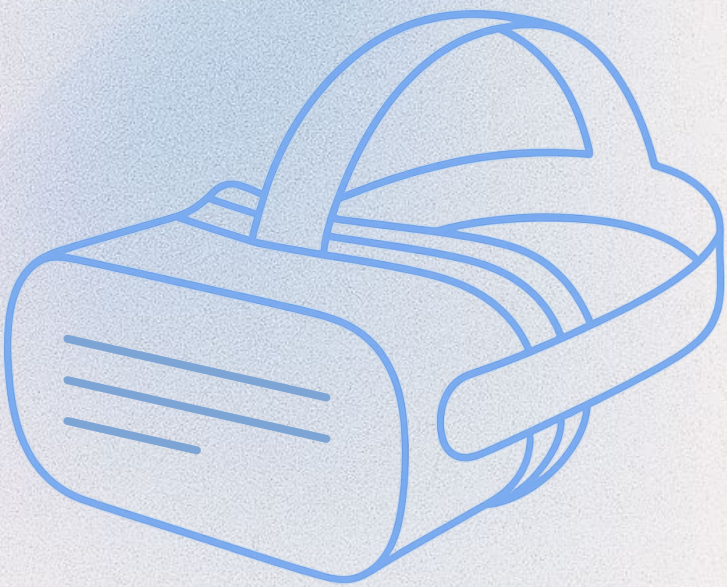
Future Reading Experience

Exploring Narrative Transportation in VR Fiction Reading

Author: Po-Cheng Chen

Master Thesis



MSc. Design for Interaction

Delft University of Technology

July 2025

Master Thesis

Delft, July 2025

Author

Po-Cheng, Chen

Master of Science

Delft University of Technology
Faculty of Industrial Design Engineering
Design for Interaction

Supervisory Team

CHAIR

Dr. rer. nat. C. (Christina) Schneegass
Delft University of Technology

MENTOR

Dr. rer. nat. T. (Tilman) Dingler
Delft University of Technology

ADDITIONAL MENTOR

Alice Vitali
Delft University of Technology

Acknowledgment

The journey of this thesis began with the IDE elective course — Graduation Launchpad. I still vividly remember the moment I saw the poster titled “Future Reading Experience” in the IDE hallway—it instantly caught my attention, and eventually led me to form the supervisory team that guided me through this project.

First, I want to express my sincere thanks to my supervisors, Christina and Tilman. Thank you for always providing insightful feedback that helped shape the direction of my thesis, and for sharing perspectives that made me consider aspects I hadn’t thought of before. I’m especially grateful for the trust you placed in me—giving me the autonomy to steer the project in my own way, while also supporting me with valuable input on the detailed aspects of research. I truly appreciated your balance of guidance and freedom.

I would also like to thank Alice Vitali, a PhD candidate at IDE, for joining Christina and Tilman in supporting my thesis process. Thank you for being an extra source of guidance and for always being approachable whenever I had questions. I feel lucky and honored to be your first graduating student during your time at TU Delft. With the support of all three of you, I was able to carry out my thesis smoothly and stay within the planned timeframe.

Beyond the academic support, I want to say a huge thank you to the lovely people I met throughout my journey at TU Delft—especially Jade, Sophia, and my friends who listened patiently when I was overwhelmed with uncertainty at the start. You were my anchors. To Anne, Amy, Cindy, Dimpy, Irene, Lori, Nanditha, Niek, Nes, Pranav, Saiyam, Yiqing, Yonghao, and Yu-Jie—thank you for always having my back, not just during the thesis but throughout the entire DfI program. To Ian, my best friend and my partner—thank you for being there through it all. Your emotional support, though you were miles away in Taiwan, made this journey possible. I can’t imagine my time in Delft without your virtual presence.

Lastly, I’d like to express my heartfelt gratitude to my dearest family and friends back in Taiwan, who have supported my dream of pursuing this degree. I’m truly grateful to have you by my side.

This five-month journey may be short for a full research and design process, and many areas of VR fiction reading remain unexplored. But I’m proud of what has been achieved. Looking back, I’m especially grateful for how much I’ve grown and how much I’ve learned—from uncertainty to insight, from concept to prototype. It’s been a challenging but truly fulfilling ride.

Table of Contents

Executive Summary

This thesis project began with a holistic exploration of fiction reading and the emerging development of immersive reading in virtual reality (VR). The investigation focused on the concept of narrative transportation—a mental state in which readers feel absorbed into a fictional world and may lose track of time in the real one. One key challenge in the context of VR fiction reading is the lack of clarity around what enables transportation in such environments. This research takes that uncertainty as its starting point, aiming to uncover the sources of narrative immersion and explore how they can be amplified through design in VR contexts.

The early phase of the project involved a user study with eight participants who regularly read fiction. Semi-structured interviews were conducted to understand their reading contexts, the sources of transportation across different media formats, and their perceptions of VR fiction reading using a 2D demo video adapted from previous studies. To analyze the abstract qualities of transportation, the Evaluation Grid Method (EGM) was applied—an effective technique for uncovering layered emotional responses and design preferences.

Key insights from the user study revealed that readers often create or seek environments helpful to immersion, and that visual cues—such as book covers or illustrations—serve as anchors that help them re-enter the fictional world and revive mental imagery. These insights led to a refined design goal:

“Amplify narrative transportation in VR fiction reading by leveraging environmental and visual cues beyond the text itself.”

Through brainstorming and storyboarding, several design concepts were proposed, focusing on “transporting readers to other locations” and “interacting with symbolic objects that reflect previously read story elements.” Multiple rounds of low-fidelity prototyping were conducted, leading to the final research prototype designed to evaluate how different visual and environmental cues affect narrative transportation. The main design variables included: (1) Google Street View vs. AI-generated panoramic images, (2) static vs. dynamically shifting imagery that conveys spatial or temporal progression, and (3) whether showing an AI-personalized book cover—based on readers’ previous responses—enhances re-entry transportation.

In the evaluation phase, four participants engaged in two sessions on different days. The first session compared the effects of Real vs. AI-generated images and Static vs. Dynamic transitions. The second session evaluated whether an AI-personalized book cover, generated from the participant’s previous reading experience, enhanced transportation upon re-entry. Results showed that AI-generated imagery generally led to higher transportation scores than real street view images, as AI visuals could better match the story’s narrative content. Similarly, dynamic imagery that progressed with the narrative yielded higher immersion than static scenes. However, the personalized book cover had limited impact on re-entry immersion, as participants struggled to relate to the AI-generated symbols and found them weakly connected to the ongoing reading experience.

