Students: Nikolaj Andersen

Supervisor: Henrik Schønau-Fog

May 28, 2019

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Contents

1 | Abstract

This study sought out to investigate the effect of environmental storytelling on creation of emergent narrative in the format of storyworlds. To achieve this, the topics of narratology with a focus on embedded and emergent narratives, environmental storytelling, and storyworlds were researched to derive requirements for an application to be evaluated. The research derived the problem statement: How does the choice and design of environmental storytelling elements influence the creation of emergent narrative in a storyworld format? To answer this problem statement, two versions of a digital environment were implemented with the purpose of embedding the same narrative into two types of environmental storytelling elements. The application was evaluated using content analysis on participant interview answers. Participants were asked to create their own storyworld from their interpretation of the digital environment, using five categories that defined the storyworld. Results indicate that the environmental storytelling elements had great potential for generating emergent narrative, but lacked validation in terms of the influence of design choices, due to a lack of a larger population sample.

2 | Motivation

I have always had a great interest in interactive story driven experiences such as games. There is a special sense of immersion in the world that the medium puts the user in, that makes the experience unique. When i started my education at Medialogy, this interest pulled me towards projects that incorporated these elements in them. In the past couple of semesters, I have worked with projects involving environmental storytelling as the main source of narrative, and these projects gave me insight in the theory of environmental storytelling as well as interactive narratives. In my previous semester, I worked an internship at the Danish Film school as technical director for a small production team, where the project theme was Storyworlds. Storyworlds act as universes that support multiple stories and characters and are yet to be fully defined in academia. Since environmental storytelling still is a rather new field of research as well, I found it interesting to investigate how the two fields could be combined to expand the storytelling potential in interactive experiences, as well as expand the knowledge of both fields of research.

The film industry is starting to look more towards ideas that holds multiple characters and plot lines, as these can be expanded upon with several sequels without necessarily having the same characters in them. The latest example of this would be the Marvel universe and the Avengers movies, which have proven to be a great success.

The goal of this study is to contribute to the creative process of creating these expanded narratives from environments utilizing environmental storytelling.

3 | Introduction

In recent times, directors in the film industry started seeing the potential in working with story worlds or universes. An unknown screenwriter made a rather famous quote stating that "In the early days of film-making, you would pitch a string story. Later, you would pitch a strong character, as character could create multiple stories. These days you want to pitch a world with multiple characters". From this assumption, creators can create several films from the same concept rather than from a single story. This tendency is not only showing in the film industry, as many other type of narrative-driven applications such as interactive narratives and games utilize multimodality and transmedial storytelling to access a broader audience on multiple platforms, as the audience can no longer be found on a single platform [14], [32], [33]. As worlds are vast and complex concepts to develop, many of the details that form the boundaries, rules and different entities in the storyworld are left out for the audience to figure out by themselves. As a tool to present concepts and previous events in a story-world, Environmental Storytelling can be utilized to convey these details without explaining the specifics to the viewer.

Previous studies in environmental storytelling mainly applied the theories to video game formats [5] [7], [13], and the theoretical framework of how storyworlds are defined is yet to be properly defined.

Previous studies on storyworlds established theoretical models for describing the concept, but was never properly evaluated to establish an actual theoretical framework [**?**], [15]. As far as implementing environmental storytelling as the main narrative technique in storyworlds has to the authors knowledge no prior examples. It would be interesting to investigate the result of a setting-driven storyworld with the story being told from environmental storytelling elements alone to determine if this format provide enough narrative context for the audience to derive an entire storyworld.

In this project, an attempt will be made to create two versions of environmentally story driven environments and test if an audience will be able to fill in the other aspects of the storyworld just from the narrative information in the environment. The initial problem state-

ment for this study is thus:

How does the design of a virtual environment affect the understanding of a storyworld?

This paper documents the different theories within narratology relevant for interactive narratives, environmental storytelling methods and strategies, and an overview of theories within storyworlds. These theories will then be applied in the design and implementation of two virtual environments. These environments will then be used to conduct an experiment to investigate the potential in storyworld creations made from the audience only from the environments utilizing environmental storytelling.

4 | Analysis

In order to properly define and answer the problem, relevant theories on interactive narratives and environmental storytelling will be covered. Based on knowledge gained from the previous studies on storyworlds, as well as previous experience of working with storyworlds in a small production, a general model of what a storyworld consists of will be derived.

This chapter will then cover a model for how environmental storytelling is utilized for generating narrative content for storyworld creation. A final problem statement will be derived from the topics covered, and chapter will conclude with a set of guidelines for designing the implementation and the evaluation of said implementation to answer the final problem statement.

4.1 Interactive Narratives

Narrative is defined as "a story or a description of a series of events"[1]. Narrative in interactive experiences are however challenging to define, as narrative and interaction are often opposites, as narration stops the user from interacting, while interaction breaks the narration. the debate between Narratologists and ludologists [24] never came to a clear definition on whether or not interactive applications such as games classify as narratives, since narration and interaction are defined as opposites (reference), this study does not intend to extend the definition of this type of narration. Instead, this study will look at narrative methods that support interaction, such as the architectures described by Jenkins as a response to the narratology ludology debate [1], and discuss how they can be used to further a narrative in environmental storytelling and storyworlds.

- **Embedded Narrative:** In narratives there is a distinction between plot (syuzhet) and story (fabula), where plot is the "Structured set of all causal events as we see and hear them presented", and story refers to the audiences own mental construction of the order in which the events in the told plot occurred [23]. An example of this relationship in linear narratives such as movies could be when the audience is presented with a flash-back in a scene. Even though the order of which the scene presents the flashback is not

[1] https://dictionary.cambridge.org/dictionary/english/narrative

chronologically consistent with the order in which the event occurred, the audience is able to construct their own understanding of when the flashback happened time wise in the story. Jenkins [1] states that most movies and novels do not follow a strictly linear narration, as most of the stories have a background that is revealed as the narrative progresses through clues or references. This type of narrative is called embedded narrative, and allows the narrative designer to build upon parts of the story that are not directly conveyed to the audience, giving the narrative a greater depth. Jenkins [1] also describes how game designers design narratives in 2 ways, with one being structured and directly conveyed to the player, and the other being embedded in the environment and through the level design, that the player can discover as they explore in the game world.

Zilber [21] describes that readers relate to embedded narratives in three spheres, where the first sphere describes the immediate inter subjective relation, the second describes a collective social field of relation, and the last describing a broader relation of cultural meaning, giving sense to any particular life meaning. This definition suggests that embedded narrative can be interpreted on several levels, dependent on the reader. This is supported by Nelles's [22] description, suggesting that embedded narrative is very broadly defined, and that the level of understanding om the embedded narrative from most relation is determined by the reader.

For any environmental design, embedded narrative is very useful to consider as the designer has the potential to convey a large portion of narrative just from the embedded information interpreted by the player. Embedded narratives are a key asset of implementing environmental storytelling, as the narrative information contained in the environmental storytelling element would be considered as embedded narrative, according to Jenkins definition above.

- **Emergent Narrative** Emergent narratives are narratives that spark from player interaction. The narrative is not structured by a designer, but is constructed by the player as a result of actions and interactions in environments. While embedded narratives are built into environments, emergent narratives are created from the narrative space that an environment potentially provides. Jenkins [1] uses the example of the Sims, a sandbox game developed by Electronic Arts, where there is no story built into the game, but as the player created characters engage with different situations and handle them differently according to personality traits, narrative emerges as a result.

  Aylett [36] describes that the very nature of narrative is emergent, as narratives often is inspired from scenarios that standalone do not provide exciting narrative, but can spark

emergent narrative nonetheless. She uses the example of a soccer game where certain events such as causing a penalty can spark emergent narrative of how that scenario affects the individual player or the team as a whole.

Louchart [18] derives a model presenting three levels of emergent action and interaction, with the lowest level being emergent sparked from interacting with different types of environments, a medium level of emergence from interacting with characters, and the highest level described as interacting as RPG game masters. In relation to this study, the emergent level of interaction will be in the low category, as interactions will occur through environments.

While emergent narrative is not necessarily a pre-requisite for environmentally conveyed narrative, the method is highly usable in cases where the audience is expected to generate their own narrative, such as storyworlds. In this study, emergent narrative is a useful tool for the process of creating narrative, in the shape of a storyworld. Designers of emergent narrative experiences should however be aware that the generated narrative can not be structured by the designer, causing a high risk of a very subjective understanding of the emergent narrative.

- **Evoked Narrative** Evoked narrative is narrative that builds upon previous knowledge or experience of a narrative. When an audience is already well familiar with a story, the evoked narrative can extend from that previous experience knowing that the audience will most likely already have a set expectation of what the narrative will contain, at least to the point of knowing the types of characters and settings that will most likely occur in that narrative. This method allows the designer of the narrative to skip most details and expect the audience to fill in the gaps of the narrative with their own knowledge of the story. Because of this, evoked narratives requires the story to be well established before being able to build upon it.

  For narrative applications that are designed as extensions of already established narratives, such as in transmedial storytelling [32], [14], evoked narrative is a strong tool for accessing deeper understanding of the overall story being told. While this narrative method is not applicable to this particular story, as the application developed will not work as an extension of already established narrative background, it is worth considering in similar studies or projects that build upon narrative background.

- **Enacted Narrative** Enacted narrative is narrative that emerges from player agency. Player agency allows the player to take on the role of an avatar or character, and that character has certain abilities or traits that make the gameplay or performance enjoyable to watch. Jenkins [1] compares this phenomenon to watching a live performance

of an artist. While the experience narrative follows a script or choreography, it is the performance of the actor or artist that makes the experience unique. Playing as a character in a virtual story is enhancing the experience by allowing the player to take the role of that character. An example could be the game "The Elder Scrolls V: Skyrim" by Bethesda Studio, where the player takes the role as the a "Dragonborne" character in the Skyrim universe. The player is actively taking the role of that character and experiences what it is like to posses the powers of such a character and how you become an actor in that story, furthering the narrative through enactment.

Enacted narrative can add extra value to narrative in applications such as games where interaction in terms of game mechanics are a large part of the experience. In this project however, less focus is put on game mechanics, and more focus on interpretation from the environment.

From the narrative architectures covered above, the most applicable strategies for this study are the embedded and emergent narratives, as these work directly with the concept of condensing narrative information into a medium, and emergent narrative as a method for creating narrative based on interaction and actions in an environment.

In addition to the narrative architecture theories, it is important for the narrative designer to be aware of the narrative intelligibility [20] of the conveyed narrative. Narrative intelligibility describes the difference in the understanding of the story between the author and the audience. The difference is referred to as Author Audience Distance (AAD) and can either either have a short interpretation gap (Didascalic narrative), meaning the audiences' understanding of the narrative is very close to the understanding that the author has, or have a large gap (Abstract narrative), meaning the understanding differs a lot from the authors understanding.

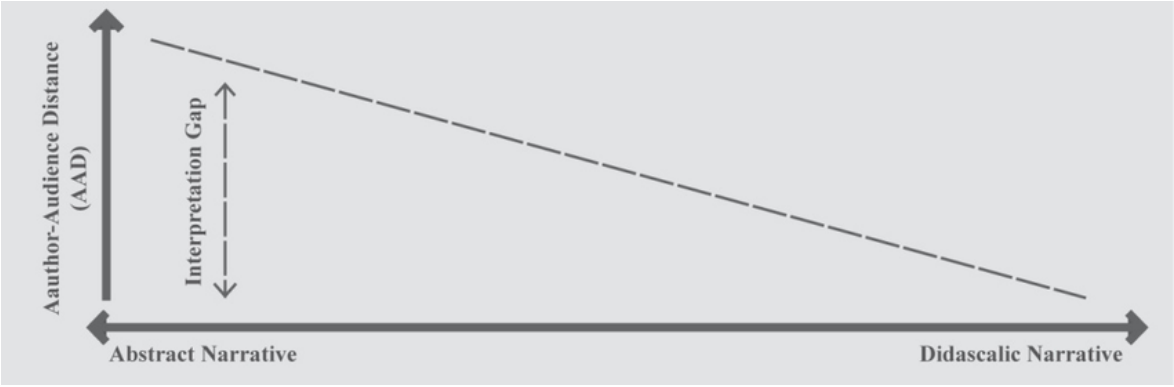

Figure 4.1: Author Audience Distance model

Having a didascalic AAD is useful when making sure that the audience has a clear understanding of the narrative. With that said, the author might risk that the narration becomes dull to the audience. An abstract narrative may result in a completely different understanding of the intended story, but can be part of the design as it allows the audience to fill the gaps themselves to piece together the story as a whole. Often designers would like the narrative to be somewhere between these extremes to make sure that the audience is not bored from the narration, but also understand the intended narrative that the author designed. There is however no right or wrong way to use these concepts as they are design choices that shapes the narration in a certain way.

For the purpose of this project, it is expected that the AAD of emergent narrative will lean towards an abstract understanding, as emergent narratives are not structured by the designer. However, as the application will also support embedded narrative design, it is expected that the AAD will not become completely abstract, as the embedded is expected to convey some similar themes common between author and audience.

From the theories mentioned above, a model has been derived, describing the relation between embedded and emergent narrative (EEN) in this project (figure 4.2).

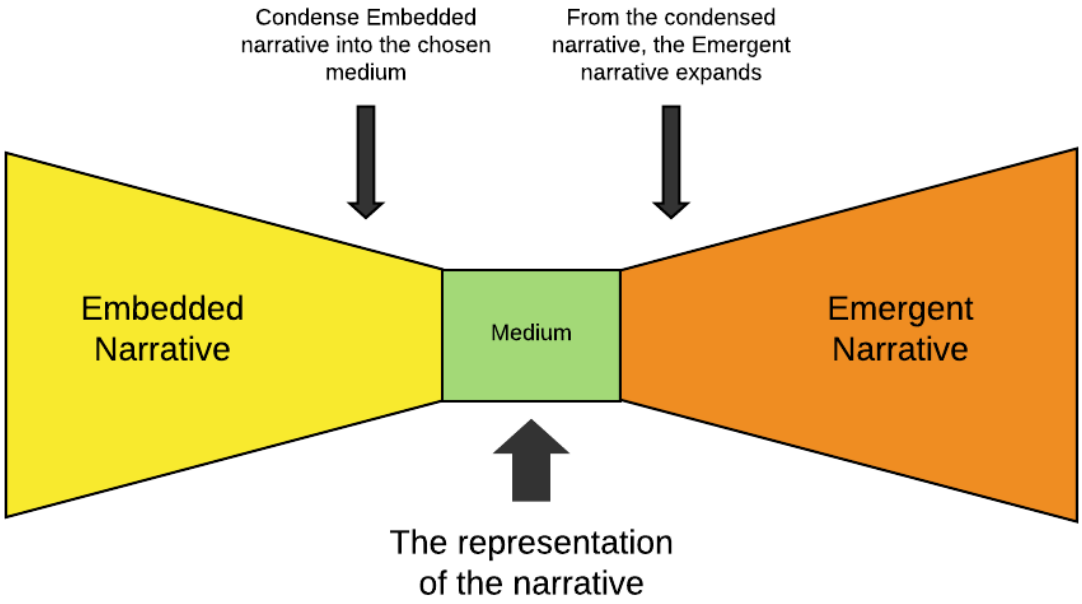

Figure 4.2: Embedded Emergent Narrative (EEN) model

The figure illustrates the embedded narrative background and how it becomes embedded

in a chosen medium. From the medium, the player should be able to interpret the embedded meaning, and use it to generate an emergent narrative.

From interactive narratives, the concepts of embedded, emergent, evoked and enacted narratives was covered. The most important types of interactive narrative strategies in relation to this study were the embedded and emergent strategies, as they were the strategies that most closely related to the topics of environmental storytelling and storyworlds. From these, a model describing the relationship between embedded and emergent narratives was derived to support the implementation of these concepts in this study.

4.2 Environmental Storytelling overview

Environmental storytelling is a type of narrative technique that does not utilize text or speech, but rather visual representations an environment that conveys narrative through embedded narrative elements. This section will cover the theoretical background of environmental storytelling, and cover what techniques can be utilized to convey narrative in environments.

