Morse Code plays in the room. [P E T S A M O]

Clue 1 Puzzle 1 *(P1 C1)* Yes, Prytz here again. Apparently, according to my informant, you are supposed to listen for a Morse code on the shortwave radio. And then relay the new final destination to the train dispatcher in Skövde. Use your ears. And your brain... End of transmission.

Clue 2 Puzzle 1 *(P1 C2)* Prytz here. It has come to my attention from a reliable source that the port from which the valuable cargo is to be transported is the Finnish port of Petsamo. Petsamo, indeed. Apparently, you should have a booklet of train stations at your disposal in the communications center. Look at it and choose the final destination for the train. But hurry for heaven's sake - the train dispatcher in Skövde is starting to get impatient. End of transmission.

Puzzle 1 Solved *(P1 S)* Well done! Yes, it's Prytz here as you hear. The train is now rolling northward towards Rovaniemi, for an onward journey to Petsamo. End of transmission.

Failure 1 *(P1 F)* Prytz here. The train has started moving northward. The government has informed the impatient train dispatcher in Skövde that the train is heading to Petsamo. Unfortunately, it cost us some gold, but don't be disheartened by that. You lose some, you win some. And there is still plenty of gold left to save. End of transmission.

Intro Puzzle 2 *(P2 I)* Good day, I'm calling from the border station here in Haparanda. We understand that a train is on its way to us with valuable cargo, destined for further transport to Petsamo. I just want to draw your attention to the fact that the track width differs between Sweden and Finland. So our engineers here need to construct width changers for the train to be able to cross the border. Now we need to know the width difference between the Swedish and Finish tracks. Find out this information and inform us as soon as you possibly can. End of transmission.

Clue 1 Puzzle 2 *(P2 C1)* Yes, it's Prytz, connecting again. I just want to remind you that it is extremely important that you solve the new mission you have been given before the train, you know which one, arrives in Haparanda. Otherwise, it could cost us dearly... Apparently, military grades could lead you to the answer. End of transmission.

Clue 2 Puzzle 2 *(P2 C2)* Prytz here. Excuse the blunt question, but have you completely lost track? Have you found the correct width difference so that the train can switch from Swedish tracks to Finnish tracks? The military grades have to be in the correct order to give you the correct tracks to measure. The government and I trust you. End of transmission.

Puzzle 2 Solved *(P2 S)* Prytz here. Well done! The train is now on its way to Petsamo, and thereafter, the valuable cargo will be shipped to New York.

Puzzle 2 Failure *(P2 F)*

Prytz here. Well, this wasn't exactly a fun story... Since you didn't manage to come up with a solution to the track width issue on time, the train had to be dismantled in Haparanda, and Finnish engineers had to construct the changers on their own. It wasn't cheap. No, it cost quite a bit of gold. Well, forget about that now. Anyway, the train is now on its way to Petsamo, the valuable cargo will then be shipped to New York.

Intro Puzzle 3 *(P3 I)* Yes, this is Prytz again. Reliable sources have informed me that the ship with the valuable cargo is heading to New York. While there is no world war there, there is indeed a mafia war that has escalated recently. The infamous crime syndicate Murder, Inc. is spreading terror and death by carrying out murders on behalf of the hardened mafia bosses in the city. So, it's far from the ideal place to arrive with a whole cargo full of... well, you know what.

We have, of course, contacted the New York police, and now they want your help in reaching informants in every police district. This way, they can guarantee safe

passage through the city and onward transport to Fort Knox. Good luck! End of transmission.

Puzzle 3 Clue 1 *(P3 C1)* Prytz, again... How are you doing with the informants? The ship has now docked in New York. Unfortunately, it seems that Murder, Inc. has taken custody of the ship, but if you can just find the five informants, the police chief has promised to resolve the matter. My informant says that you need to use the informants' mugshots, to connect to the correct district.

Puzzle 3 Clue 2 *(P3 C1)* Prytz here. Things are getting urgent. Murder, Inc. has started searching through the cargo on the ship... So you must use the arrest information in conjunction with the mugshots to connect them to the correct district. There should be some connecting device to relay the information to New York.