The findings highlight the potential of AI-enhanced visuals in immersive VR reading. When the background visually resonates with the narrative, it can significantly support transportation. At the same time, the study reveals a potential tension between AI-generated visual cues and the reader’s desire for imaginative freedom—a core motivation for fiction reading. Future research must investigate the optimal level of visual abstraction that supports immersion without undermining creative interpretation.

While the current VR prototype was relatively static, this project points to broader affordances of VR in enabling multisensory and immersive experiences. The outcomes are forward-looking, offering insights into the evolving intersections between AI, VR, and reading. In an era where attention spans are fragmented and reading motivation among younger generations is declining, immersive reading formats like VR could offer new ways to revive narrative engagement.

Future directions include exploring how reader profiles, fiction genres, and physical reading environments may affect the effectiveness of AI-supported immersive reading. This thesis contributes early groundwork toward that vision.

Chapter I — Contextualization

1. Introduction

At the starting point of this thesis, the researcher reflected on the significance of the project's context, considering why fiction reading still holds meaningful value in today's media-saturated world, where audiovisual content dominates. This reflection included an exploration of prior research that considers virtual reality (VR) as a promising medium for enhancing the fiction reading experience. These reflections led to defining the core research focus of this project and planning the direction of the following research process.

1.1 Background

Reading fiction is a common leisure activity enjoyed by many. As a form of recreation, reading can simply be relaxing, help us understand different people and cultures, or allow us to escape from reality and experience the lives of characters in a story (Clark & Rumbold, 2006).

Reading plays a crucial role in human cognitive development. It fosters social cognition by encouraging readers to imagine characters' perspectives and thoughts—an ability cognitive scientists refer to as Theory of Mind. Fiction literature enhances readers' theory of mind by encouraging them to actively engage in understanding the characters' inner worlds—such as by filling in narrative gaps, navigating multiple perspectives, and challenging their own expectations(Kidd & Castano, 2013). Additionally, reading certain genres, such as detective fiction, helps develop source-tracking skills, enhancing our ability to store information and reassess its validity based on new clues(Zunshine, 2006). Hodges's interviews with young students further highlight that reading fiction allows them to exercise imagination and develop empathy for fictional characters (Hodges, 2010). Furthermore, compared to passive information consumption, researchers have found that reading text significantly strengthens imagination (Suggate, 2023).

Beyond cognitive development, fiction reading also positively influences our understanding of social knowledge. In addition to applying insights gained from characters' social experiences and emotional simulations to real-life interactions, novels provide concrete social knowledge, particularly about distant or inaccessible countries and civilizations (Dodell-Feder & Tamir, 2018).

Despite the meaningful impact of fiction reading on imagination, empathy, and cognitive development, leisure reading among younger generations has seen a significant decline. According to an international student assessment in 2018, young people are spending less time on leisure reading, and compared to historical data, there is a growing trend of youth perceiving reading as a waste of time (Schleicher, 2018). This decline is closely tied to the development of technology. The rise of visual media is often seen as a major threat to book reading during leisure time, with concerns that it "takes away children's and adolescents' time and interest in reading books" (Johnsson- Smaragdi & Jönsson, 2006). Interview findings also suggest that digital leisure activities—such as gaming, social media, and watching YouTube—have replaced reading as a way to pass time, especially after young readers gain access to smartphones (Loh & Sun, 2022).

Reading plays a crucial role in adolescents' cognitive development and mental training. Beyond the previously mentioned benefits—such as fostering cognitive growth and supporting interpersonal imagination—reading also contributes significantly to young people's literacy skills and personal development. Moreover, studies have shown that re-engagement in reading is possible even for those without an existing reading habit, particularly when reading opportunities are personalized around their interests and more explicitly connected to other media already embedded in their cultural lives, such as films and television (Clark et al., 2025). Therefore, it becomes important to ask: how can we further support and enrich fiction reading experience in today's evolving media landscape?

Technology may have reduced the time people spend reading and weakened their inner

motivation to read, but at the same time, it also opens up new possibilities for reading experiences on digital devices. In the past decade, the development of E-ink readers has notably altered how readers engage with novels. Compared to physical books, E-ink readers offer a lighter form factor, low electricity consumption, and customizable reading interfaces—making them a popular medium among reading enthusiasts (Rabbani et al., 2023). Furthermore, according to independent reports, mobile phones have become the world's fastest-growing digital reading device. Their powerful integration of hardware and software has made leisure reading more accessible to audiences who were previously excluded due to physical limitations (Kuzmičová et al., 2018).

The convenience of digital devices can also potentially increase young people's motivation to read. The UK's National Literacy Trust reported in 2012 that, for the first time, children reported reading more on computers and other electronic devices than on paper. By 2014, the same organization found that 88.6% of surveyed students were using technology for reading outside of school (Picton & Clark, 2015). The studies also show that some students tend to prefer reading on digital devices due to customizable and practical features. However, when it comes to immersive experiences in fictional narratives, students still show a stronger preference for traditional print books. The tactile quality of physical books supports their ability to imagine story worlds more vividly. Therefore, while today's digital devices offer significant convenience for reading, their capacity to foster narrative transportation still warrants further development and exploration.

To further enhance reading motivation, scholars have begun exploring how immersive technologies like Virtual Reality (VR) and Augmented Reality (AR) can be integrated into novel reading. These types of immersive media offer richer, more interactive, and multisensory reading experiences. Among them, VR stands out for its hardware features—such as blocking external distractions and offering an all-encompassing visual field—which support full immersion and a strong sense of presence (Kaplan-Rakowski & Gruber, 2023; Şimşek & Direkçi, 2022). VR has also been identified by researchers as a promising tool to enhance users' motivation to read. This underscores the research value and contribution of investigating fiction reading in VR, particularly as its application remains in an exploratory phase. Understanding how fiction reading functions in VR, and how experiential design can shape that experience through empirical research, is a critical step in advancing the field.

Conclusion

This project envisions the future of reading experiences. It is believed that exploring the intersection of technology and human interaction can redefine reading—a seemingly simple activity that is, in fact, the foundation of human society. By reimagining reading through the lens of human-computer interaction, this research aims to inspire new perspectives in academia.

However, this thesis does not aim to predict a future where VR replaces any other existing form of readers such as E-ink readers and physical books. Instead, it seeks to propose design recommendations based on users' envisioned factors of future reading experiences and explore how VR's unique advantages can enhance fiction reading activities.