4.2.1 Theoretical background

Environmental storytelling was first defined by Carson [3] [4]. Carson used his practical knowledge from working in the theme park industry to describe how an environment could facilitate themes and stories. He describes how the same concepts apply when creating virtual environments, describing them as virtual theme parks. He outlines several considerations that one should make when constructing each area, such as consistency in theme and making sure every element in the scene fits the theme. This was further defined by Jenkins [1], who defined several types of "narrative architecture", whereas in relation to environmental storytelling the embedded and emergent narrative structures work well in the context. He explains how virtual environments support narrative methodologies such as the embedded and emergent narrative architectures. He states that "In the case of embedded narratives, the game space becomes a memory palace whose contents must be deciphered as the player tries to reconstruct the plot. And in the case of Emergent narratives, game spaces are designed to be rich with narrative potential, enabling the story-constructing activity of the players".

Smith and Worch [9] took the field further by describing the potential of environments, using numerous examples from the game Bioshock and how certain narrative strategies are implemented. They defined how environments should be “staging player-space with environmental properties that can be interpreted as a meaningful whole, furthering the narrative of the game” [9]. They explain that environments should provide the player with narrative context.

Bruno Dias [16] later criticized how environmental storytelling in the industry was starting to follow a pattern of using dead bodies and skeletons to facilitate the narrative events that occurred. He stated that while this method proved effective at visualizing the effect of past events, it had become overused as an easy way to implement environmental storytelling. He used numerous examples of games that implements this method, and states how the method can be done the "cheap" way, as well as the right way where the dead body sparks an emotional response in the player. "We need games to be autopsies or funerals, examinations and celebrations of what came before" [16]. He takes the games "The Witness" and "Firewatch" as his main examples, but also uses examples from games like Fallout, Bioshock: Infinite and Dark Souls to describe the phenomenon and how he considers the techniques are used correctly and how they are cheaply implemented.

Aporia [5] is a game that started its development as a study on environmental storytelling at Aalborg university. The game was developed further and was released as a game production in its own. As an extension of this production, a masters thesis was written [7] which establishes a framework on environmental storytelling and guidelines for how to use it. He makes his own definition of environmental narration:

"A selection of staged objects, events, and environmental setting, suggesting a cause-effect relationship of a semiotic relationship from a story theme in a non-linear time and space".

He further explains how environmental storytelling differs from classic interactive storytelling in games by how the user interact with the story. For this reason, dramatic narratives are not well suited for environmentally told stories, as these seek to give the player more control in exploring the story. For this purpose, he suggests that the environment layout could directly reflect the narrative structure that the designer want the player to follow.

4.2.2 Guidelines for implementing Environmental storytelling

This subsection will cover some of the current strategies for implementing storytelling in environments

Fernandez [8] describes how stories can be told through indexical signs, which leaves the audience with the pieces of the puzzle, allowing them to figure out themselves what happened in the scene. Indexical signs are part of the theory regarding semiotics, signs and meaning making, described by Chandler [12]. Indexical signs are signs indicating a cause and effect relation between the sign and the cause of the sign. An example of an indexical sign could be a footprint. In this example, the footprint is the effect resulted by the cause, which in this case can be interpreted by a foot stepping down in this spot, causing the sign. Indexical signs are part of the theory of semiotics, which is the study of signs and meaning making. In addition to indexical signs, there are symbolic signs, which are signs that have been given meaning

through convention, such as symbols for bio hazard, which only indicates the meaning it represents through the conventional use with bio hazards. The last type of sign is iconic signs which are signs that closely depict their associated meaning. An example of iconic signs could be pedestrian lights, showing a man drawn as if he is walking, symbolizing that pedestrians are allowed to walk when that sign is on. While all types of signs are usable in environmental storytelling, the most commonly used type of sign is the indexical signs, as they often occur naturally in relation to cause and effect events.

Bordwell [11] describes the elements that go into Mise en scene, which is the creation of a set or stage and the effects that certain props can have. Mise en scene is from theory on film making, but the concepts can also be applied to virtual environments and general level design, as the process of creating environments closely relates to the process of set-dressing a scene for film. When placing any element is a scene, the designer must make considerations such as how important objects are placed compared to objects part of a background.

Combining environmental storytelling with the model derived in figure 4.3 requires the above mentioned techniques for an environmental storytelling element to convey the desired embedded narrative. In order to incorporate environmental storytelling in the model, the medium is replaced with the environmental storytelling element that the embedded narrative condenses into. The embedded emergent narrative model with environmental storytelling as the medium is shown in figure 4.3

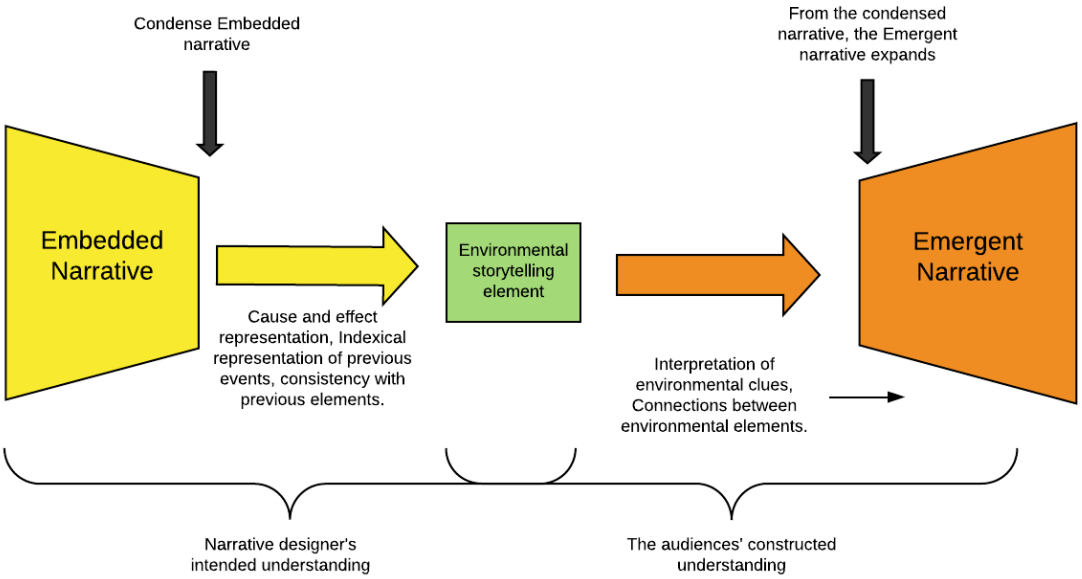

Figure 4.3: EEN model applied with Environmental Storytelling

The model depicts how the environmental storytelling element through techniques such as cause and effect representation, indexical sign representation and consistency with other environmental elements represent the designed embedded narrative. The relation between the embedded narrative and the represented element is the representation of the authors understanding of the conveyed narrative. The right side of the model represents the emergent narrative that the player creates from their interpretation of the environmental element as well as the perceived relation between other environmental elements in the scene. The relationship between the environmental element represents the players understanding of the emergent narrative generated.

This section has covered the background of environmental storytelling as well as examples of how it can be implemented into environmental design. In extension of the embedded emergent narrative model derived in section 4.1, a version of the model with the medium being represented as an environmental storytelling element has been derived. The model represents the general strategy for allowing players to generate emergent narrative based on the design choices of environmental storytelling elements.

4.3 Storyworlds

Storyworlds are not yet properly defined, as the term often changes meaning depending on the context in which it is used [14]. Storyworlds often refer to stories that expand beyond a single set of characters, but rather defines a story universe that contain several characters. At this current time, there does not exist a validated method for creating or analysing storyworlds, as the examples of methods have not yen been evaluated further than in theory. The goal of this study is not to create a definition of storyworlds, but rather to establish a method for expanding emergent narrative to describe the content of a storyworld.

In a post on his official website, Jenkins [6] write about transmedia stories which "Are based not on individual characters or specific plots but rather complex fictional worlds which can sustain multiple interrelated characters and their stories" [6]. He describes further how we as readers are continually drawn to expanding narratives that are never finite, as with movies or theater plays where you leave the experience with a sense that you have understood the entirety of the narrative.

Herman [15] has his own definition of what a storyworld is, as he describes storyworlds as "mentally configured worlds". However he presents an interesting method for defining the world using 5 dimensions:

- **When:** The timeline that describes the history and time of the storyworld.

- **Where:** The location of the narrative. He elaborates on this category explaining that the location both entails place that is narrated, as well as in relation to the viewers own situation.
- **How:** The How category covers how narrated events are spatially constructed in the world. One has to state in this category if changes happen over time in the constructed space.
- **Who:** The Who category describes the characters and inhabitants of the constructed world. He divides the characters into two types, one that acts as Foreground inhabitants who act as main characters in the world, and the Background inhabitants that fill out the world.
- **Why:** This category concerns the point of view of the situation, objects and events are perceived through. He emphasizes that the view is required to be of a vantage point as it is required to be able to construct the presentation of the world.

While these dimensions work well for describing the storyworld overall, they are heavily influenced by the definition of the world being a "mentally configured world". The storyworld acting as mental configurations makes it difficult to adapt the the environmental storytelling format.

As part of the 9Th semester at Medialogy, The author of this paper was part of a small production at the Danish Film school. The theme of the production revolved around building storyworlds in real-time engines such as Unreal Engine, with the purpose of creating a benchmark of a one minute long animation movie rendered real-time. At the film school, the coordinator of the production was a man named Simon Andreasen, and he had his own format designing storyworlds. His format followed a star-shaped model that contained 5 categories that described the storyworld. The categories were Timeline, Setting, Characters, Rules, and Dilemmas. While the framework was only loosely based on academic research, with the categories closely resembling the five dimensions of Herman [15], the model proved quite effective at generating the basic framework of a storyworld rather quickly. However, the category of Dilemmas proved to slightly vague at describing the storyworld compared to the other categories.

From the experience gained at the production, the storyworld star worked as a sufficient guideline when implementing the actual 3D representation of the designed storyworld. Based on the experience with the star format, and the resemblance between existing theoretical frameworks of storyworld frameworks, the storyworld star appears to be a sufficient practical framework for describing storyworlds, however the framework still needs further validation

before it can be considered a suitable framework for creating storyworlds from a theoretical stance.

Based on the previous experience with the star format, the category of dilemma will be changed to a more suitable category. The author of this paper recommends changing the category to Themes rather than Dilemmas, as Themes to make the model more flexible to work with. The storyworld star is shown on figure 4.4.

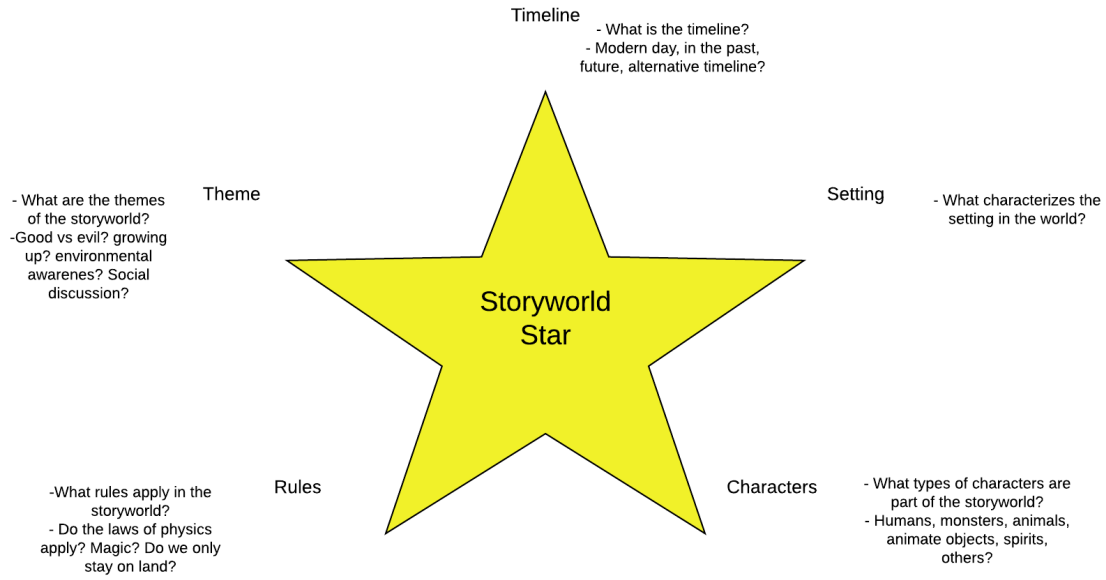

Figure 4.4: The storyworld star template for describing the storyworld elements

The storyworld star support five categories that the emergent narrative generated from the environmental storytelling elements should be used to describe the generated storyworld from the environment.

4.4 Final Problem Statement & Design requirements

From the analysis, theories on interactive narratives were analyzed, from which a combination of embedded and emergent narratives were chosen as the main strategy for generating narrative. Environmental storytelling theory was covered to get an understanding of the topic, and strategies for implementing environmental storytelling was applied to the strategy of embedded and emergent narrative as shown in figure 4.3. Finally, the topic of storyworlds were briefly covered, and a strategy of how to describe a storyworld using 5 categories of Timeline, Setting, Characters, Rules, and Themes was chosen. Based on these conclusions from the

analysis, the following problem statement was derived:

How does the choice and design of environmental storytelling elements influence the creation of emergent narrative in a storyworld format?

To answer this problem statement, a prototype will be implemented with an embedded narrative conveyed through an environment utilizing environmental storytelling techniques such as indexical signs, cause-effect relationships and mise en-scene. In order to evaluate the problem, an evaluation strategy must be derived that supports the analysis of narrative data to determine if there is a notable difference in the emergent narrative if the design of environmental storytelling elements are altered.

5 | Methods

The research approach for this study was determined through the research onion concept [28], [29]. The research onion concept is an effective tool for designing most research processes, as it helps the researcher decide on the methodology to be used based on the type of knowledge being analyzed and type of work the researcher will perform to find solutions to the problem in a given study (see figure 5.1 for the model). The research onion uses 5 steps that should lead to the methodology suitable for the research problem.

The first step is the research philosophy and is decided based on the type of knowledge being analyzed in the study. The philosophy should help justify the choices for the overall methodology, as certain choices of methods tend to work better in certain fields of study, but is not defined in the sense that some research philosophies are stronger than others.

The second step is the research approach, and can either be deductive or inductive. The deductive approach seeks to answer a hypothesis derived from existing knowledge and theories, where the inductive approach seeks to establish general theory on topics not yet defined.

The third step is choosing a research strategy for the study. The strategy should be chosen from how the researcher will attempt to answer the problems in a given study, and is not necessarily limited to a single type of strategy.

The fourth step is the time horizon of the study. In the research onion, there are 2 types of defined time horizons: Cross-sectional and longitudinal. Cross-sectional timeline follows a pre-defined timeline with a deadline for when the data should be collected, and the longitudinal timeline refers to an expanded timeline with repeated data collection over time.

The fifth and final step is choice of data collection and analysis methods. The methods should be chosen to support the choices of the first 4 steps in the research onion as best as they can. Additionally, a study can follow a mono-method, a mixed-method, or a multi-method research approach [28]. In the mono-method approach, the study follows a single research approach. The multi-method approach uses several approaches in different iterations to answer the problem in a study. The mixed-method uses a combination of 2 or more methods and combine them in a single research approach [28].

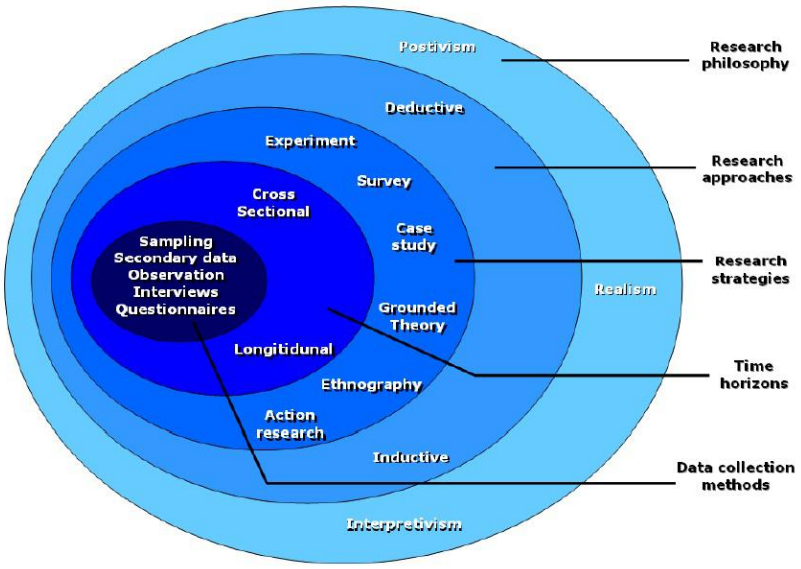

Figure 5.1: The research onion model. Each layer of the onion represents a step in the process of deciding the overall research strategy in a study.