Puzzle 3 Solved *(P3 S)* Yes, it's Prytz here again. Damn fine work by you! Now, the gold that remains after this perilous journey is on its way to safety in Fort Knox. Thank you for all your help. Now we just have to hope that this terrible war will end someday. But it surely will - I'm used to getting what I want. End of transmission.

Puzzle 3 Failure *(P3 F)* Yes, it's Prytz here again. From a reliable source in New York, I have now learned that unfortunately, we had to bribe our way through the city. It cost us quite a bit of gold. But now, at least, the remaining gold after this perilous journey is on its way to safety in Fort Knox. I want to thank you for all your efforts. Now we just have to hope that this terrible war will end someday. But it surely will - I'm used to getting what I want. End of transmission.

OVER AND OUT!

Air raid done (Air Raid Over) That was a close one, air raid over! Back to work!

B

Evaluation & Analysis

Consent Form

CHALMERS

Consent and information about processing of personal data in student thesis

I agree with the collection of personal data in the form of video and audio which may be treated by Chalmers University of Technology for the study.
The material will be used to study the participants behavior and to keep track of task completion to gain a better understanding of the effect of different key factors in escape rooms.

Information

This information will be stored and used by the experiment leaders for the duration of the thesis work. The data will not be handled or shown to any other parties.

Your consent is valid until further notice. You have the right to withdraw your consent at any time. You do this by contacting odaspost@gmail.com or bohmanemil@gmail.com or registrator@chalmers.se
If you withdraw your consent, we will cease processing the personal data we have collected with the support of your consent. Some information may be saved due to Chalmers's obligations under Swedish archive legislation.
Chalmers University of Technology, org. No. 556479-5598 is the personal data controller. You can find Chalmers's privacy policy at www.chalmers.se.
As a participant, you have the right to receive information about how your personal data is processed. You have the right to correct incorrect information, delete redundant data, request that processing be restricted, and transfer data to another actor. You also have the right to submit a complaint to the Swedish Authority for Privacy Protection (Integritetsskyddsmyndigheten). If you have any questions about Chalmers's processing of personal data contact Chalmers's data protection officer at dataskydd@chalmers.se.

I agree that Chalmers University of Technology processes personal data about me in accordance with the above.

Date
Signature
Name clarification

Figure B.1: Consent form.

Group Interview Transcript

Welcome to this group interview. We are Emil Bohman and Olle Anthin. You have been chosen to participate in this group interview as you have just been to our escape room. And thank you for taking the time to be a part of this study. We are both doing our master thesis at the Interaction Design Master at Lindholmen. Our area of research is educational escape rooms in the commercial space. We are working with Kistone AB, building an escape room at Karlsborg's Fortress. But this group interview will be about the down-scaled escape room you just took part in.

1. What did you think of the escape room?
2. What was the best part of the escape room?
    (a) Which aspect of the escape room did you find most enjoyable or engaging, and why?
    (b) How did you find the level of difficulty throughout the escape room?
3. What was the worst part of the escape room?
    (a) Were there any elements of the escape room experience that you felt could have been improved or enhanced? If so, what were they, and how do you think they could be addressed?
4. How did you perceive the intensity of the experience?
    (a) Would you have wanted it to be more or less intense?
    (b) How did you feel about the pacing of the escape room experience? Did it feel rushed, or did you have enough time to fully immerse yourself in solving the puzzles and unravelling the storyline?
5. What did you think about the group size?
    (a) Did you ever feel like you didn't have anything to do?
    (b) Did you ever get bored?
    (c) How did the collaboration go?
    (d) Reflecting on your teamwork during the escape room, what strengths did your group exhibit, and were there any areas where you encountered challenges in working together?
6. What did you think of the story within the experience?
    (a) Did you bring any knowledge of the story with you?
    (b) Did it matter if the story was made up or based on reality?
    (c) Did you feel that the storyline or theme of the escape room added to your overall enjoyment of the experience? Why or why not?
7. Did you have a problem with any of the puzzles?

8. What did you think about the tempo and your progression through the escape room?

   (a) Did the clues feel useful and welcome?

9. Our master's thesis isn't about creating the best escape room experience but researching how different key factors affect the experience. With your particular group, we applied these factors: *Factors are explained*. Are any new thoughts coming to mind with this out in the open?