1.2 Project Process and Methods

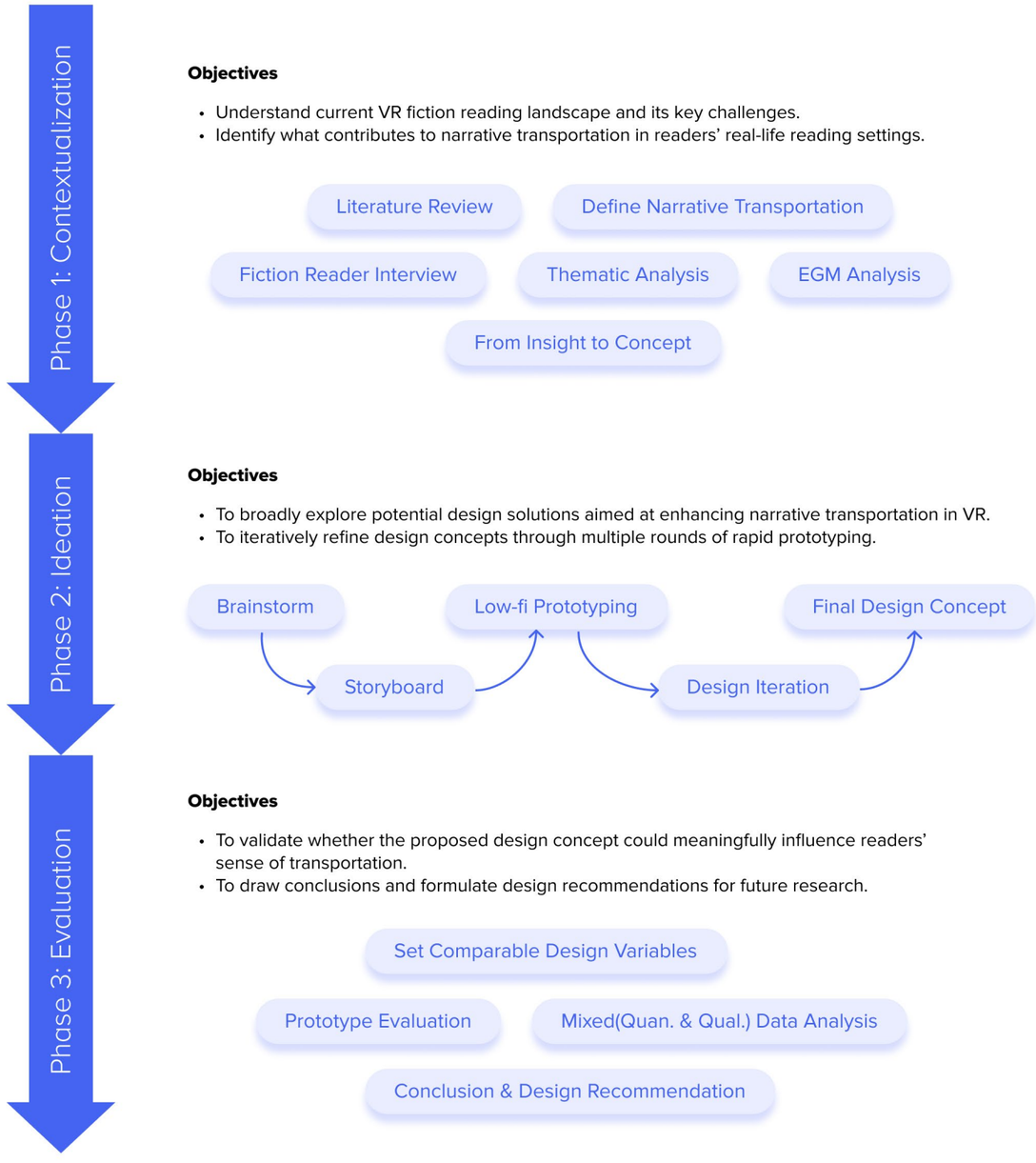


Figure 1. Project Process and Methods

Chapter I — Contextualization

2. Literature Review

To explore how fiction reading can be meaningfully enhanced in Virtual Reality, it is essential to understand how readers become immersed in narrative experiences. One of the key psychological phenomena associated with fiction reading is narrative transportation, a mental state in which readers are deeply absorbed into the story world. The following literature review begins by examining the concept of narrative transportation, before moving on to the role of VR in shaping reading experiences, and recent developments in VR fiction reading.

2.1 Narrative Transportation in Fiction Reading

During leisure reading, many readers experience a gradual mental shift as they become immersed in the world of the novel. They begin to visualize scenes, emotionally invest in characters, and imagine the unfolding of the story. This personal, immersive experience is one of the key reasons why people enjoy reading fiction. The concept itself is not unfamiliar, and scholars have conducted various studies to understand this form of narrative engagement and have developed tools to measure it.

Over the past few decades, researchers have explored the immersive aspects of reading experiences (Green et al., 2004; Busselle & Bilandzic, 2009, Green et al., 2012). Across studies of novel reading, scholars have framed and defined this rich and abstract psychological state in different ways.

Immersion

Immersion is a broad, overarching term that refers to a psychological state of deep engagement, which may also involve physical dimensions. In the context of leisure reading, immersion is often one of the core experiences that readers seek. It can be further categorized into phenomenological immersion and technological immersion.

Phenomenological immersion arises from the reader's psychological and cognitive abilities to construct a fictional world through symbolic representation (Mangen, 2008). It describes the mental state sustained while being captivated by a compelling narrative.

In contrast, **technological immersion** is induced by the affordances of the technology itself. A clearer distinction lies in the concept of VR immersion, which originates primarily from VR-related literature. As mentioned in the introduction, VR benefits from its enclosed visual environment and multisensory capabilities, allowing users to feel as if they are "present" in the virtual world (Klimmt & Vorderer, 2003). Therefore, when discussing immersion in VR-based reading activities, it is important to recognize that the sense of immersion arises from both the narrative itself and the affordances of the VR medium.

Flow

Another term frequently used to describe the immersive experience of reading is flow. Flow refers to a subjective psychological state in which individuals become deeply engaged in an activity that they lose track of time, fatigue, and awareness of anything beyond the activity itself (Csikszentmihalyi et al., 2014). Flow can be applied to many areas of life, and reading is a common flow experience—especially when readers become absorbed in a compelling story and forget the passage of time. However, the concept of flow primarily focuses on the balance between challenge and reward, emphasizing a sense of personal achievement. It is applicable to any activity that offers a balance between difficulty and skill, with the goal of enjoying the activity for its own sake.

Absorption

Absorption, as defined by Kuijpers et al. in the Story World Absorption Scale (SWAS), describes a reader's immersive engagement specifically within the narrative world of a fiction—rather than with its form or structure (Kuijpers et al., 2014). The concept of absorption more precisely captures the experience of being drawn into the story. Unlike broader terms such as engagement or involvement, absorption emphasizes a focused psychological state where the reader becomes mentally detached from the physical world and is fully immersed in the fictional reality.