For this study, the problem statement is derived from existing theory on narratology, environmental storytelling and storyworlds. These topics both hint at the type of research philosophy to use, namely the interpretivism philosophy in regards to measurement of human perception and understanding, as well as a deductive research approach since the research is based on previous studies in these fields. The study is also bound to a cross-sectional timeline, as the project is due within a set time frame. To answer the problem statement, an experimental research strategy will be used to determine the effect that environmental storytelling has on storyworld creation. For the data collection and analysis methods used in the study, a qualitative approach was chosen in the form of interviews. Figure 7.5 shows the general derived strategy for answering the problem statement.

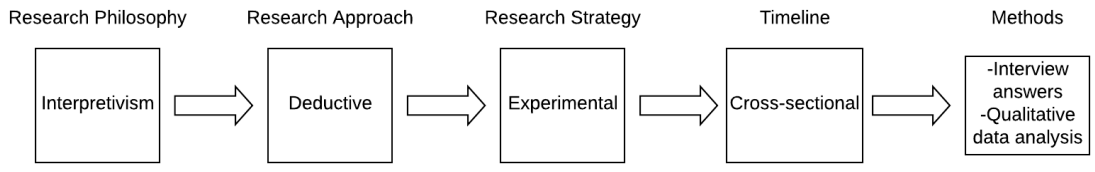

Figure 5.2: The research strategy derived from the research onion model.

With the strategy created, a test was designed with an overall goal: to determine if the environmental storytelling approach is an efficient approach for conveying narrative in the embedded emergent narrative model (figure 4.3).

To evaluate the emergent narrative created by the participants, the storyworld format will

be used to allow participants to expand their narrative further than just a single plot. Success criteria will be for the answers from multiple participants within the same testing group to revolve around similar themes in the storyworld categories. It would also be valued to gain additional feedback on the general use of environmental storytelling and their subjective feedback on the use of the format and how it could be improved for further testing.

In order to answer the problem statement, a prototype was created using the guidelines from sections (Environmental storytelling and narratology section references). To determine how the environmental storytelling elements affects the audiences emergent story, 2 versions of the prototype was created with changes to the environmental elements as the key difference. These environmental differences are the dependent variables for the experiment. The implementation process and design choices of the prototype is covered further in chapter 6. The prototype was designed to have the participant walk through an environment, following a path designed to take the participant past the environmental elements that hold the embedded narrative, which in turn should allow the participants to make their own emergent story from these elements.

5.1 Test Design

The test design will follow a between group test design (also known as between subject testing [26]), meaning that test participants will be divided into 2 groups where each group is given a version of the test with different values of an independent variable. The independent value that is changed is the design of the environmental storytelling element in the given prototype version.

Between-group design was chosen over within-group design (where participants in each group is exposed to both values of the independent variable). There are 2 reasons for this choice; the first being the risk of biasing the participants and their story creation from experiencing the same embedded story twice, even though the environmental elements change. The other reason is due to fatigue in testing. The task of creating a storyworld can potentially be a lengthy process, which would both be a tiresome task for the participant to complete twice, as well as limit the amount of test subjects that can realistically complete the test in the testing period.

With the choice of between-group testing comes a set of disadvantages as well. for one, the test will compare the performance of 2 separate groups of participants, meaning that the differences of each participant will affect their results, increasing the risk of type II errors (failure to reject the null-hypothesis [26]). The best solution to avoiding type II errors would be to test on a larger sample size, which is a challenge with the design of the test resulting in lengthy test sessions. As the study is only conducted by a single researcher, it is quite challenging to run the test on a large enough sample to rule out the possibility of type II errors.

As the problem statement involves creation of narrative in the form of emergent narrative from the participants, the chosen data analysis method for this test is content analysis of interview answers [26]. The emergent narrative will be discussed in a semi-structured interview, and answers will be categorized using emergent coding [26], which generates codes from the interview answers, then assign all the interview answers to the generated codes. Since these codes are generated from the gathered data, and not chosen from previously established knowledge in the field, the reliability of the coded data may suffer from the lack of inter-coder reliability [30], as there will only be a single coder available to analyse the data. The ideal procedure for emergent coding would be to have several coders generate the codes, then evaluate if the codes describe the data accurately. The codes should continue to be evaluated until all coders agree that the codes are accurate enough to ensure the data is reliable.

5.1.1 Participants

The ideal participants for the test would be people that either have experience with story creation, or people with interest narratology and story creation. At the medialogy masters program, a mandatory course at the 8'Th semester was 'Narratives in digital culture' which covers most of the basics of traditional storytelling and narratology in interactive media, making the students at the masters program viable participants for storyworld creation. The participants were gathered through convenience sampling at Aalborg university Copenhagen, in the time period 9Th of may to 14'Th of may. Convenience sampling was used to gain as many participants as possible to minimize the risk of type II errors. To further the validity of the data gathered from the participants, a demographic questionnaire was created to gain a better understanding of the types of participants gathered. The design of the demographic questionnaire is covered in section 7.4.

5.2 Test setup

Show the layout of the testing setup. The test was conducted at Aalborg University Copenhagen, in the time period 09/5 - 14/5. The test setup used 2 laptops, one for the participants to play-test on, as well as answer the demographic and storyworld questionnaires. The second laptop was used by the test conductor to take note on, as well as note down answers from the interview. The test setup layout is shown in figure 5.3.

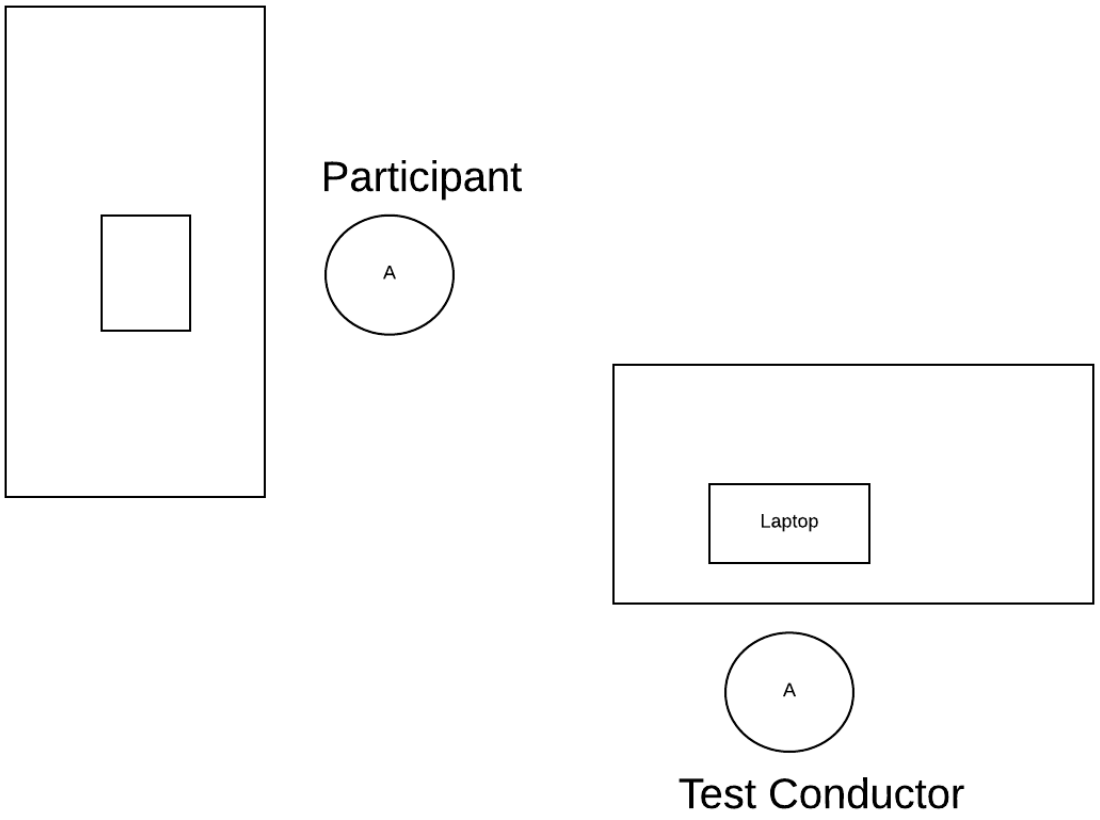

Figure 5.3: The basic layout of the test setup.

5.3 Procedure

The test procedure will be divided into 5 overall steps, where each step has a specific purpose:

- Introduction: The test introduction should inform the participant about the purpose of the test and what type of tasks they will need to complete during the test. When the participant is first greeted they will be introduced to a consent form. The form will state what type of data will be collected during the test, how that data will be used after the test, and that the participant will remain anonymous.
- Demographic data collection: The first part of the test will be to gather information on the participant. This information will be age, gender, current occupation, as well as a player type survey to identify how the participant usually engage with similar applications, as well as getting a better understanding of what brings that participant motivation. The demographic questionnaire will conclude with the question: "How

much do you agree with the statement: I see myself as good at constructing stories". They can answer with a rating between 1 and 7 where 1 represents "Strongly disagree" and 7 "Strongly agree". (**Maybe expand this part with more questions?**)

- Testing session: The participant will be asked to play through their assigned environment. They will be introduced to their task, which is to observe the environment as they walk through it and walk through to the end. The participant will also be informed that it would be very helpful if they think out loud as they play, making it easier to gather observational data as they play. The participant will be informed that they need to construct a storyworld afterwards, which should help motivate them to spend more time in the environment observing the different elements, rather than walk through the environment with the highest completion time. As the participant plays through the environment, 2 types of data will be gathered. The participant will be timed as they walk through the environment with 4 different stages of the test that will be logged: The start of the test, at the first intersection where the environments start to differ, at the entrance to the last area, and at the end of the playtest.

  The second type of data will be observation data. The type of observations will be either comments the participant make as they play, specific interactions they might make (ie. if they seem lost, if they show particular interest in any specific parts of the environment, if they make any unexpected interactions such as backtracking or trying to "break" the prototype). The observation data will be gathered by taking notes as the participant plays.

  The participant will be informed that they are free to ask questions if they need help, or if they believe that some part of the prototype is acting unintentionally.

- Storyworld creation: After the participant has played through their environment, they will be asked to fill out the categories of a storyworld star with the 5 categories: Timeline, Setting, Characters, Rules, and Theme (See figure 4.4). The Participant is asked to write a small description for each category, but they are free to be as descriptive as they want in each category. The answers should be based on their interpretations of the environment they played through in the playtest.

- Interview: After the participant has filled out the storyworld star, a semi structured interview will be conducted. The interview will be divided into 3 focus areas: Overall experience with the environment, their storyworld interpretation and understanding, questions related to observations and further elaboration on answers to the storyworld if needed. The overall experience in the environment seeks to accomplish 2 goals. The

first goal being to make the participant feel comfortable in the interview and reflect on what they just experienced. The second goal is to establish if there were some parts of the experience that seemed to strongly influence the participant (whether that influence affects their answers in the storyworld creation or general motivation to complete their task).

The 2. focus area of the interview will function like an open discussion of the storyworld they created with the star. This part aims to get further elaborations on the answers in the star, as well as identifying what part of the environment that inspired the participant to their own conclusions.

The last focus area of the interview aims to answer any further questions that may have occured from earlier parts of the interview or from the observations made during the playtest session. This part of the interview is expected to vary a lot between testing sessions, as each participant will have a different experience and understanding of the environment. This will conclude the test session.

5.4 Demographic design

While the answers in the demographic will be anonymous, Demographic data regarding age, gender, and current occupation will be gathered. The participants will also be asked to choose a player type category that they believe they identify themselves with the most. The player type information will help determine if the specific participant has certain motivational factors in similar applications, and might help determine if the participants actions and answers are driven from these. The player types follow the empirical player type model established by Quantic Foundry [27], who developed this model from more than 400,000 data gatherings from different types of video game players across the world. The model uses 12 different types of player motivation factors for playing games and assign each motivation factors to 6 different overall player types. The empirical model is shown in figure 5.4.

types.png types.png

Figure 5.4: The player type model created by Quantic Foundry.

The desired player type for this test is the Immersion type, as the main motivation factor for Immersion players is story elements and the sense of being somewhere or someone else.

The demographic will then cover how capable the participants see themselves as story creators as well as their general interest in the subject. Questions in this part of the demographic will be in a likert scale format where participants state whether or not they agree with a statement, with answer possibilities ranging from 1 (Strongly disagree) to 7 (Strongly agree). The questions are as follows:

- I have an interest in story universes that hold multiple stories.
- I consider myself as capable of constructing my own stories.
- I regularly make my own stories or narratives.

These questions seek to determine if the participants fit the target group requirements as storytellers, and their interest in the matter.

5.5 Interview

The interview is designed as a combination the semi-structured and unstructured interview method [26]. The interview seeks to cover a specific set of topics, but parts of the interview can not be structured beforehand, as the storyworld is better evaluated with questions arising as the participant is asked to elaborate on the 5 categories in the storyworld star. The interview follows an order of topics divided into 3 question groups, and every question group follows the same order of topics.

The first group of questions serves as an introduction to the interview, where the participant will be asked to reflect over the experience in the play-test, as well as identify the strengths and weaknesses of the implementation. This is done with 3 questions:

- **How was your overall experience?** This question is the opener to the interview, and allows the participant to recall the experience.
- **Was there any part of the experience that you enjoyed in particular?** The participant should pick the part of the experience that was the most positive part in the session. This serves to pinpoint the part of the experience that participants tend to remember most, which might explain how they shaped their storyworld from the overall environment.
- **Was there any part of the experience that you disliked in particular?** Same purpose as the question regarding positive experience, but with a focus on the parts that tend to have a negative impact on the experience.

The answers from the first group can yield guidelines for further development of the study by identifying the parts that needs improvement, as well as the parts that worked well.

The second group focuses on the storyworld created by the participant. This part will go through the 5 categories of the storyworld star, but questions will depend on the answers given to these categories, attempting to make the participant elaborate on their answers. Apart from following the 5 categories, the this part of the interview will mostly be unstructured, as answers in one of the categories might lead to expansion on answers in another category (ie. the description on themes in the storyworld may lead to further elaboration on the types of characters in the storyworld). As each category is elaborated upon, the interviewer will attempt to condense the answers into descriptive labels with the help of the participant to make the answers easier to compare between participants.

The last group of questions seek to uncover any further information not covered in the first 2 groups. The first question is based on observations made doing the playtest session. If the participant is observed acting in a manner that sparks a question, such as suddenly start backtracking through the map, a question in this category could be why the participant acted in that manner and what the purpose and thought process was behind the observed action. Elaboration on these observations could identify causes of bias in the test design, as well as flaws in the prototype. The final question asks the participant for any final comments. This serves to round off the interview, as well as giving the participant the opportunity to give any further comments that may not have suited for the first part of the interview.

5.6 Observation method

The observational data will be divided into notes on player behavior that appear either out of the ordinary or appear to have the desired effect (Such as spending more time than usual at certain objects in the scene). The notes will be made by the conductor of the interview, viewing the screen over the shoulder of the participant (See test setup section for reference) as a non-participating observer, meaning the observer will not be observing as part of the activity. Apart from observation notes, the participants will also be timed as they play through the environment. The environment is divided into 3 sections and as the participant enters a new section, the test conductor will log the time. The purpose of the time logging will be to determine if there are certain parts of the experience that players tend to spend more time, as well as how long time they spend in the overall experience.

6 | Design and Implementation

Based on the requirements from the analysis and methods chapters, 2 environments were designed and implemented. This chapter will go through the design choices for the environments, as well as highlight the most important technical aspects of the implementation.

6.1 design of the environments

The design of the environments supported an embedded narrative that was similar in both applications, but told through different environmental storytelling elements. The goal with the design of these elements was to supply the participant with a "staging ground" for their own storyworld, following the concept of the embedded emergent narrative model shown in figure 4.3.