Post-Its from the Thematic Analysis

Below are the quotes extracted from the group interviews. Firstly, by source and then categorised.

Divided by Source

Figure B.2: Post-Its Interview.

Figure B.3: Post-Its Video.

Quotes explicitly for Guidelines to Kistone

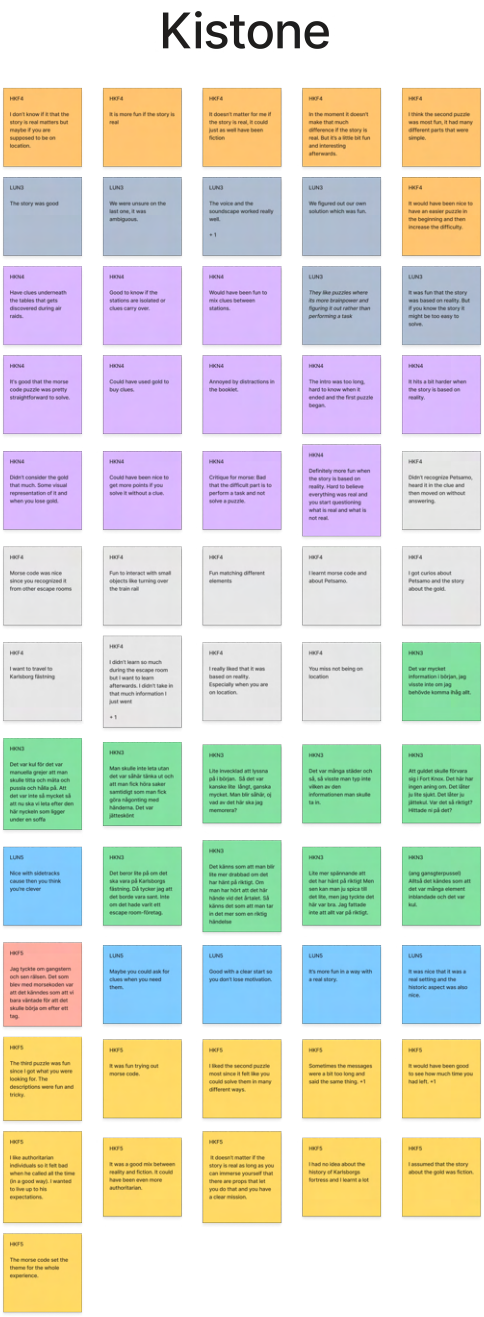

Figure B.4: Post-Its Kistone.

Interview - Categorised

Below are the earlier displayed Post-Its from the interviews categorised into different subject areas.

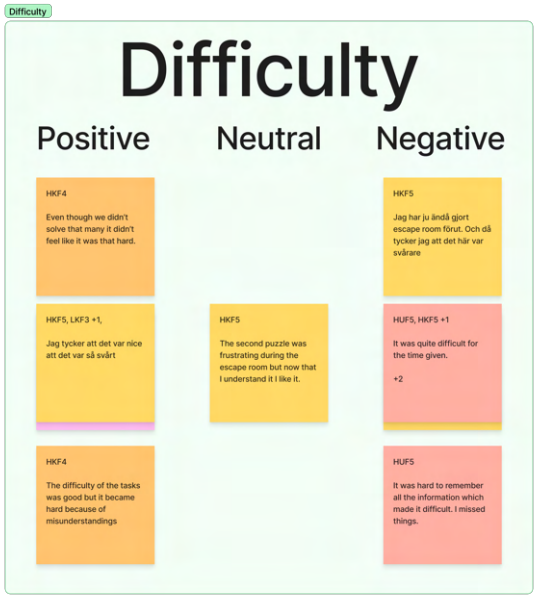

Figure B.5: Post-Its Interview - Difficulty.

Figure B.6: Post-Its Interview - Group Dynamics.