Narrative Transportation

Narrative transportation is defined as a state of immersive experience in which all mental processes—such as attention, emotion, and imagination—are focused on the events unfolding within the narrative(Green & Appel, 2024). It involves both emotional and cognitive engagement, as well as the active formation of mental imagery. Building on this, Kuijpers et al. integrated the concepts of absorption and transportation in their Story World Absorption Scale (SWAS), organizing transportation along with three additional components—emotional engagement, mental imagery, and attention—as core factors that together constitute story world absorption.

Narrative transportation is a subjective psychological experience. However, building on earlier measurement tools developed by Green & Brock (2000) and Busselle & Bilandzic (2009), the Story World Absorption Scale (SWAS) provides a reliable method for quantifying this immersive state. As noted by Kuijpers et al., the scale can be used either as an integrated evaluation of all four dimensions or as an independent measure of each dimension. This type of subjective assessment tool has recently been applied to examine how different reading media influence narrative world absorption. Further discussion of this application will be presented in Section 2.3: Current Development of VR Fiction Reading.

In addition, researchers have attempted to understand the factors that influence narrative engagement in fiction reading. Green et al. (2012) analyzed the relationship between readers' emotions and their sense of immersion, finding that when a reader's current emotional state aligns with the emotional tone of the narrative, transportation is enhanced. They also observed that highly immersed readers tend to experience more intense story-related emotions after reading. Furthermore, the more deeply readers are transported into the narrative, the stronger their emotional responses to the story become. From a media format perspective, other studies have found that the choice of medium (e.g., reading a physical book vs. watching a film) and individual cognitive traits—such as a high or low need for cognition—can also impact story world absorption (Green et al., 2008).

To summarize this section, the thesis adopts the definition of narrative transportation based on Kuijpers et al.'s framework: it refers to a subjective psychological state that occurs when a reader feels mentally transported into the fictional world. Drawing on their work, this thesis also acknowledges that this subjective experience can be reliably measured using a validated questionnaire instrument.

2.2 User Interface Design and Interaction in VR Text-Based Reading

VR is a multi-sensory medium that, beyond its immersive visuals and sound, sometimes incorporates haptic feedback. Through three common features—immersion, sense of presence, and interaction—VR experiences are generally believed to enhance user engagement (Mohammad & Pedersen, 2022). This advantage has been widely applied in both entertainment and education. The strength of VR lies in its ability to create a highly immersive environment—blocking external distractions through enclosed visuals, offering boundless interactive spaces, and transporting users into entirely different worlds. This distraction-reduced setting enhances user focus, while the personalized nature of VR environments improves comfort (Demir & Büyükbaykal, 2024; Kunzovà et al., 2024). In addition, the heightened engagement and sense of presence in VR can help balance cognitive load, allowing users to concentrate better and improve content comprehension (Kaplan-Rakowski & Gruber, 2023).

The VR reading experience is shaped by multiple factors. When it comes to text-based reading, it is unsurprising that the user interface and text interaction design play a direct role in shaping the overall experience. Scholars have conducted empirical research on text display in VR and examined how various experimental design variables impact the reading experience. For instance, Rzayev et al.'s research (see Figure 2) on the effects of content display (RSVP and paragraph style) and position on VR reading concluded that: optimizing text presentation is crucial for improving system usability and reducing subjective cognitive load (Rzayev et al., 2021).

UI guidelines and recommendations suitable for different contexts are compiled. The design of VR text presentation brings significant influence on users' overall experience, user preference, and reading performance. The attributes of text display interfaces in virtual environments can be categorized into two: visual attributes, including font size, font color, font type, and transparency, and the location of the display (Chen et al., 2004). Kojic et al.'s experiment introduced the values for basic text parameters - angular size and color contrast ratio - that create positive and negative user experiences in VR text reading (Kojić, 2020).

In long text reading situations in VR, the presentation of long text paragraphs significantly affects aspects of UX. Gabel et al. studied the recall and UX of reading long texts in VR using discrete and continuous display modes, shown in Figure 3. Results showed that the discrete display method had better user experience due to better usability of pagination button than scroll bar (Gabel et al., 2023). In Mack et al.'s experiment, the placement of anchored text readers on the wrist, inside, or top of the hand, and whether it's on the dominant or non-dominant hand, affected user preference, sense of frustration, and usability (Mack et al., 2024).

In summary, a well-designed UI is a key factor that directly influences the VR reading experience. When designing a long-form text reading experience in VR, it is important to consider the mode of text presentation, the placement of the text window, and the nature of user interaction. These UI design elements primarily affect user preference, usability, and overall user experience. However, how these factors can be effectively implemented within the context of VR novel reading still requires further exploration. Moreover, whether such UI design recommendations impact the immersive quality of reading also remains an open question that warrants additional research.

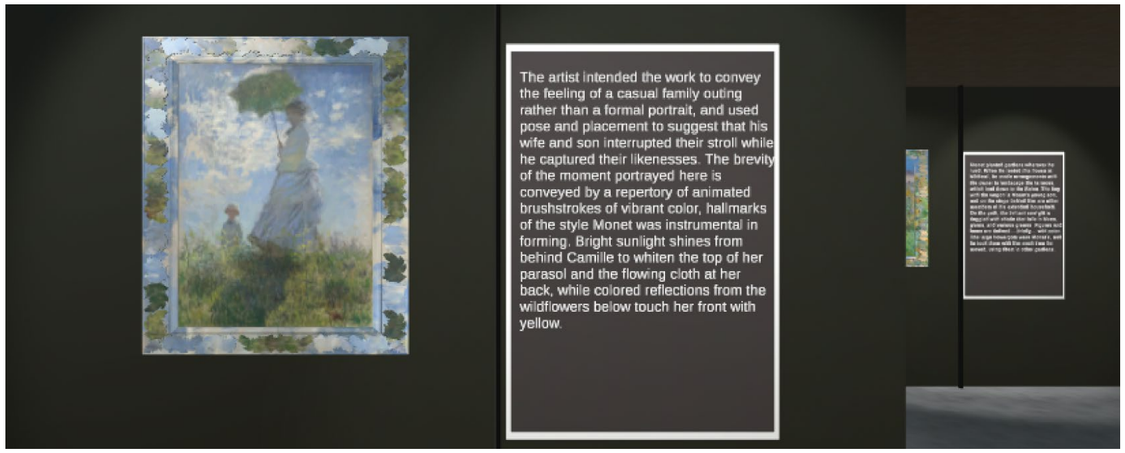


Figure 2. World-fixed reading panel is suggested to enhance reading comprehension for reading paragraph text in VR.