6.1.1 The Embedded Narrative

The embedded narrative was designed as a background story that the environmental elements in both environment versions should reflect. While the embedded narrative is not strictly defined, the overall theme is that the environment in both versions of the application is divided into three sections, with each section portraying a part of the story.

The first section, where the player starts, portrays a peaceful and beautiful field with lots of healthy vegetation, and a small cabin indicating that people still live in this area.

The second part of the environment will show a gradually withering environment with dead trees and grass. This area has a few clusters of strange structures growing out of the ground, which appear to be the cause of the environment withering.

The third and final area of the environment is completely overrun with the structures growing out of the ground. Strange stone structures also populate the environment, leading to a large stone temple entrance, that appears to be the source of the growing structures.

The difference between the two environment versions will be the design of the structures growing out of the ground. The goal with this design is to investigate how the change of the designs of these structures affect the emergent narrative of players, as the rest of the

environment remains unchanged.

6.1.2 Environmental Storytelling Elements

The design of the environmental storytelling elements in environment version A and B both are designed as relatively simple shapes.

Environment A was inspired by spherical designs with a mystical feeling about them. Figure 6.1 shows the inspirational design used when designing the elements of environment A.

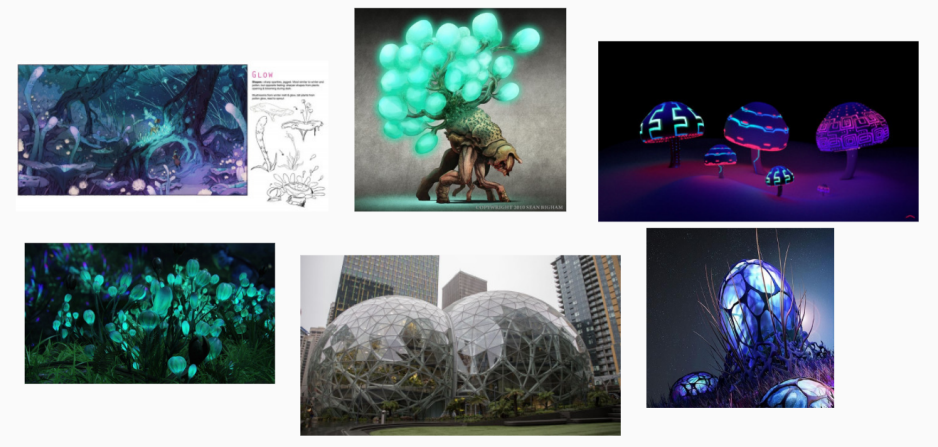

Figure 6.1: Inspirational concepts for designing the dome elements

Environment B was inspired by harsher and more dangerously looking designs. Figure 6.2 shows the inspirational design used for designing the elements of environment B.

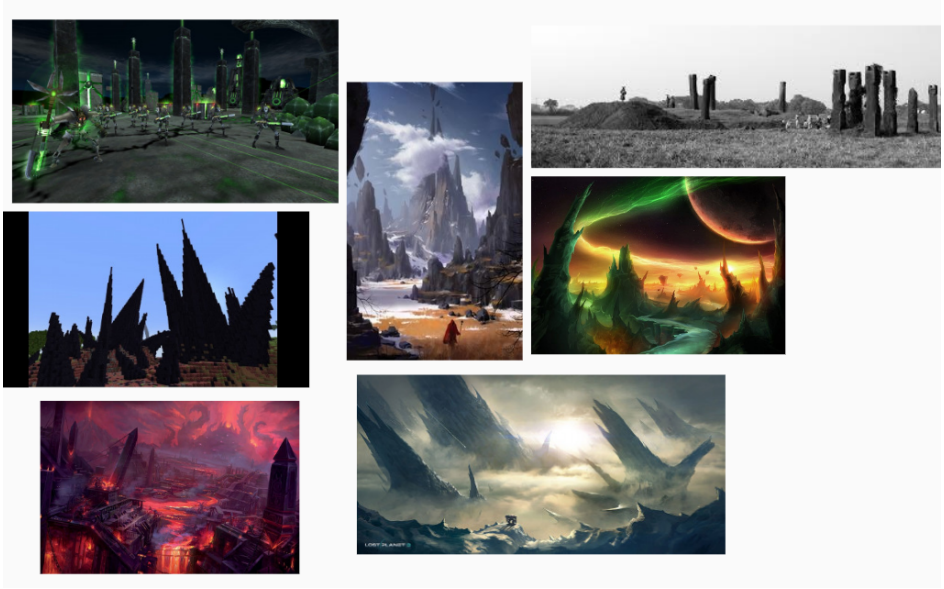

Figure 6.2: Inspirational concepts for designing the spike elements

Apart from the designs of the elements themselves, both versions of the environments were designed to have the exact same placements of the elements. This was done to limit the amount of variety between the environments to the elements alone, as the elements are the independent variable in the test. In early development of the implementation, the environments were marked with placeholders for the placements of environmental storytelling elements (as shown in figure 6.3), that the surrounding environment was built around.

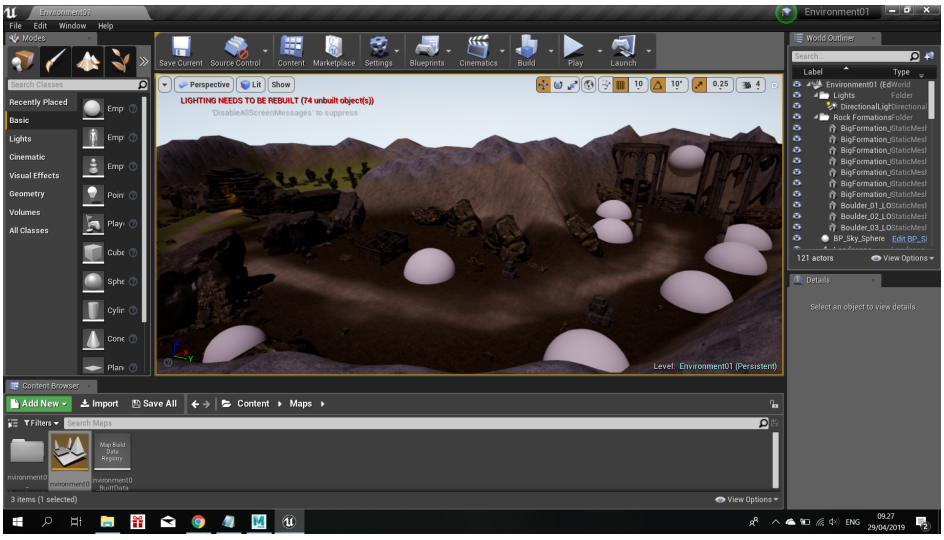

Figure 6.3: Common placeholders for the domes and spheres in each environment version.

The task that test participants would be given with the implementation was to simply walk from point A (where the player starts) and follow the path until they reach point B

(Where the environment ends). The path leading to the end was designed to block out lines of sight between the three parts of the environment. This was implemented to make the transition between the areas exciting and surprising for the player by not revealing the next area before entering it.

Figure 6.4: The environment curves to avoid direct sight lines into the following areas.

6.2 Implementation

The environments were implemented using Unreal Engine and Maya 3D. Unreal Engine was chosen as the main tool for creating the environments due to it's intuitive interfaces, and because of the tools such as the material editor, foliage and landscape creation tools. The majority of assets were assets bought in the Epic store during the world building projects at the Danish Film school.

6.2.1 Functionality

The functionality of the environments were implemented using the Blueprint system in Unreal Engine. Blueprints are visual scripts that support a multitude of functions for working with object oriented scripting, and is the main method of implementing functionality in Unreal Engine. In this project, the main appliances of blueprints were in the player character, the menu system that allows the user to select levels, and collision functionality used for detecting when players enters certain areas.

Character

The player controlled character in the application is a default 3'rd person controller that is tweaked to fit to this project. It was desired to have the player control a character that

would move in a convincing manner, as the only interaction the player could perform was to move and look around. The default character comes with a rigged 3D model, and standard animations such as running, jumping, and standing idle.

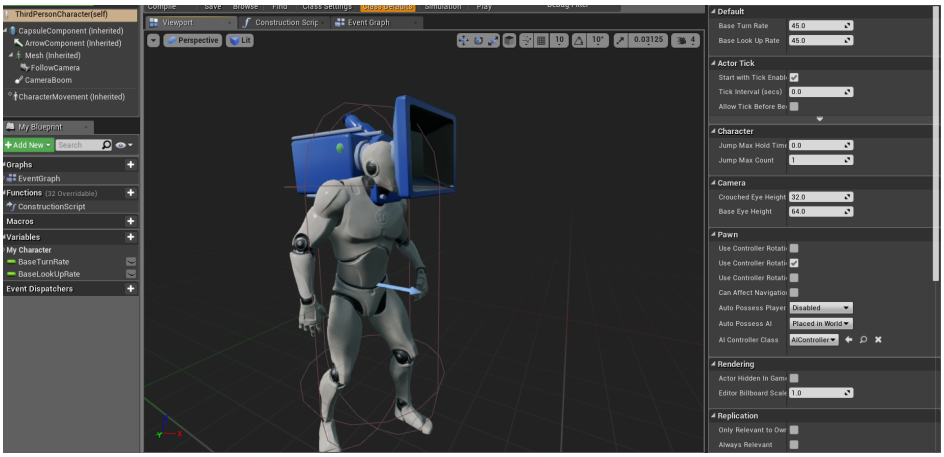

Figure 6.5: The modified 3'rd person controller Blueprint for supporting camera movements based on character animations.

The character blueprint has a basic movement system for transformation and rotation operations based on input from various systems such as keyboard, game-pad and Virtual Reality controllers. The major changes needed to the Blueprint was the camera controls, as it was desired to have the full functionality of the character movement, but from a 1'st person perspective. This was achieved by parenting the camera to the character mesh, which would allow the camera to be affected by the transformation and rotation input, as well as the animations, simulating that the camera follows a head-bopping motion when standing idle and running around. As the default controls for the camera was set to 3'rd person controls, the camera rotations was also tweaked to inverse the vertical rotation of the camera from mouse input. Lastly, footstep audio was applied to match the running animation providing audio feedback from moving around in the environment.

Menu system

The Menu system was implemented to easily allow the user to access both environments in the same application. In Unreal Engine this is achieved by creating a separate scene that acts as the temporary loading scene from where the a menu widget is called. Widgets act like panels you can place in a scene, and is the standard way of implementing user interface (UI) functionality. The menu panel is simply a canvas with 3 buttons: A button for loading each level, and a quit button.

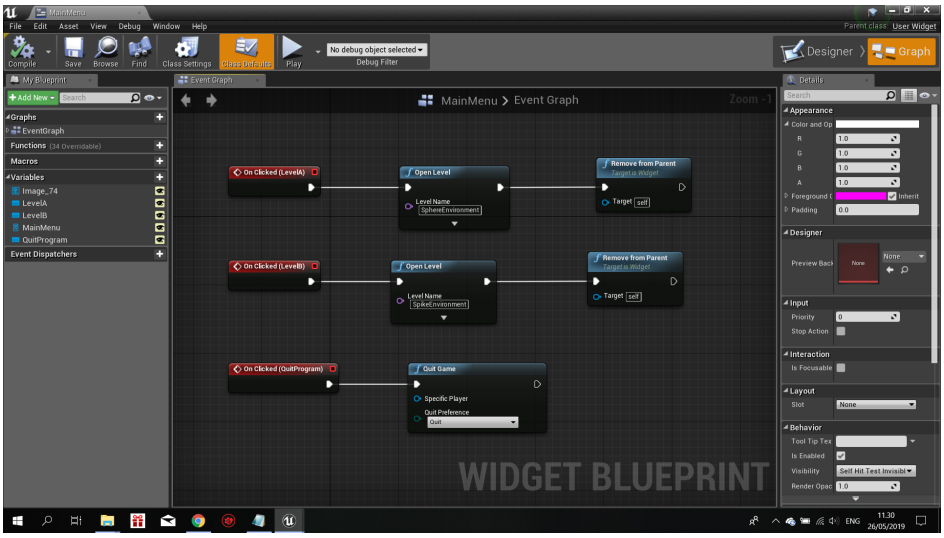

Figure 6.6: The functionality of the main menu widget buttons.

Each level button has an On-click function that loads the desired environment level, then destroys the widget to clear the screen. The quit button simply calls the "Quit Game"- function part of the Unreal API. The functionality of the menu system is shown in figure 6.6

Trigger boxes

Trigger boxes are used to detect when the player has reached the end of the level. The trigger box is placed at the end of each level at the desired point to end the experience, and called in the Level Blueprint when the character controller's collider overlaps. The following blueprint is then called:

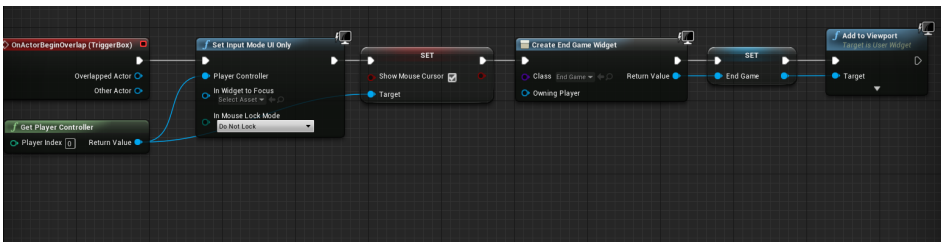

Figure 6.7: The functionality of the trigger box at the end of the environment.

The Blueprint first changes the Input mode to "UI only" removing control of the player controller, set the mouse as visible in the viewport. Another UI widget is then instantiated, which contains some text stating that the level is complete, and a single button for quitting the game. The widget functions the same way as the widget shown in figure (ref figure).

6.2.2 Environmental storytelling elements

The most important assets in the scene are the assets that hold the environmental storytelling of the embedded narrative. Each version of the environments support a different design strategy for the elements based on the theory of simple shapes in (cite shape reference). Additionally, each version of the elements are designed with different colour themes to set a certain mood.

Domes

In environment version A the shape based structures that grow out of the ground are designed as spherical dome structures. The domes are made from a 3D model used in a previous project, that is modified to fit the purpose of this project.

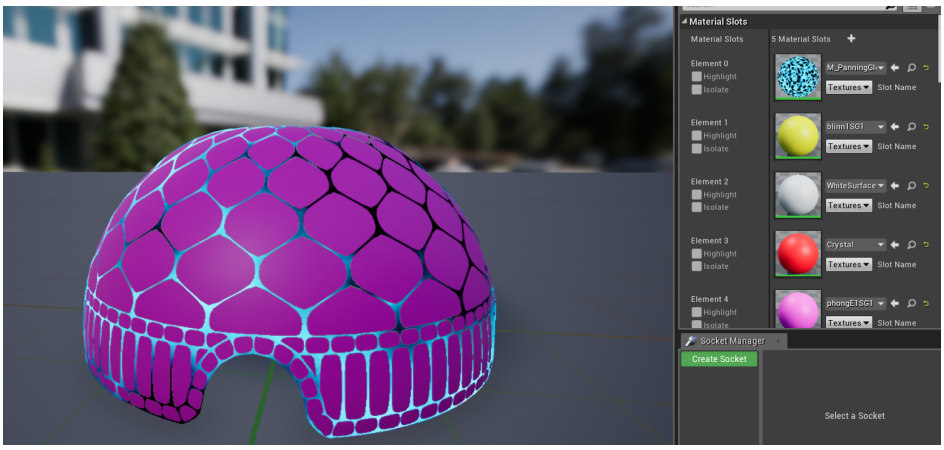

Figure 6.8: The Dome static mesh without final materials.

The model uses material placeholders that can be overridden in Unreal Engine to achieve the desired look. This was done using a completely transparent material for the parts of the model that were not desirable, such as the pink surface of the dome model.

Spikes

The spike elements were implemented for environment version B, designed to look visually opposite of the dome structures, while following the same concept of being structures growing out of the ground with similar visual effects for conveying the same embedded narrative.