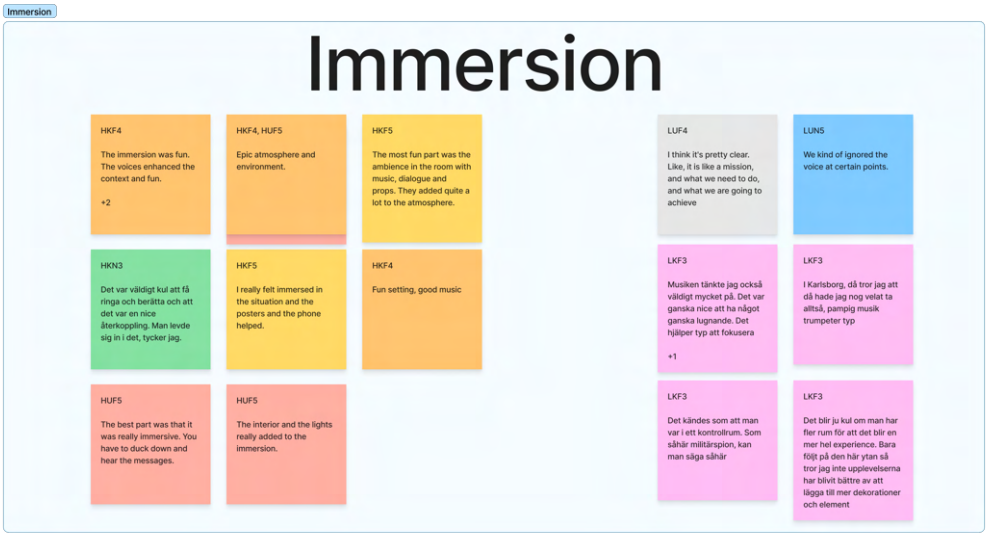

Figure B.7: Post-Its Interview - Immersion.

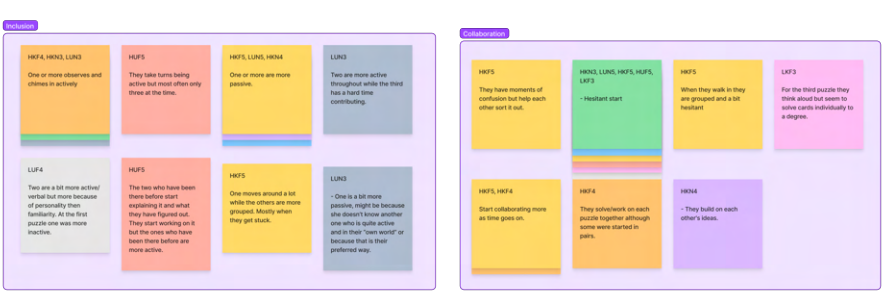

Figure B.8: Post-Its Interview - Inclusion and Collaboration.

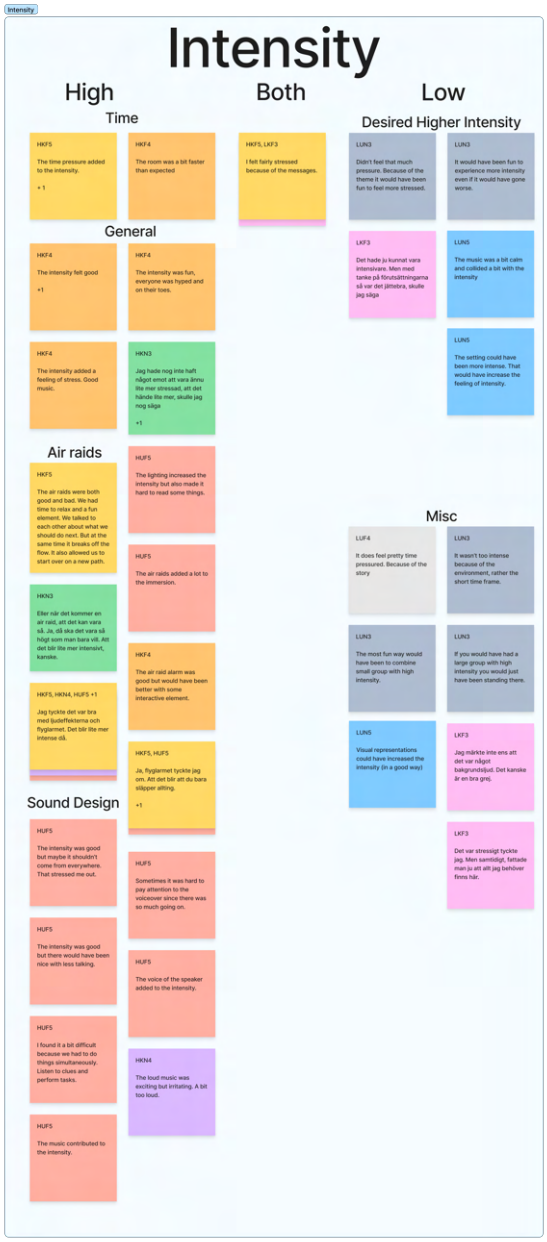

Figure B.9: Post-Its Interview - Intensity.