Note. Reprinted from *Reading in VR: The Effect of Text Presentation Type and Location*(Rzayev et al., 2021)

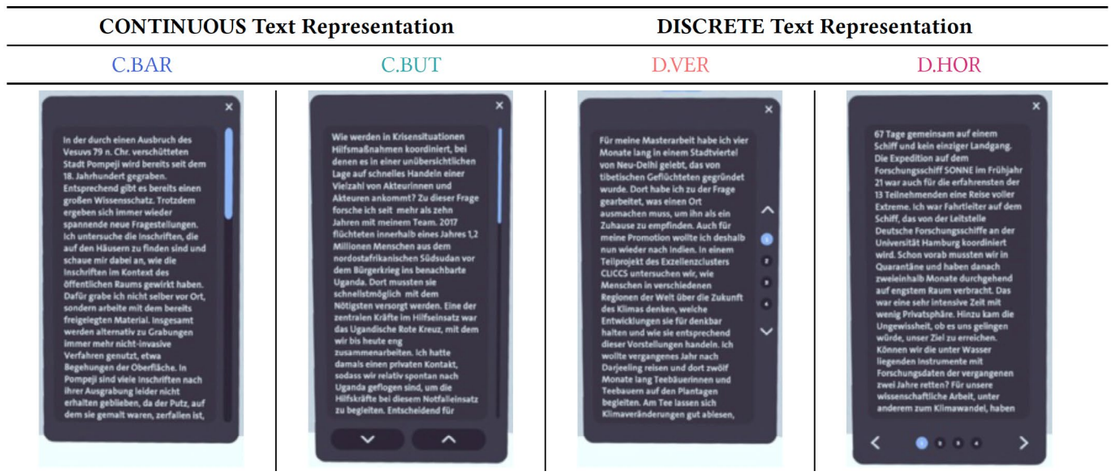


Figure 3. Various Types of Long-form Text UI Control and Representation in VR

Note. Reprinted from *Immersive Reading: Comparison of Performance and User Experience for Reading Long Texts in Virtual Reality*(Gabel et al., 2023)

2.3 Current Development of VR Fiction Reading

In recent years, researchers have begun applying VR technology to fiction reading experiences. Compared to traditional print reading, VR reading has been found to foster higher levels of **empathy** (connection to characters' emotions and narratives), **transportation** (deep immersion in the story), and **intention to read** (Pianzola et al., 2019). Surrounding users with visualized story elements in VR can provide additional cues that enhance imagination.

Early VR reading solutions primarily aimed to replicate traditional reading experiences, such as displaying virtual books in a digital environment, shown as Figure 4. However, recent research has shifted toward prioritizing the narrative experience itself, exploring how VR's unique capabilities can enhance reading enjoyment and immersion. For instance, Kunzová et al. (2024) introduced BookWander, a VR reading prototype that brings Jules Verne's Twenty Thousand Leagues Under the Sea into a virtual environment through four distinct methods: kinetic typography to emphasize narrative events, scrollable paragraph layouts with blog-like interactive illustrations, scenic reading that presents key scenes through immersive VR environments, and interactive association-based puzzle games woven into the narrative. Among these, scenic reading was identified as the most promising approach shown as Figure 5. It combines traditional text reading with spatial immersion, allowing participants to experience a flow state similar to conventional reading while still benefiting from VR's environmental depth. This method also employs semi-abstract visual representations of story elements, leaving space for the reader's imagination.

In follow-up studies, Kunzová et al. found that individuals with higher transportability—the trait-level tendency to become immersed in narratives—reported greater levels of narrative absorption and presence during VR reading. Their findings also showed that both textual and visual elements in VR significantly contribute to readers' mental imagery.

In summary, recent research consistently suggests that VR, with its powerful visual and auditory immersive capacities, can deepen narrative absorption and presence in reading experiences. By thoughtfully incorporating visual styles and background elements that align with the narrative, VR has the potential to become a compelling medium for reading. Moreover, it may serve as a motivational tool for individuals who are less engaged by traditional forms of text-based reading.

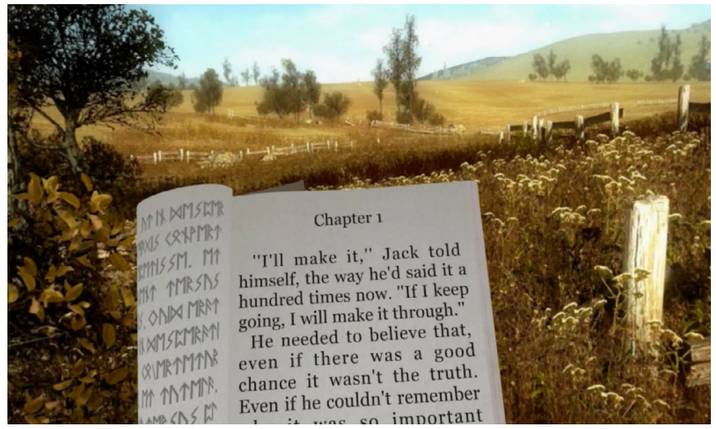


Figure 4. Early VR Reading Solution

Note. From Andromeda (Imbanova Entertainment, 2024). Retrieved from https://store.steampowered.com/app/457660/Andromedum/

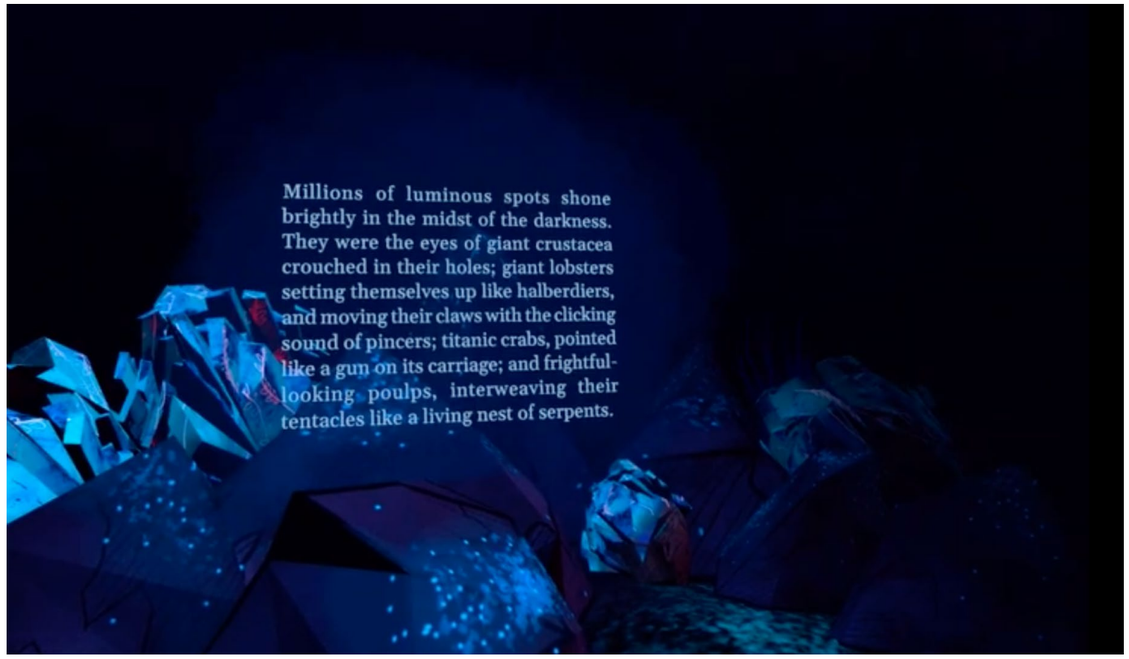


Figure 5. Screenshot from the VR reading prototype 'scenic reading' demonstration by Kumzová et al.