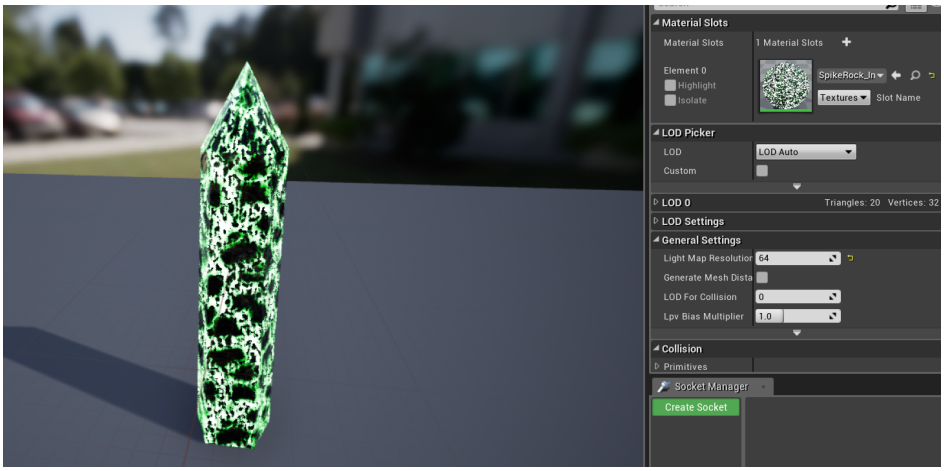

Figure 6.9: The static mesh of the spike elements.

The spikes were designed as simple 3D objects acting as building blocks for kit-bashing different appearances of the spike structures. Kit-bashing is a technique that uses already created assets and modify or combine them to create new assets fast. This technique allowed several shapes of the spike structures to be created with simple 3D models.

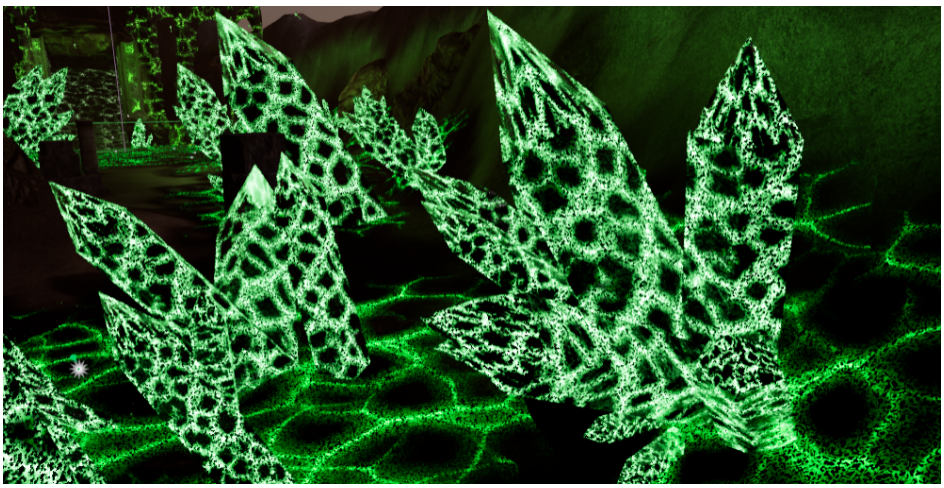

Figure 6.10: Spike meshes kit-bashed together into the final result.

6.2.3 Materials

Materials are one of the largest aspects of the implementation, as the majority of all the assets placed in each level use them to a certain degree. While most assets in the implementation only required their materials to cover the basic physics based rendering (PBR) and shading concepts such as roughness, specular, metallic and normal map values, as well as applying base colour such as textures, other materials required additional shader effects for visual effect, or for special requirements for the asset.

Emissive materials One of the most interesting material types created for the application was the emissive materials used for both the Environmental storytelling elements, as well as some of the surrounding structures and ground cracks. These materials were unique in the sense that they focused less on standard shading and more on achieving a specific visual effect such as the animated glowing patterns on the spikes and domes.

The emissive effect is achieved using the same technique in all the materials, but each material has a unique requirement that such as having the effect look animated or added on top of already existing material. For the purpose of keeping this section short, the material for the Ground cracks will be covered as an example.

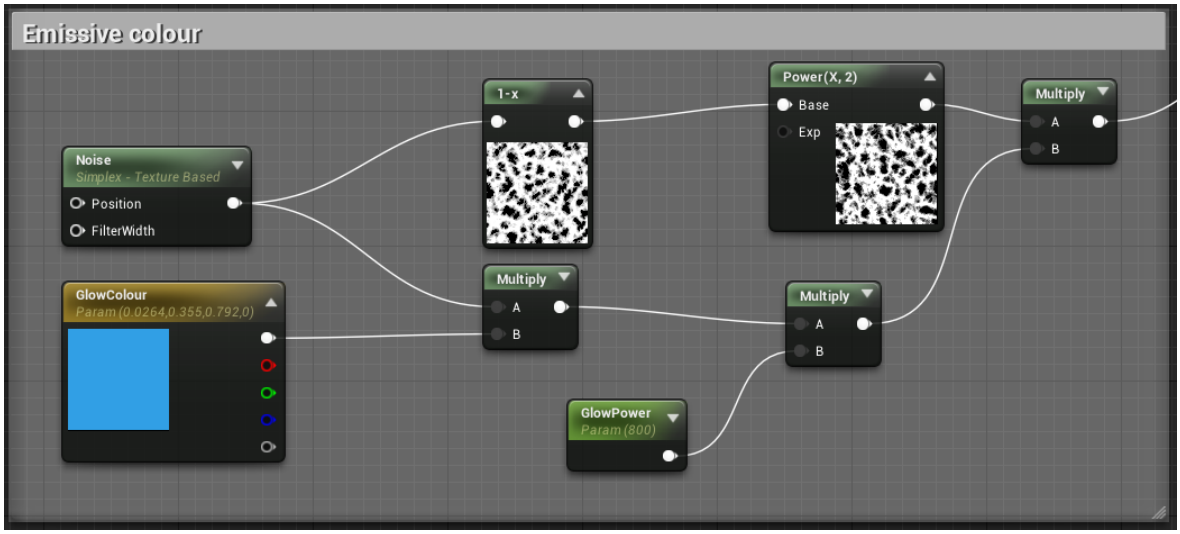

Figure 6.11: The emissive material effect from the material editor.

The material is divided into 2 sets of effects. The upper part of the material editor functions like an opacity mask, controlling which parts of the material that is opaque. The editor takes an input from the texture, and reads the black areas of the picture as values of 0 (complete see-through), and white as values of 1 (completely opaque). These values are then multiplied with a "RadialGradientExponential" node, which acts as a radial gradient with values approaching 0 as they move further away from the center. The gradient and opacity mask multiplied together gives the effect that the opacity of the material fades out the further away from the center each pixel is.

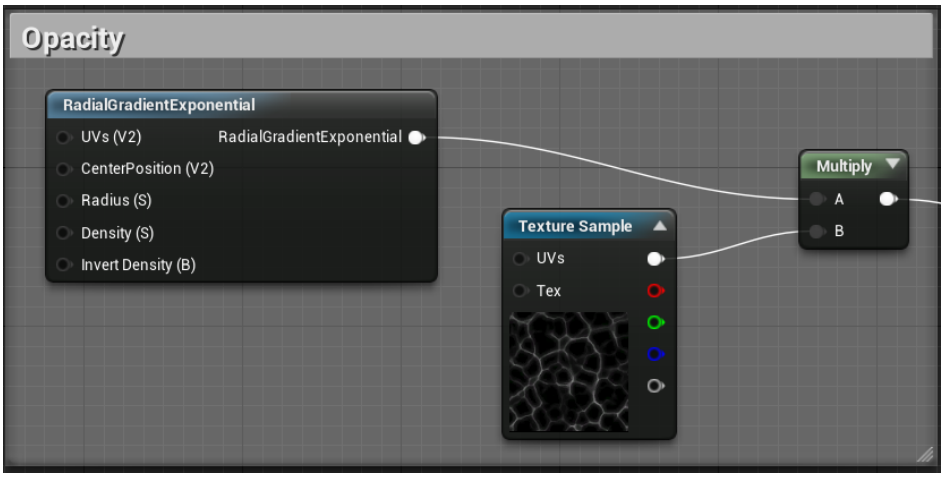

Figure 6.12: The opacity mask and fade effect for the ground cracks material.

The lower part of the material editor shows how the emissive effect is achieved. The material takes a colour parameter, which determines the colour of the glow. This colour is then multiplied with a "Noise" node, which creates a noise field of values between 0 and 1, creating variation in the the colour. The noise field is then modified with a "1-x" which takes the noise as input and modifies every value of the noise field and returns 1 minus each separate value. The output is then raised to a power of 2, before once again being multiplied with the colour value. This step is what creates the large patches of black in the emissive materials, which in the case of the cracks on the ground becomes transparent spots due to the opacity mask. The last step multiplies the emissive colour with a glow power parameter, which controls the intensity of the emissive glow.

Landscape material

The landscape in the environment is created using the Unreal Engine landscaping tool, which can shape a large plane into a desired shape for a landscape. In order to colour the landscape, a certain type of material was needed for the tool to be used as paint.

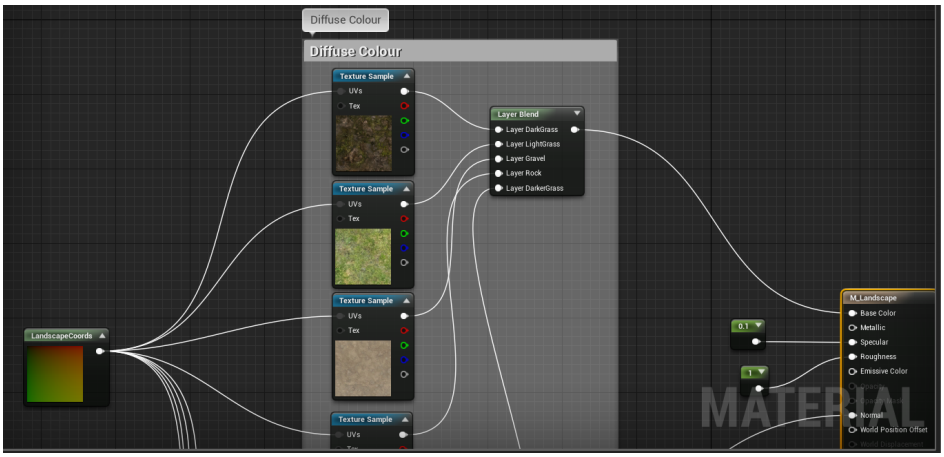

Figure 6.13: The diffuse colour graphs of the landscape material.

The material functions like most basic materials, but with the addition of Layer blend nodes. These nodes allow the landscape to be painted with several textures and their corresponding normal maps, which is useful when a landscape should support several types of textures like grass, rock, or sand. In the landscape editor, the material will allow the creator to swap between the layer types when painting the landscape.

Material instances

An important part of working with materials in Unreal Engine is instances of materials. When a material is called, the shader function created with the graph needs to be calculated. This is however not very cost efficient if you want to create various versions of the same material, but with minor adjustments. To avoid having to run calculations on every single material, one can create instances of materials were only the values of parameters can be changed. When several instances of a material is called, it is only the parent (also referred to as master material) that is compiled. This is especially useful for materials with a more complex calculations such as the water material instance (figure 6.14).

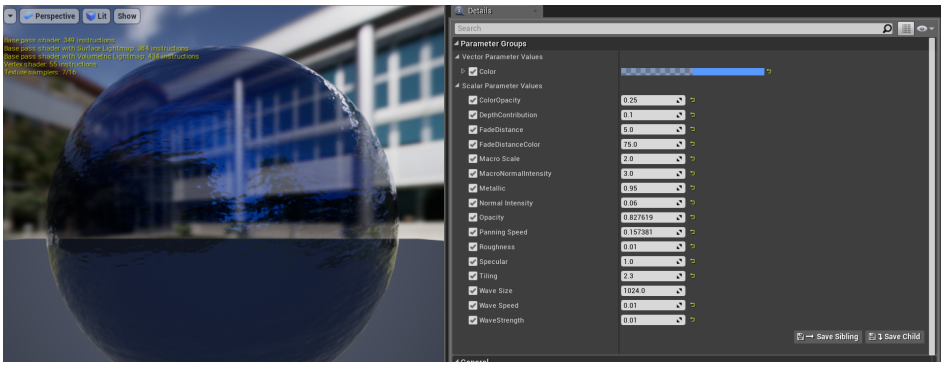

Figure 6.14: Material instance of the water material used in the first area.

6.2.4 Foliage and LOD systems

As the majority of the environment consisted of vegetation, the foliage tool was a great part of creating the environment. The foliage tool allows the creator to assign static mesh actors to a list of foliage types that can then be painted unto landscapes and other meshes, creating forests and fields very fast.

Figure 6.15: The foliage tool with different foliage types and brush settings.

When working with foliage it is important to be aware of the performance cost of the chosen assets, as assets will often be instantiated thousands of times in a scene for models such as flowers or grass. One of the cheapest methods of implementing thousands of foliage assets into a scene, is to make sure each asset has more than the standard level of detail (LOD) model. An LOD model is a version of the same model, but simplified in terms of polygon count. When the camera moves a certain distance away from the asset, the model will switch to an LOD with lower polygon count to maximize performance.

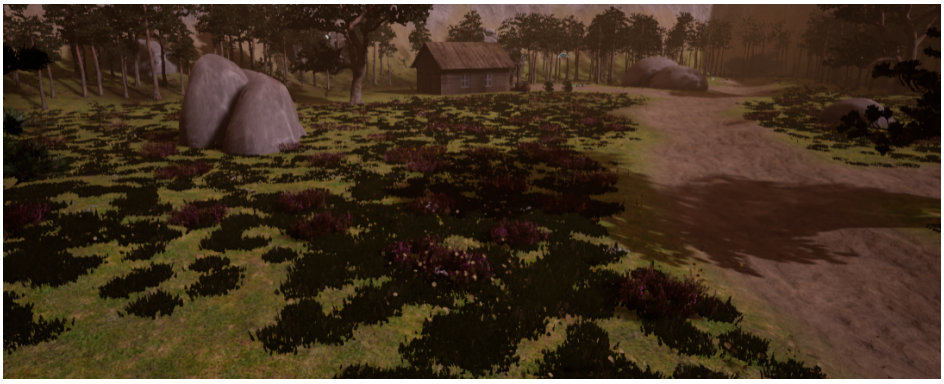

Figure 6.16: Grass foliage uses simpler meshes the further away the camera is.

as shown on figure (ref figure above), the LOD's of the grounded vegetation uses a model that is not visible once the camera moves a certain distance away, however at that distance, and at ground level angle, the change is not noticeable by the player.

6.2.5 Lighting and Post processing

The implementation mainly use standard lighting such as directional light used with the standard Unreal Engine SkySphere blueprint, as well as a skylight that make the shadows softer. There are however a few techniques that are more advanced which will be covered bellow.

Emissive lighting

The emissive materials appear to emit light, however in order to have the light affect the surrounding assets, a few steps must be taken. Firstly, the static mesh actor, with the material applied to it, needs to be changed to support emissive static lighting. This is done under the lighting settings of the asset details.

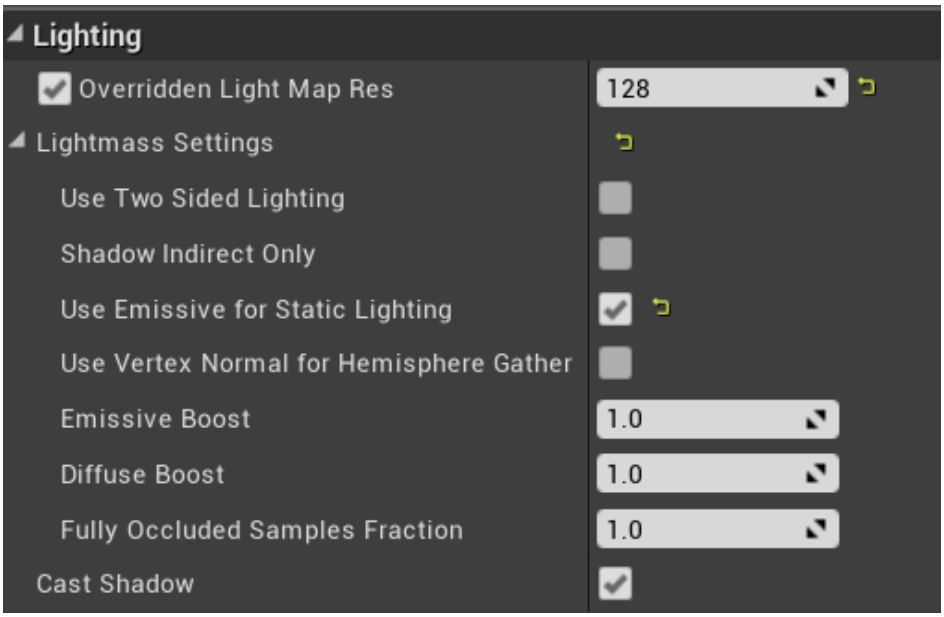

Figure 6.17: Lighting setting of static mesh to enable emissive lighting.