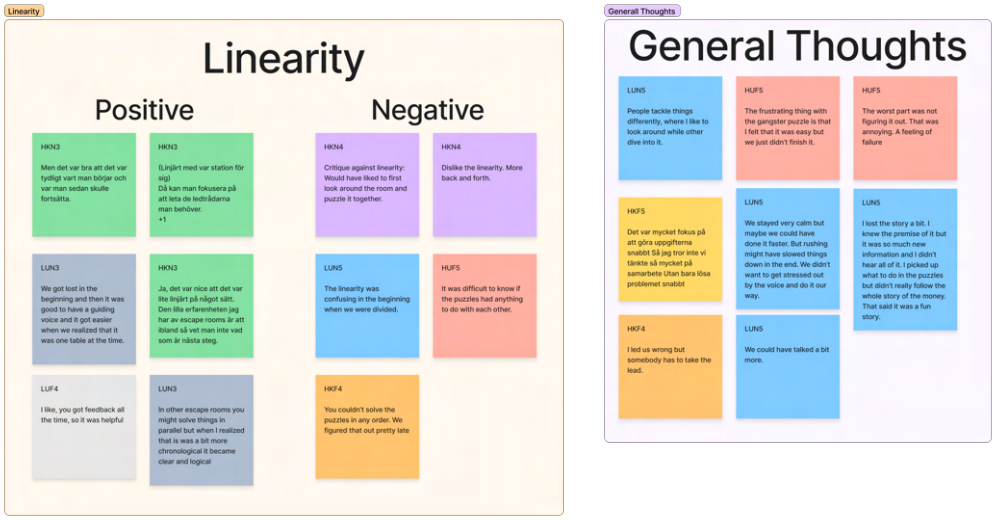

Figure B.10: Post-Its Interview - Linearity and General Thoughts.

Video - Categorised

Below are the earlier displayed Post-Its from the videos categorised into different subject areas.

Figure B.11: Post-Its Video - Linearity and Forced Progression.

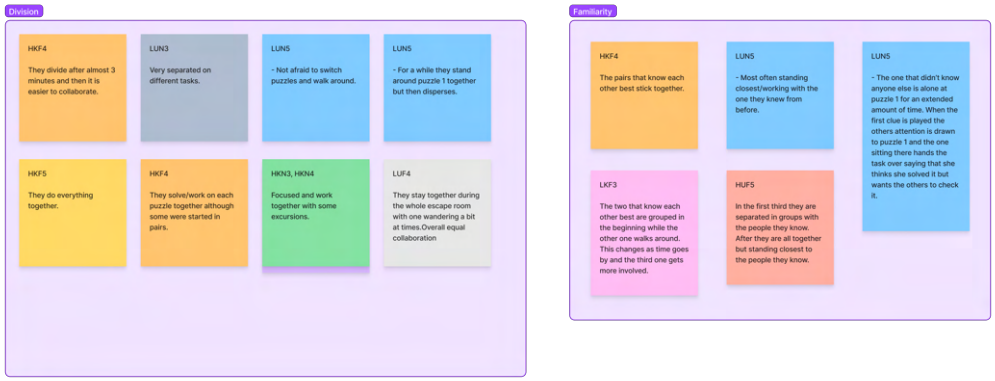

Figure B.12: Post-Its Video - Division and Familiarity.

Figure B.13: Post-Its Video - Communication.