Note. Reprinted from *Stories with Style: Narrative Virtual and Imaginary Spaces of Reading Fiction in Virtual Reality (*Kunzová et al., 2024), screenshot taken from YouTube video: https://youtu.be/V0aIQIxYJsc.

2.4 Challenges & Limitation of Exploring Fiction Reading in VR

Considering the current state of VR development, it is evident that VR's immersive visual and auditory capabilities can enhance readers' sense of narrative transportation and, compared to print reading, may also increase reading motivation. However, there are still unresolved questions regarding the **underlying sources of immersion in VR reading**. While Pianzola et al.'s experimental results indicate that VR can stimulate a greater sense of transportation than paper-based reading, the study did not clearly identify the specific factors responsible for this effect. Furthermore, existing measurement tools—mainly subjective self-assessment forms—do not enable participants to distinguish between "immersion in VR as a medium" and "narrative transportation" arising from the story itself. It is also important to consider reader attitudes toward different media. Experienced readers may be hesitant to adopt VR as a reading platform due to their strong familiarity and comfort with print books.

Several limitations should also be noted in current VR fiction reading experiments. First, familiarity with the selected text may influence the results. Pianzola et al. suggested that their choice of Alice in Wonderland might have increased participants' intention to read simply because the story is widely known and culturally familiar. Second, due to constraints in experimental duration, studies often rely on a single reading material. Researchers have therefore recommended including a broader range of fiction genres—such as detective stories, thrillers, or science fiction—in future studies to better evaluate the versatility and design considerations of VR reading media.

While VR offers immersive experiences, concerns about user comfort remain a significant barrier to its broader application—especially for text-intensive tasks. One major issue is digital eye strain, a negative effect on productivity and well-being caused by prolonged exposure to digital screens. This is particularly relevant to head-mounted displays (HMDs), which require users' eyes to remain focused at a fixed distance, often resulting in headaches, blurred vision, and difficulty refocusing—effects that become more pronounced during extended reading tasks (Hirzle et al., 2022). In addition to visual strain, VR interaction also involves head movement, not just eye movement. The weight of current VR headsets can lead to physical discomfort, particularly in the neck and shoulders (Kim & Shin, 2020). However, these hardware limitations are being actively addressed by the industry. As noted in previous references, recent VR hardware developments are trending toward lighter form factors, higher screen resolutions, and increased refresh rates—advancements that could make future VR reading experiences more viable and comfortable.

Figure 6. VR fiction reading prototype conducted by Pianzola et al.

Note. Reprinted from *Virtual reality as a tool for promoting reading via enhanced narrative absorption and empathy*(Pianzola et al., 2019)

2.5 Research Question & Project Goal

Based on the initial literature review, this thesis has established a foundational understanding of the significance of reading in human life, the ways in which technological developments have shaped reading behaviors and habits, the conceptualization and measurement of narrative transportation in fiction reading, and the potential of VR to enhance narrative immersion through its unique immersive features. Among these themes, the source of transportation in VR reading remains an area that requires further clarification.

This thesis centers on two main areas of inquiry:

(1) examining the sense of narrative transportation during fiction reading

(2) exploring the experience of reading fiction within VR environments.

The research aims to **explore the factors that influence transportation during leisure reading activity**, then to **enhance the VR reading experience by designing around the identified factors of transportation**.

In discussing reading experiences, this research not only focuses on the in-the-moment experience of reading—as emphasized in prior studies—but also takes a broader view by considering the reader's overall reading context. This includes the environmental setup, the presence of people and objects, and other contextual factors that may influence immersion. This comprehensive perspective offers potential insights into the relationship between reading environments and the sense of being transported into a story world.

Accordingly, this study is guided by the following research questions:

> RQ1. What factors influence the sense of transportation in the context of reading fiction across traditional and digital media?
>
> RQ.2 How can the insights from user evaluations of transportation factors inform the design of VR reading experiences that maximize immersion?

Chapter I — Contextualization

3. User Study

Understanding Fiction Reading Experiences

To gain a deeper understanding of what contributes to the sense of transportation, a qualitative research approach was adopted to explore fiction readers' habits and their reading contexts. In order to uncover valuable insights from participants' lifestyles and perspectives, interviewee selection was based on the criterion of having an established habit of reading fiction, with a reading frequency ranging from daily to weekly.

The objectives of the interviews were as follows:

- To concretely define what reading contexts look like in readers' everyday lives;
- To understand the factors that make fiction reading appealing to readers;
- To identify the elements that contribute to the sense of transportation when reading fiction across different media;
- To gather readers' thoughts, imagination, and emotional responses regarding the potential of transportation-related factors in VR reading environments.

3.1 Research Design

The interviews were divided into three main parts: first, to understand the reader's personal reading context; second, to explore their perceived sources of narrative transportation; and third, to gather their thoughts and reflections on VR reading, based on existing video demonstrations of VR fiction reading prototypes developed by Kunzová et al.. A semi-structured interview format was adopted, allowing flexibility to explore each participant's context while adapting to their responses and reasoning behind their experience of transportation. Figure 7 illustrates the visualized process of the interview process.

Prior to the interview, participants were asked to document the following:

- Photos of the places where they typically read
- Photos (or physical examples) of the reading mediums they use
- Any items involved in their reading activity

If privacy concerns or access issues made it difficult to gather these materials, participants were invited to prepare written descriptions to bring into the interview instead. These artifacts served as prompts to facilitate discussion, helping both the researcher and participants better articulate and visualize the reading context. They also supported deeper reflection in the second part of the interview, where participants were asked to analyze the elements contributing to their sense of transportation during fiction reading.

To begin with, understanding a reader's reading context allows the researcher to identify potential factors influencing narrative transportation—such as the spatial arrangement of the environment, the objects involved, and the presence of other people. As a warm-up section, the first part of the interview included a series of questions focused on reading rituals, preferred reading locations, and typical reading times. These questions helped participants ease into the conversation while offering valuable insight into the situational elements surrounding their reading practices.