Secondly, the emissive material instances need to have a high enough glow value for the light intensity to be noticeable. This is done by using the glow power value shown on figure (ref emissive material figure) and set it to a value that is large enough to get the desired lighting intensity. Since emissive light is static light, the change can only be seen in the environment once the light has been built in the scene.

Post processing As the player progresses from the first area with bright nature, and into the second area that seems to have withered, the light should fade dynamically to fit the mood of the second area. Since the main light source is a directional light, this effect is achieved using post processing volumes.

Figure 6.18: The post processing volumes in the scenes.

The post processing volumes adjust the minimum and maximum brightness of the camera exposure over a blending radius, which interpolates from the current exposure brightness values (either outside any volumes or going from one volume to another) to the set brightness values of the volume.

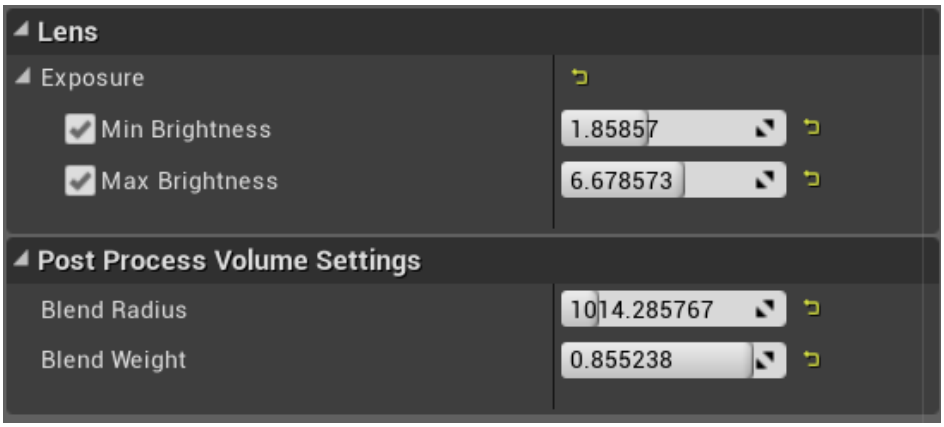

Figure 6.19: The exposure and blending settings applied to the post processing volumes.

6.3 The finished application

The finished application supports 2 environment levels portraying the same embedded story, but using different environmental storytelling elements to convey the embedded narrative. For the test, the participants will be tasked to walk through their given environment and create their own narrative in the format of a storyworld.

Figure 6.20

Figure 6.21

Figure 6.22

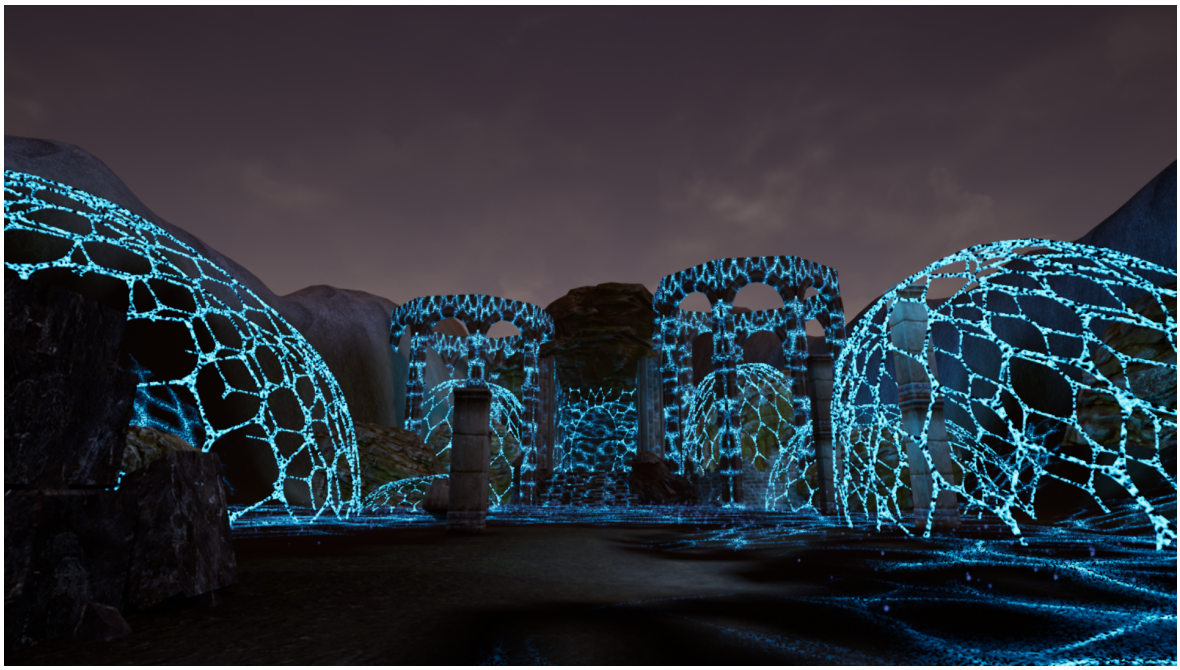

Figure 6.23

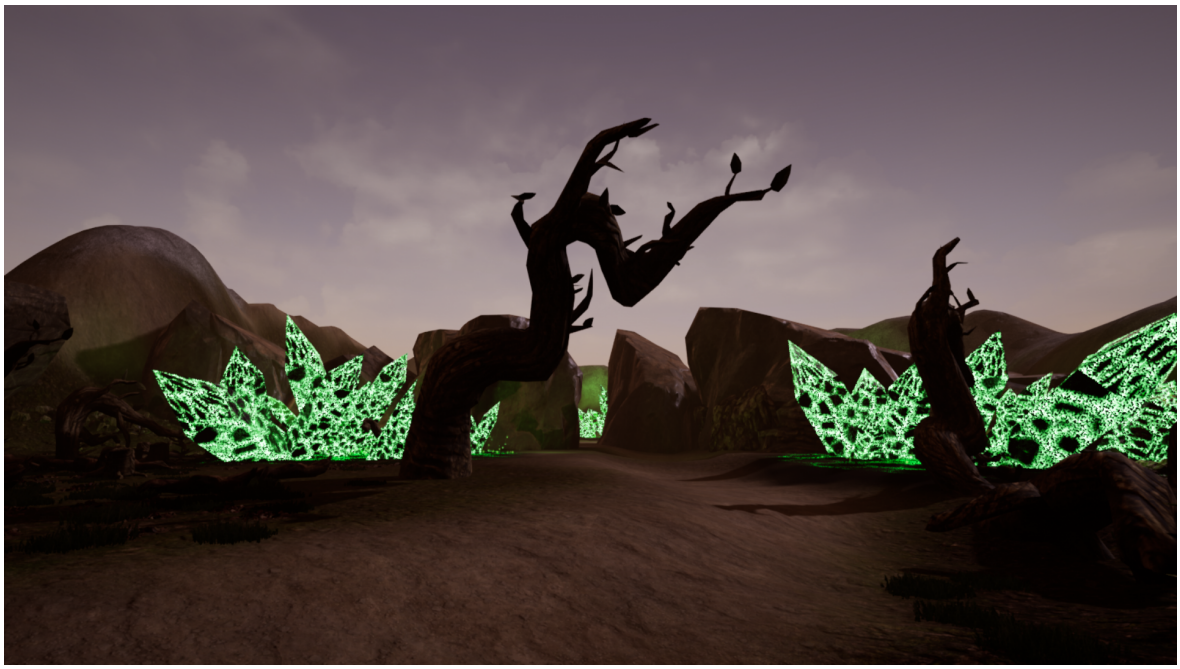

Figure 6.24

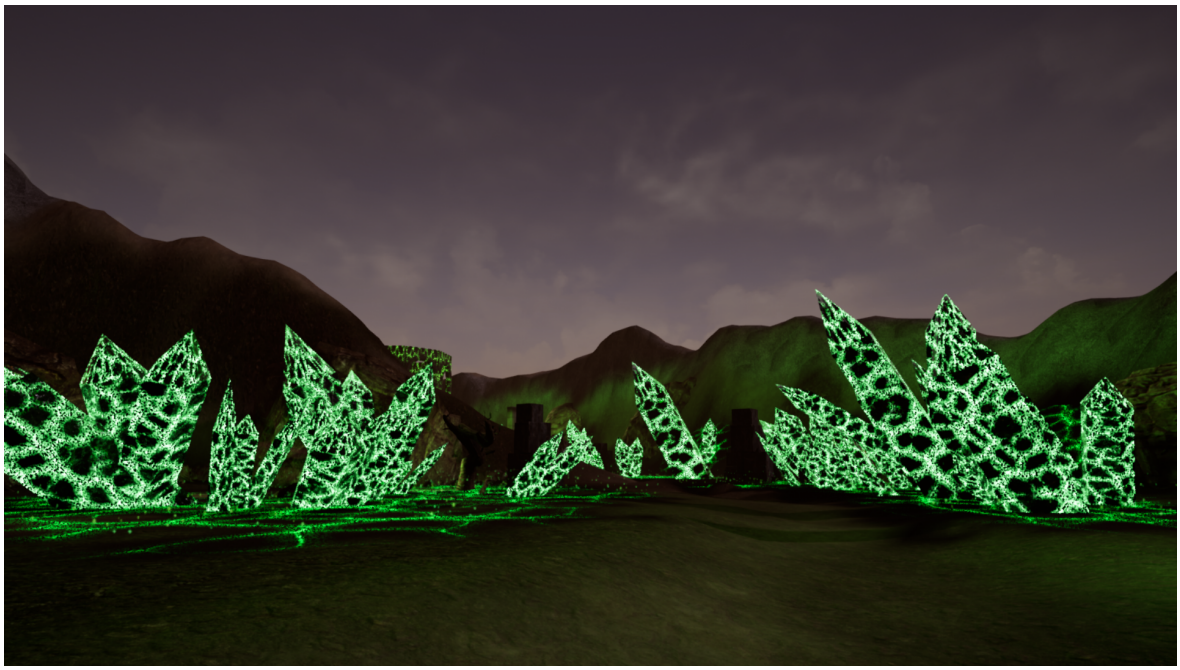

Figure 6.25

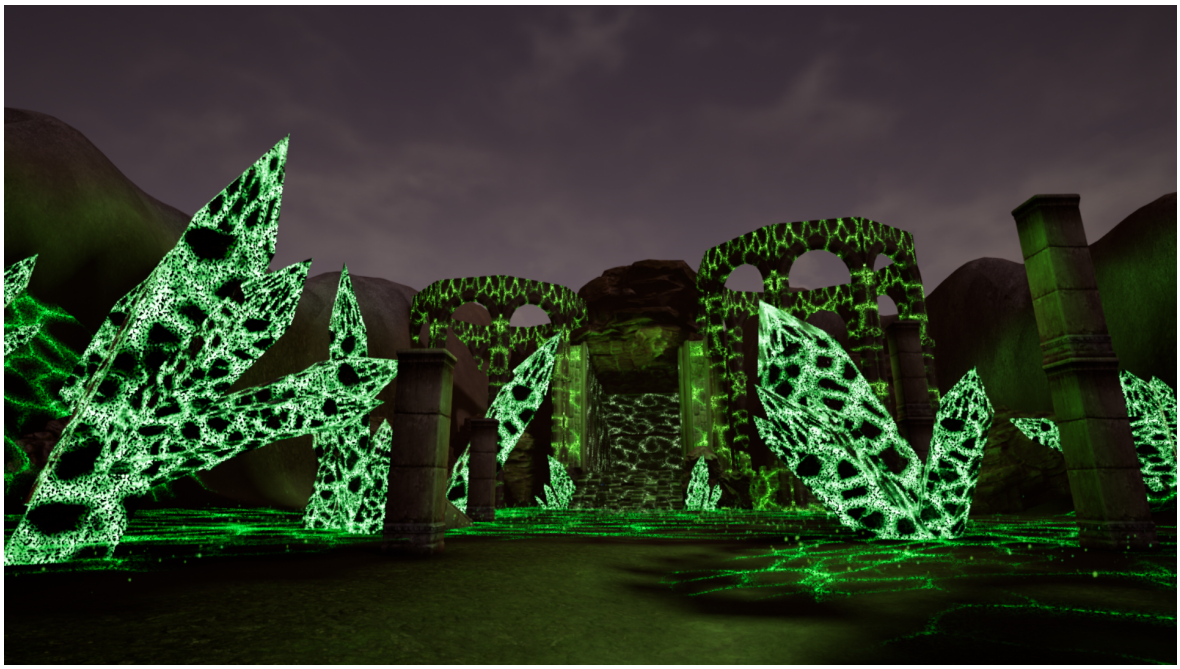

Figure 6.26

7 | Results

From the test conducted at Aalborg University between May 9-14Th, 2019, 20 participants participated. 15 participants were male, 5 were females. 18 of the 20 participants were students at the medialogy masters. These participants were divided in two groups, with Group A testing environment version A, and Group B testing environment version B. This chapter will present the analyzed data gathered in the testing period and highlight tendencies found in the data to answer the problem statement.

7.1 Demographic results

The majority of the participants were between the ages of 25-30 years of age (as shown in figure 7.1.

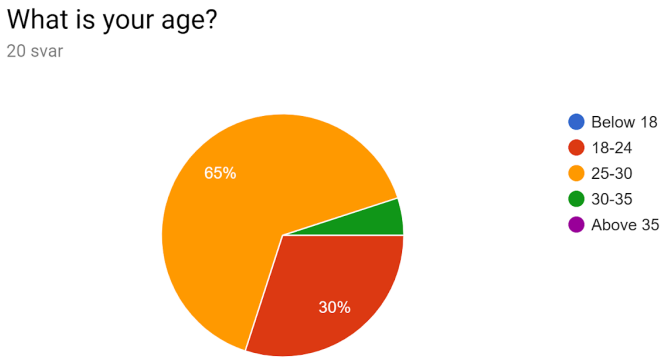

Figure 7.1: Demographic of age division between participants.

The majority of the participants played games either every day or every week, with only 10% answering they played a few times every year.

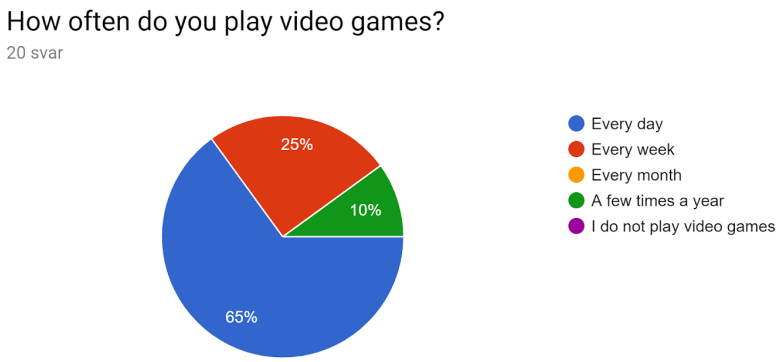

Figure 7.2: Demographic of time spent playing video games.

The most frequently player type chosen in the demographic was the Immersion type with 50% of the participants identifying as so. Second to Immersion is shared between Social players and Mastery players with 15% in each category.