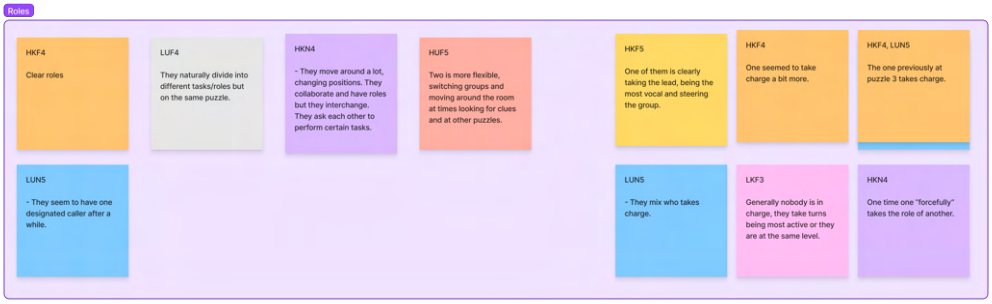

Figure B.14: Post-Its Video - Roles.

Kistone - Categorised

Below are the earlier Kistone-specific Post-Its displayed and categorised into different subject areas.

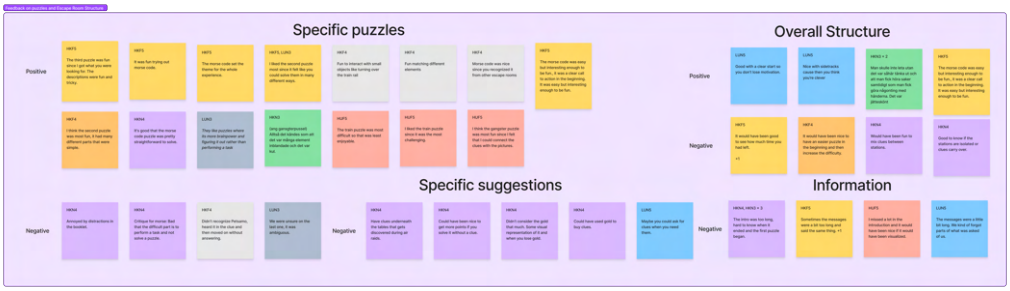

Figure B.15: Post-Its Kistone - Feedback on Puzzles and Escape Room Structure.

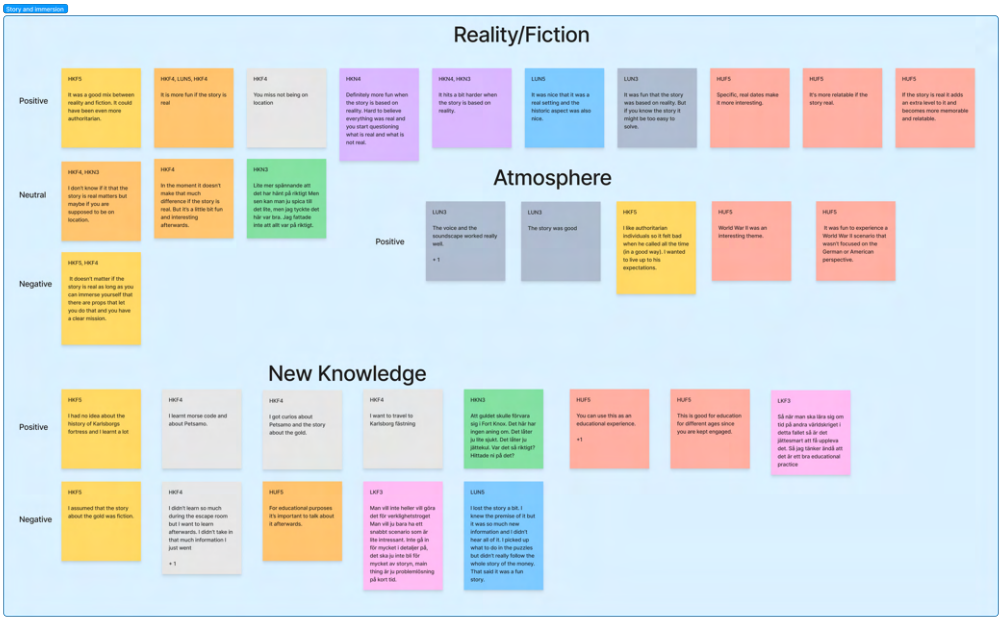

Figure B.16: Post-Its Kistone - Story and Immersion.

Figure B.17: Post-Its Kistone - Storytelling.