The second part of the interview delved deeper into the reader's experience of narrative transportation. This section was structured using the **Evaluation Grid Method (EGM)**, a technique commonly used in Kansei Engineering, particularly Type I, to identify and classify factors that contribute to a product or experience's appeal (Nagamachi, 2001). Kansei Engineering is a user-centered design approach that seeks to uncover the emotional and psychological responses users have toward products. Type I focuses on building a hierarchical structure of attractiveness, moving from abstract emotional concepts to concrete physical attributes (Nagamachi, 1995).

EGM supports this process by helping participants articulate abstract feelings and link them to tangible features through a structured “laddering” interview technique (Kang et al., 2018). By using this method, researchers can trace how specific sensory or contextual factors contribute to higher-level emotional responses—such as a sense of immersion—within the reading experience.

While the analysis of connected factors is performed after the interviews, the design of the interview itself included efforts to guide participants in understanding how laddering works—specifically in identifying both abstract psychological impressions and concrete physical attributes. This adjustment was made following feedback from participant P1, who noted some confusion when the researcher simply asked for “abstract” or “concrete” answers without further explanation. In response, for subsequent interviews, the researcher created a visual aid (see Figure 8) showing the three columns of the EGM framework, to help participants better grasp the types of responses each level of the ladder required.

Additionally, to ensure that all participants shared a consistent understanding of the term “sense of transportation,” the researcher prepared a simplified and rephrased version of the definition proposed by Kuijpers et al. This accessible version was printed and used as a brief guided reading at the beginning of the second interview phase, allowing participants to clearly grasp the concept before moving into deeper discussions.

Given that VR fiction reading is still in a very early stage of development and has not yet become widespread in the reading market, it was extremely challenging to recruit participants with direct experience in reading fiction within VR environments. Due to practical research constraints—such as the time required to develop a custom VR reading interface—the researcher opted to show participants a video demo of an existing VR fiction reading prototype instead. The 2D video featured BookWander, developed by Kunzová et al., and was played on a laptop during the interview. Participants were then asked to share their thoughts, imaginations, and personal attitudes toward VR reading based on the content and experience shown in the demo.

Figure 7. Interview Structure

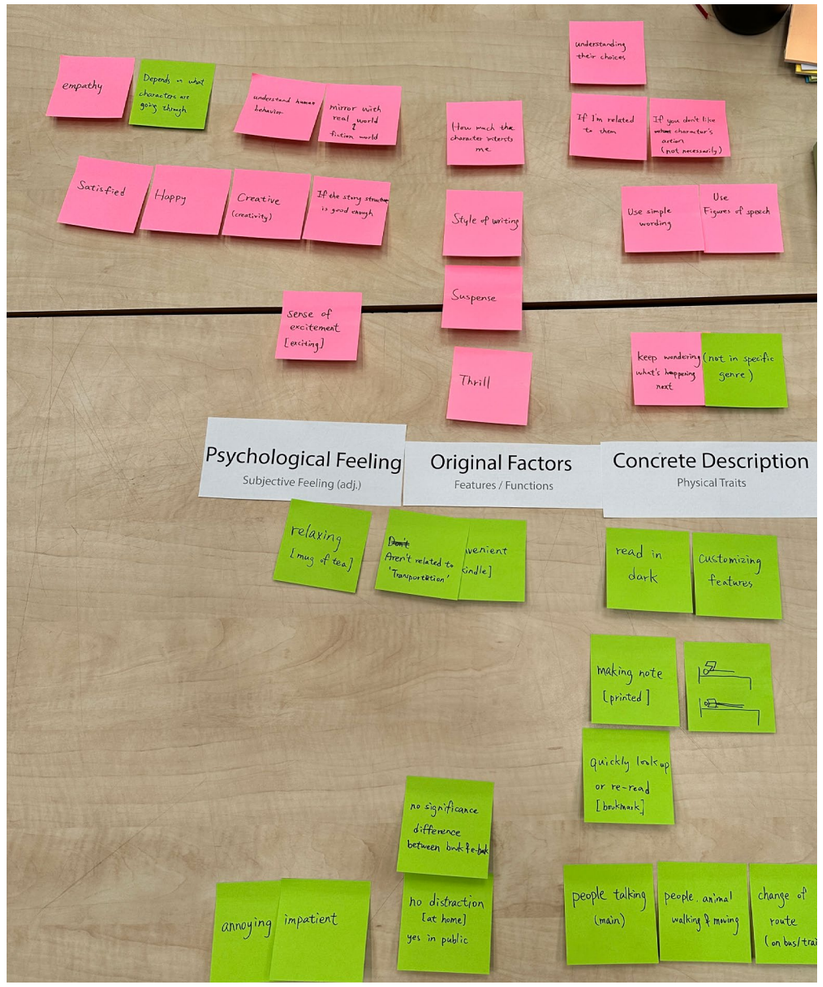


Figure 8. EGM Laddering Result Taken after P5 Interview

3.2 Participants

A total of eight participants—five female, two male, and one non-binary—were interviewed, all of whom were bachelor's or master's students at TU Delft. Three participants were from the Faculty of Industrial Design Engineering (IDE), while the remaining five came from non-design disciplines. In terms of fiction reading frequency, four participants reported reading daily, three read weekly, and one participant (P3) selected "monthly" due to a recent change in lifestyle, although they typically read on a weekly basis.

Participants' ages ranged from 20 to 36 years (M =25.13, SD =4.67). The reading media used by participants included physical books, E-ink readers, tablets, mobile phones, and computer screens. Most participants reported average reading sessions lasting between 30 minutes to one hour. Two participants (P1 and P5) typically read for less than 30 minutes per session, while P2 noted that their reading duration "varies based on occasion." Half of the participants acquired previous VR using experience.

3.3 Data Collection

The data for this study were primarily collected through one-on-one semi-structured interview recordings, supplemented by participant-provided photographs that depicted their personal reading contexts—such as common reading locations and devices used. These visual materials served to enrich the interview discussions and supported a deeper understanding of each participant's immersive reading experience.

During the interviews, the researcher took notes based on the ongoing conversation and used post-it notes to document factors mentioned by participants that were related to the sense of transportation, as well as other relevant insights. These notes were placed visibly on the table and reviewed with each participant to ensure their meanings were accurately interpreted.

All interviews were conducted in person, held in either a project room or meeting room within the Faculty of Industrial Design Engineering (IDE) at TU Delft, depending on room availability. Each session lasted approximately 50 minutes to one hour. Prior to the interviews, participants were required to sign an informed consent form outlining the data collection process and the measures taken to anonymize and protect their personal information.