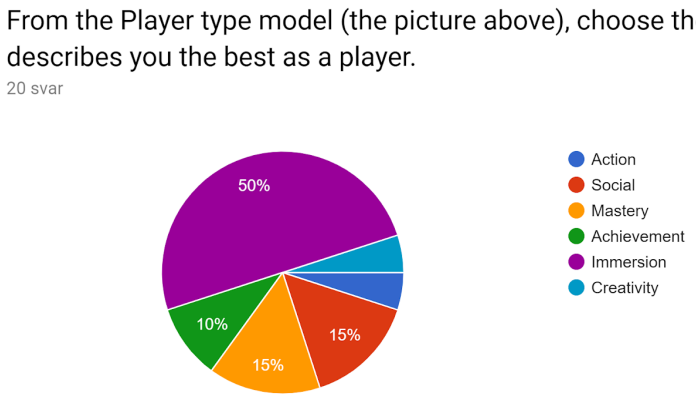

Figure 7.3: Player type division.

In the likert scale measuring interest, capability and experience in narrative and story-worlds it was found that the majority generally enjoyed story universes, with a mean value of 6.2 out of 7.

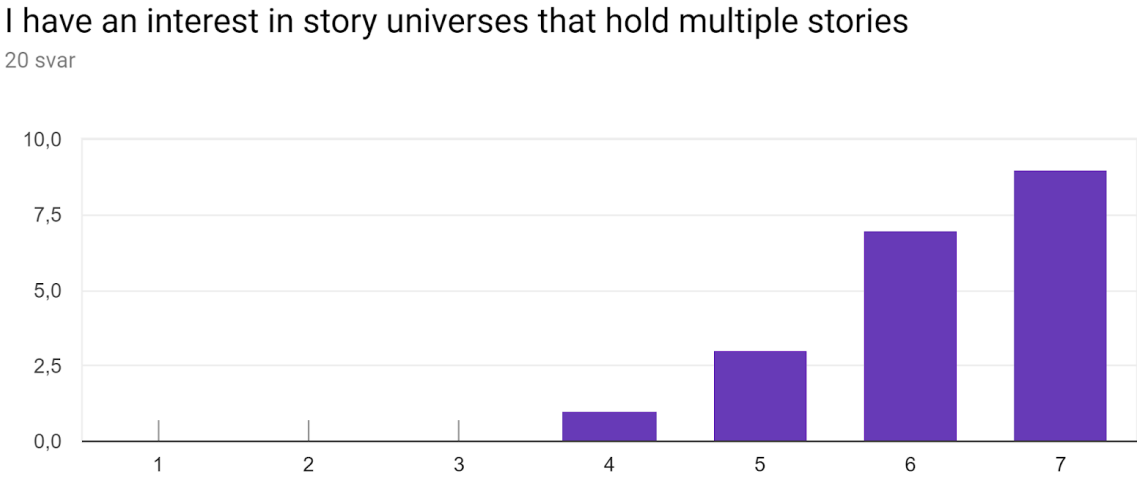

Figure 7.4

In terms of how capable the participants found themselves of creating their own stories, the majority of participants found themselves either capable or very capable with a mean value of 5.15 out of 7.

Figure 7.5: The research strategy derived from the research onion model.

To the statement "I regularly construct my own stories or narratives" the answers were very divided among the participants (see figure 7.6). The mean lies at 3.75 out of 7, indicating that on average the participant sample lacked experience in creating stories.

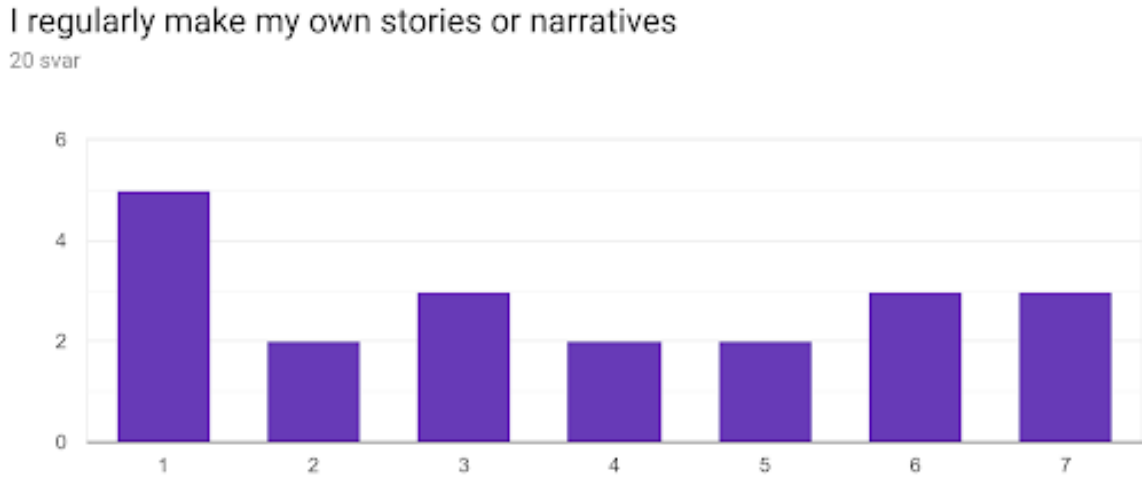

Figure 7.6: The research strategy derived from the research onion model.

The majority of the participants were from the desired population group of medialogy masters students, with only two participants occupied as an EMT and an IT supporter respectively. The most picked category from the player types was the Immersion category with 50% of the participants choosing this category, indicating that majority of participants had the desired motivation in similar applications.

In terms of the participants experience with creating stories, the answers were very scattered with a higher tendency of answering that they did not create stories very frequently. However, the interest in story worlds and capabilities ranked higher, indicating that participants in general had a great interest in story universes, and that they generally saw themselves as capable of creating stories themselves. This indicate that the participants generally fulfilled the requirements for the desired participants, but that more experience with creating stories would have been preferred in the sample to improve validity of the answers.

7.2 Interview data

The interview answers was analyzed using the emergent coding method [26]. The codes were generated from the interview answers, then evaluated if the interview answers could be assigned to the generated codes. This process continued until every answer in the five categories of Timeline, Setting, Characters, Rules ,and Themes could be assigned to one or more categories. The amount of detail participants described their storyworlds varied a lot, with some participants writing no more than a few lines to each category, and other spending great time describing relations between the categories.

In the Timeline category (see figure 7.7) Group A show a tendency to create their story-world timelines either in alternative timelines (five mentions) or in the future (three mentions), while group B show a highly occurring tendency of of setting their timelines in medieval times, with 70% of answers describing these. This indicates that the different environments tend to inspire differences in the perceived timeline.

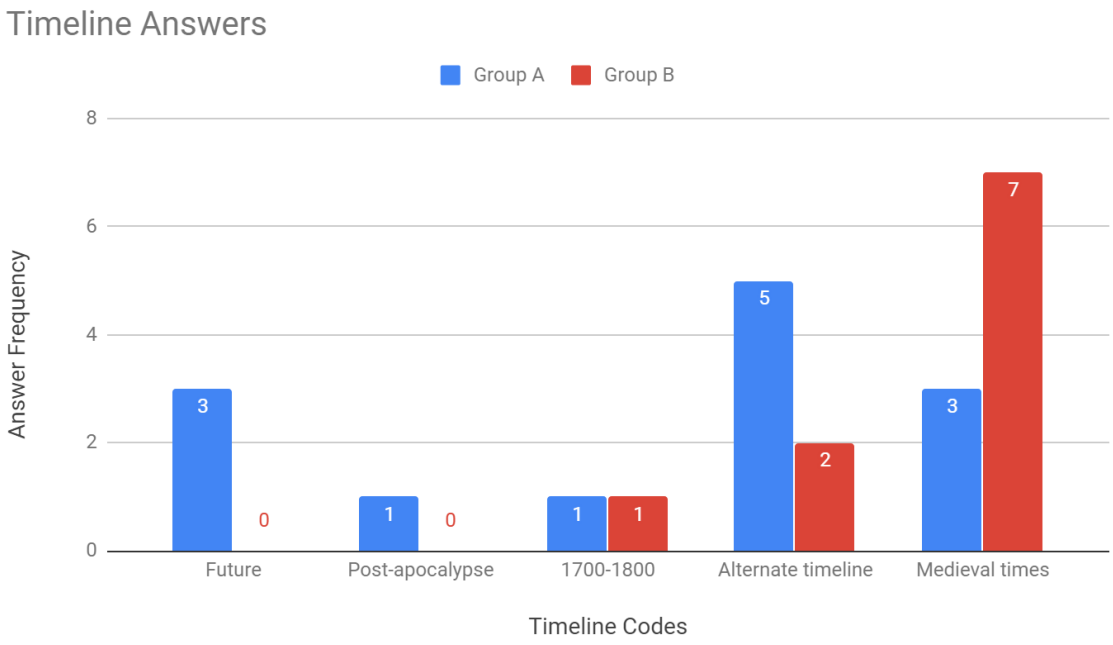

Figure 7.7: Codes mentioned in the Timeline category.

In the Setting category (see figure 7.8) the answers tend to be more spread out in both groups. The most frequent answers in Group B described the setting as medieval fantasy or dark and gloomy with four mentions each, whereas Group A tend to describe their setting as either post-apocalyptic or war-torn with three mentions each. The spread of answers indicate that the derived settings are less consistent for both groups.

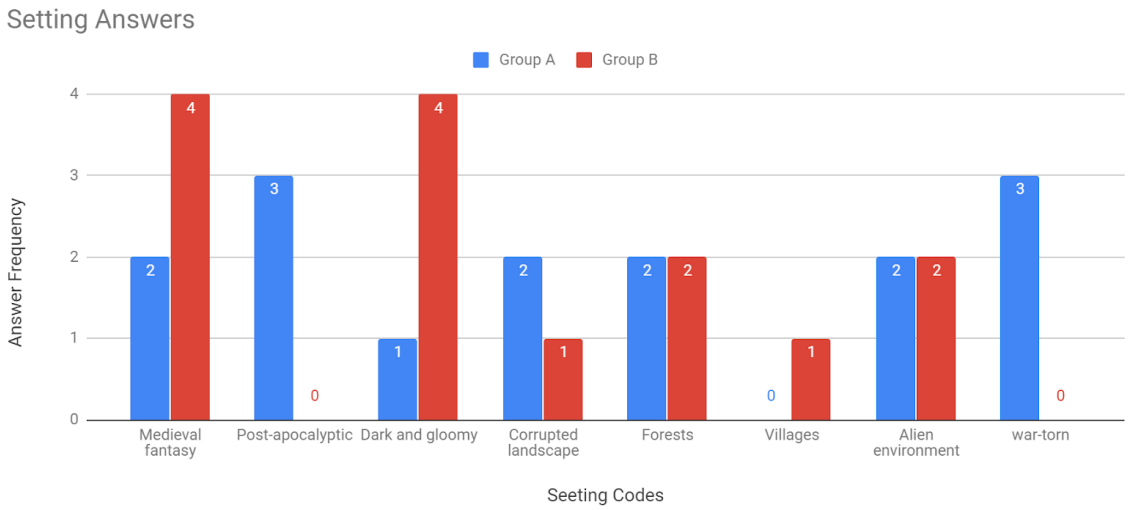

Figure 7.8: Codes mentioned in the Setting category.

In terms of the characters category (figure 7.9) almost all participants described human characters as part of their storyworld (18 mentions, nine in each category). Apart from humans, the answers show a great variety in the types of characters described across both groups. Group A show a higher tendency to describe Alien characters, while Group B tend to describe Monsters, Fantasy Creatures and Human-like characters. Overall, both groups tend to mention multiple types of characters as part of their storyworlds.

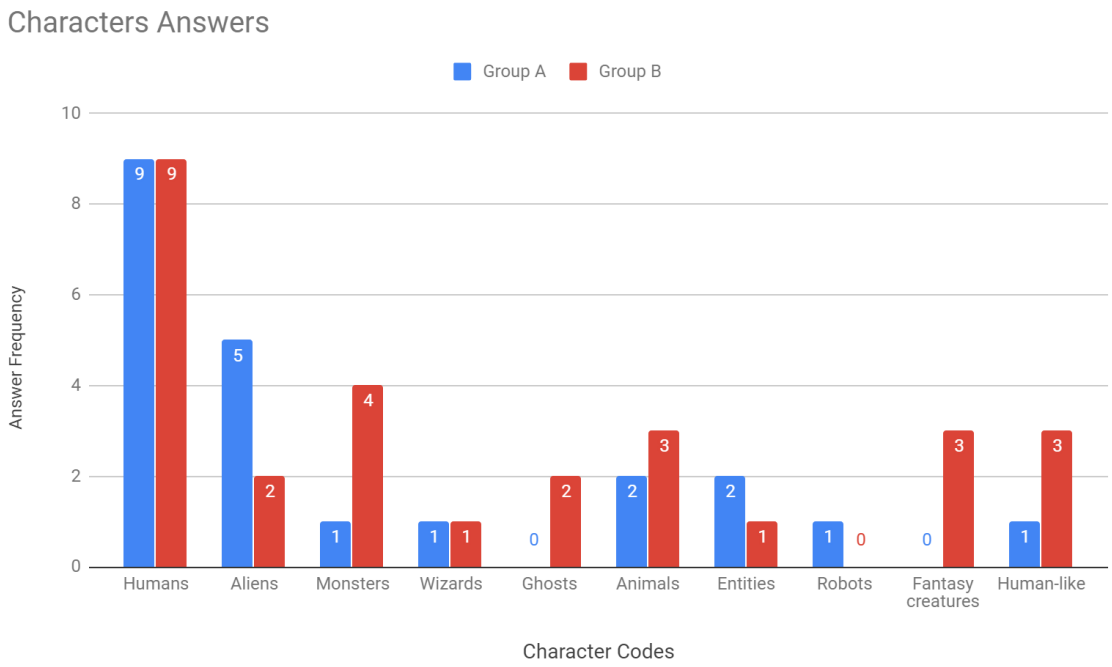

Figure 7.9: Codes mentioned in the Characters category.

In the Rules category (figure 7.10) Both groups most frequently mention Magic as a rule in their storyworld, with Group B being the most frequently mentioned with seven mentions and Group A with five mentions. Apart from magic, Group B also tends to mention physics to be altered in the world (3 mentions) and for some sort of corruption to be spreading in the world (four mentions). Group A has a wider variety of rules mentioned, but with no other mentions higher than two apart from the five mentions of magic.

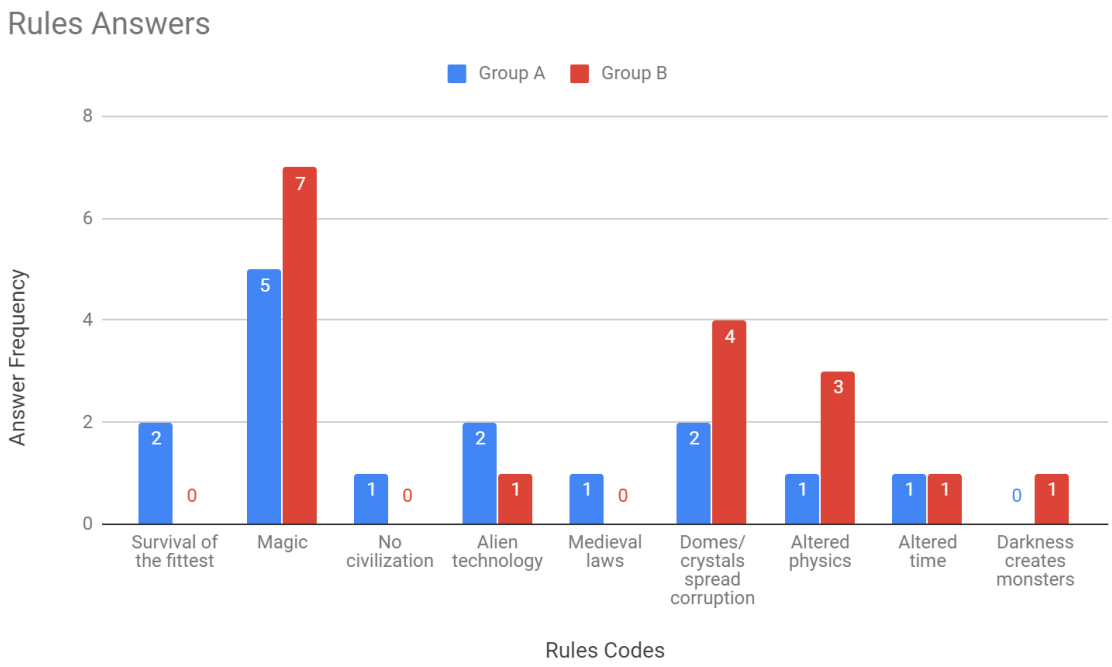

Figure 7.10: Codes mentioned in the Rules category.

In the final category Themes (figure 7.11) both groups mention a wide variety of themes. Group A had the theme of Environmental Awareness as the most frequently mentioned theme with four mentions, followed by themes of Survival and Good Vs. Evil with two mentions respectively. Group B had mentioned Exploration as the most frequent theme with four mentions, followed by Environmental Awareness and Them Vs. Us with three mentions respectively.

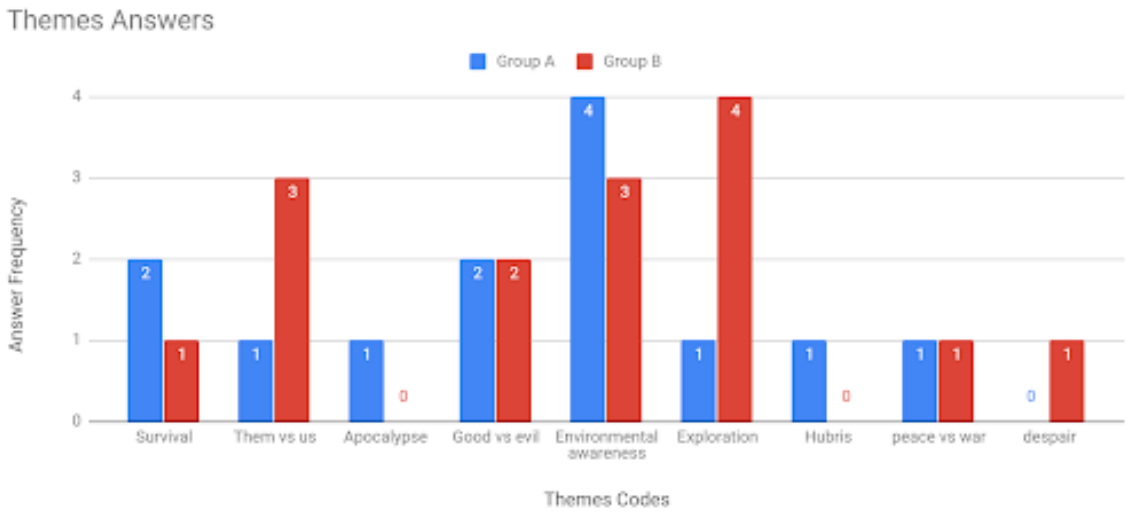

Figure 7.11: Codes mentioned in the Themes category.

7.3 Observations and logged time

From the observations made during the play session, the most frequent observations in participant behavior was that participants often attempted to enter the cabin at the start of the play-session, which was observed seven times across Group A and Group B. Participants frequently seemed to notice the default player model in the model beginning of the session. It was also frequently observed that participants would closely inspect the glowing domes and spikes upon entering the second area.

To the questions "What part of the experience did you enjoy the most", the most frequent answer was "The last area of the environment" with six total mentions across both groups. The second most mentioned part was the shift in the environment from the forest area in the beginning to the second area where the environment had withered, with a total of four mentions. Lastly, the first forest area was mentioned as the most enjoyable part three times.

To the question "What part of the experience did you dislike the most?", it was generally commented that the experience felt too short, and that the participants wanted to see more. In Group B it was also frequently mentioned that the last part of the environment was too dark, sometimes to the extend where it could be difficult to see anything. Some participants mentioned that they would have liked to be able to enter the cabin in the beginning, and that the sound could be improved.

Most participants show similar behavior in both groups, indicating that the task given to both groups was well understood.The most notable difference between the groups was the

tendency in Group B to mention that the environment was too dark, which could indicate that environment B was less intriguing.

Each play-session was timed with time stamps at the intersections between new areas, as well as at the end of the play-session. figure 7.12 shows the means of the logged time at each time stamp for each group. The graph indicates that Group A on average completed the play-session quicker, spending less time in the environment.

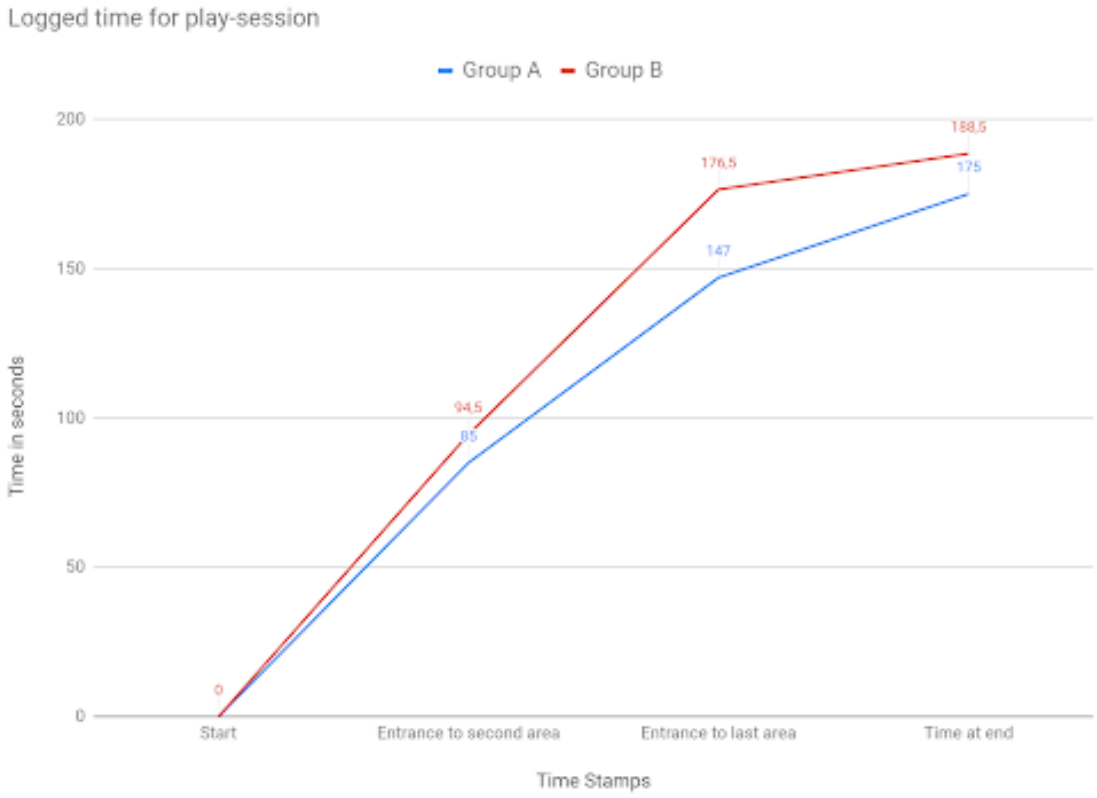

Figure 7.12: Logged time during the play-session.

It was however noticed that participant 20 from group B spent significantly more time in the environment than the rest of the group, with a finish time of 241 seconds, which is more than double the average of group B. When asked why the participant spent so long in the environment, she replied that she wanted to explore everything to discover the story. Since this behavior was considerably different from the rest of Group B, it was decided to remove the logged time of participant 20, along with a random time log from group A (participant 9) to provide a better representation of the average time spent. Figure 7.13 shows the graph of time logs after the removal of the outlier.

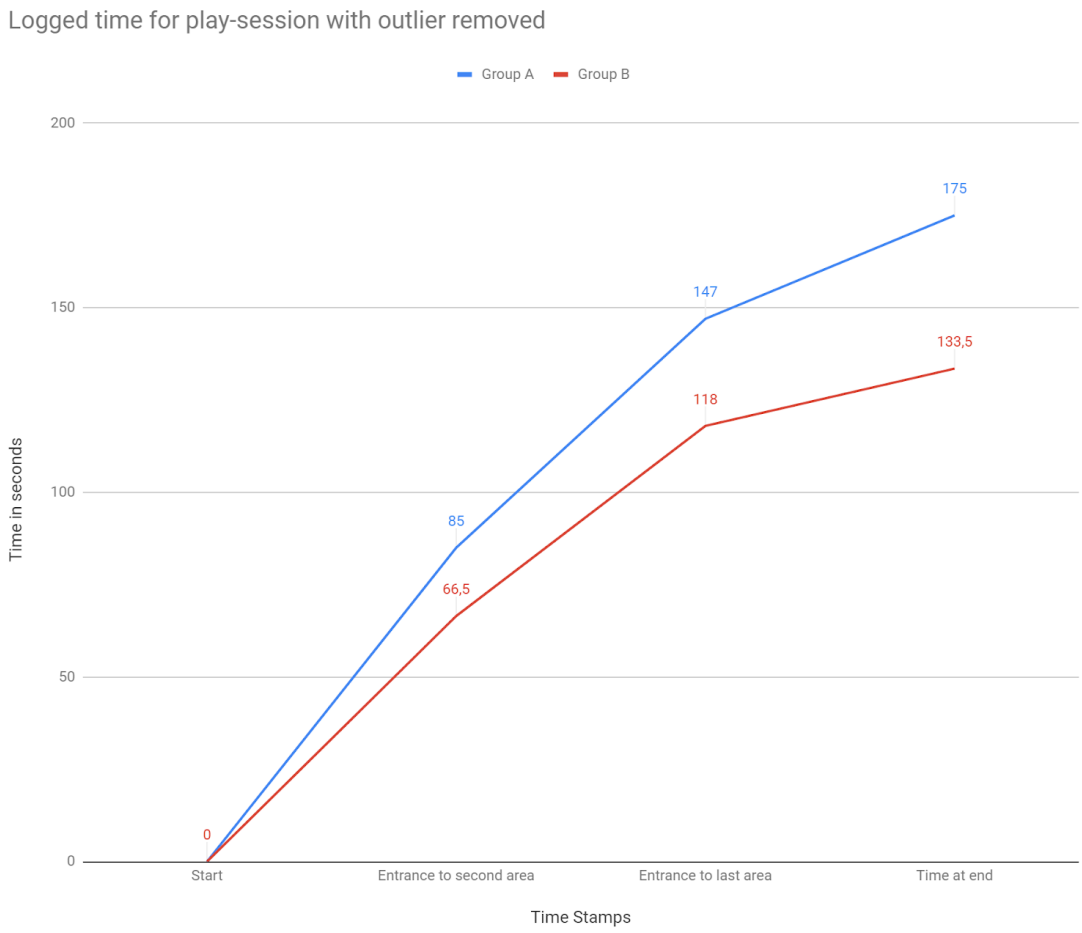

Figure 7.13: Logged time with outlier removed.

As figure 7.13 shows, Group B averagely spent less time in the environment than Group A after the removal of the outlier. The fact that Group A on average spent longer time in the environment could be an indication that environment A was more intriguing than environment B. This supports the indication of environment B being too dark from the observations. However, the change in the results after the removal of the outlier shows how much influence the individual participants answers had on the data, making the reliability of the results questionable.

The general tendencies in the results show that participants varied a lot in the amount of detail their storyworlds were created with, indicating that a larger sample of participants would have been desired to decrease the amount of variation between participants. However, there are patterns in each group, especially in the categories of Timeline (figure 7.7), Setting (figure 7.8), and Characters (figure 7.9) that indicate that the difference in the environmental

storytelling elements supports different types of emergent narratives. These tendencies would need further testing on a larger sample to be properly validated.

8 | Discussion

In this chapter, the test methods of the study will be discussed to determine if they were suitable for answering the problem statement. The design of the the test will also be discussed to determine any potential cause of bias, or faulty test design that could have been improved further validate the results. Finally, the findings from the results will be discussed to determine if the problem statement has been answered.

8.1 Test discussion

The procedure of the test design worked well in the sense that the task was clear for the participants and very little assistance was required once the task had been presented. However the variation in the storyworld creation process could possibly have been improved had the task of storyworld creation been introduced differently, or with additional requirements such as asking participants to make further elaboration on each storyworld category in the actual creation process, rather than in the interview post creation.

In terms of the demographic data gathered, it would have been beneficial to determine if participants had participated in the "Narratives in Digital Cultures" course, as it was discovered, after the test had been conducted, that the class was not a mandatory course in the study curriculum, but rather an elective course. Had the demographic included this aspect, the demographic data would have given a better representation of the targeted population.

The effects on the emergent narrative caused by each environment's environmental elements could also have been detected with better validation had the test followed a within-group design [26], allowing the same participant to experience both environments. While the within-group method was avoided due to the risk of fatiguing the participants and biasing them with the experience from the first environment they would play through, it would be interesting to run a within-group test design in the future to compare the results with the data gathered in this study. Using the within-group method would also have reduced the risk of type II errors in the results, as the sample size would not need to be split between groups.

The choice of data analysis method, namely the emergent coding method [26], was chosen since, to the authors knowledge, no similar kind of test had been run previously, making

the process of generating codes from the gathered data necessary. However since the study was conducted by a single researcher, the emergent codes was not supported with inter-coder reliability [30], risking that the generated codes were not as accurately describing or informing as codes generated by several researchers could have been. Had the study been structured differently, an iteration of the test could have been conducted with the purpose of generating a coding table for analysing the data in final test design, making the codes more reliable.

8.2 Results discussion

The results presented in chapter 7 are heavily influenced by the small sample size in each group. Combined with the fact that the gathered data is very subjectively influenced by each participants, it is difficult to establish the validity of the discovered tendencies. While one could argue that validity and reliability is difficult to establish in most qualitative studies [31], the results would definitely provide a better representation of the phenomenon, had the sample size been large enough to determine if patterns in the category answers were the result of type II errors.

This being said, the results tendencies do show a high potential of the environmental storytelling elements supporting the creation of emergent narrative in the storyworld format, as all participants were able to derive form of storyworld, but with varying amount of detail in the categories. This corresponds well with the findings in the "Environmental Storytelling Framework" derived by Bevensee [7], as the results in that study indicated that 90% of the participants stated that they were able to construct a story from the environmental storytelling elements used in the study. However, the categories of Rules and Themes showed less apparent patterns in the answers. This could indicate that either participants found it more difficult to describe these categories, or that the categories themselves should have provided a better explanation of what these categories meant for the created storyworld.

To answer the problem statement: **How does the choice and design of environmental storytelling elements influence the creation of emergent narrative in a storyworld format?**

The designs used in each version of the environments appear to allow participants to create their own storyworlds from the elements, indicating that environmental storytelling elements hold the narrative potential required to create these. However, the tendencies found in the influence of the different versions of environmental storytelling elements were deemed not validated enough to answer how the designs specifically influenced the storyworlds. To validate the results, further testing is required on a larger test sample.

9 | Conclusion

Due to the growing interest in the industry for the concept of storyworlds, and the lack of prior research in the field of environmental storytelling as part of generating storyworlds, this study sought to investigate the effects environmental storytelling elements had on storyworld creation. The research topics covered to gain the theoretical understanding for this problem were narratology, with a focus on embedded and emergent narrative forms, and how embedded narrative can lay the foundation for emergent narrative. These topics, combined with theories from environmental storytelling led to a theoretical model describing the relationship between embedded narrative, environmental storytelling, and emergent narrative. The analysis of these theories led to the problem statement:

How does the choice and design of environmental storytelling elements influence the creation of emergent narrative in a storyworld format?

To answer the problem statement, two versions of an environment with an embedded story told through environmental storytelling elements was created to evaluate if test participants were able to construct storyworlds from these elements. This was tested by conducting a test on 20 participants, with 10 participants testing each version of the environment, where the participants were asked to create a storyworld from the environment. The answers from the test were analyzed using content analysis and emergent coding to identify any patterns in the answers from each version.

The results indicated that participants were able to construct storyworlds from the environments, suggesting that the environmental storytelling elements were successful at conveying narrative. However, while some patterns were found in the emergent coded data, the sample size of participants was too small, making the validity of the results insufficient for determining the effect of environmental storytelling element design on the created emergent narrative.

For future iterations of this study, the test conducted would need to be expanded with a

larger population sample to determine if the patterns found in the answers from the first test were valid, or the result of type II errors.

It would also be interesting to expand on the implementation by incorporating adaptive narrative [19], [34], [35] into the framework. As the name implies, adaptive narratives adapt to the interactions and choices of the player. This type of narrative would allow the experience to act dynamic, changing different aspect such as non-playable character interactions or responsive real-time adaptation in environment to further the potential of emergent narrative.

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