3.4 Data Analysis

The interview recordings served as the primary material for data analysis. The audio files were first uploaded to Microsoft Word, where they were automatically transcribed into verbatim text, with speaker labels and timestamps included. The transcriptions were then imported into the online qualitative analysis tool ATLAS.ti, where the researcher systematically reviewed the transcripts and assigned quotations to thematic codes. These quotations were categorized using a hierarchical structure consisting of upper-level, middle-level, and lower-level labels.

To further organize and synthesize the data, the coded quotations were visualized using FigJam, a collaborative digital whiteboard tool. This platform allowed the researcher to map connections between concepts and visually group related ideas for pattern recognition.

In the final stage, ChatGPT was used as a supporting tool to assist in consolidating overlapping factors and refining the structure of the thematic hierarchy. This included merging redundant labels, re-evaluating the assigned levels of abstraction, and simplifying unnecessary hierarchical depth. Using ChatGPT offers high versatility, helps reduce researcher bias, and can improve the efficiency of qualitative analysis(Tabone & De Winter, 2023). However, all suggestions provided by ChatGPT were carefully cross-checked against the original interview transcripts to ensure the accuracy and traceability of the findings.

3.5 Results from User Study

This chapter presents the core findings derived from interviews conducted with eight participants who engage in fiction reading as part of their leisure routines. These semi-structured interviews were designed to explore not only the practical conditions under which reading occurs—such as time, location, posture, and objects—but also the psychological and emotional dimensions that contribute to immersive experiences. Participants were also invited to reflect on a VR fiction reading prototype, offering insights into the future potential and limitations of immersive technologies in reading contexts.

The findings are structured into three parts. Section 3.5.1 focuses on the **contextual factors** that frame the reading experience, highlighting how everyday environments and embodied routines may subtly shape the reader's ability to become transported into the story. Section 3.5.2 presents an Evaluation Grid Method (EGM) analysis, uncovering factors related to the **sense of narrative transportation**. This section draws out both the positive drivers and potential barriers that affect immersion. Finally, **participants' perspectives on VR reading** are included n Appendix A, serving as a reference for understanding how VR may support the immersive qualities of fiction reading.

3.5.1 Contextual Factor

Reading Time and Location

Among the eight participants, six reported that they typically read **before going to sleep**, while two mentioned reading during the evening. Additionally, two participants noted that they read while traveling.

Reading location was closely tied to the time of day participants preferred to read, although some reported reading in public settings depending on the situation. To capture this variation, locations are categorized into private and public spaces.

In private spaces, seven participants reported reading in **bed**, two mentioned reading on a **sofa**, another two on a chair, and one participant said they enjoyed reading while sitting on the pavement during good weather.

Regarding public spaces, five out of eight participants reported reading while traveling by **train**. Two specifically mentioned reading on public benches, and another two enjoyed reading in the park.

“When I start feeling more tired or I don’t feel like reading that, then I put it away and then I lay down in bed and read from my Kindle.”

— P1

“Yes, I think reading at night feels just right, because it’s quiet, there’s no one around, and it’s late. Your next step is going to sleep anyway, and usually, when you’re reading until you feel tired or you can’t concentrate anymore, it actually helps you fall asleep better.”

— P8

“So the bed is the only comfortable spot. If I had to read on a chair, for example, I don’t like it because. It feels too professional, and reading is my hobby…”

— P4

Objects Involved During Reading

Participants reported that various objects were involved in their reading experiences. These can be grouped into three categories: **physical support**, **facilitating tools**, and **food & drink**.

In the physical support category, several participants who read in bed highlighted the importance of comfort-enhancing items. P1 and P7 specifically mentioned using **pillows** for support, while P1 also described wrapping themselves in a **blanket** while reading. P2 and P4 noted the presence of **plush toys** during their reading sessions. For P2, the plush toy sometimes relates to characters in the story—particularly when reading fan fiction—whereas for P4, the plush toy was unrelated to the narrative.

The facilitating tools used during reading varied depending on the medium chosen by participants. For those who read physical books, common associated objects included **bookmarks** (mentioned by P1, P3, and P5). Several participants also reported the habit of annotating directly on the page—P1, P5, and P8 mentioned using **pencils** to make footnotes or highlight passages during reading.

In contrast, for digital reading, tools often served dual purposes. **Phones**, for example, played conflicting roles. P6 identified the phone as a frequent **source of distraction**, while P7 described it as a useful tool for **looking up background information** about the novel’s setting or characters, especially when reading complex or unfamiliar stories.

Food and drink also played a role in participants’ reading routines, particularly beverages. Most participants mentioned having something to drink nearby during their reading sessions. For example, P3 and P5 typically drank **tea**, P4 kept a water bottle close at hand, and P6 preferred **milk** while reading.

While beverages were commonly integrated into the reading experience, snacking appeared to be less frequent. P3 mentioned having tried reading while eating **snacks**, but noted that such instances were rare.

In summary, participants’ reading routines were shaped by consistent temporal and spatial patterns—most notably reading at night in private, comfortable settings such as the bed. These environments were often accompanied by supportive objects and personal rituals, including pillows, plush toys, drinks, and annotation tools, all of which contributed to a familiar and focused reading atmosphere. Such elements, while often overlooked, form the broader reading context that may influence the reader’s ability to become immersed in the narrative. Understanding these contextual factors offers valuable groundwork for exploring how narrative transportation emerges in both traditional and emerging digital reading environments, including VR.

“There are also more specific cases, like when I’m reading fan fiction, I might hold a plushy that’s related to the character.”

— P2

“Sometimes if I read something that I really connect with, I like to underline that with the pencil.”

— P5

“Usually they’re sort of on my side. So if I’m sitting over here, then they’re right on my side.”

— P4

“We need to imagine how the monument is, so I usually look into my phone, look at the monument and then, you know, just when I’m reading again, I will picturize how it is.”

— P7

3.5.2 EGM Analysis Result — Factors of Sense of Transportation

The Evaluation Grid Method (EGM) analysis relied on the researcher's interpretation of the interview transcripts, including how terms and expressions were understood and grouped into related factors(see Figure 9). This process required multiple iterations in order to refine and simplify the initial, often complex, EGM diagrams. To support this refinement, ChatGPT was employed as a linguistic tool to help identify redundancies and inconsistencies in hierarchical relationships—such as when similar factors were repeated or when parent-child relationships between concepts appeared inverted. These AI-assisted suggestions provided useful feedback that helped the researcher better clarify and organize the factors contributing to the sense of transportation during fiction reading.

Unlike typical EGM analyses, this thesis was guided by a clearly defined research focus on reading immersion—specifically, the sense of transportation. As a result, all identified original factors from the interviews were directly linked to the same **kansei level**, reflecting their relevance to the immersive reading experience. Consequently, no further upper-level conceptual categorization was applied, allowing the findings to remain centralized and focused on the elements that influence transportation in fiction reading.

Notably, the other EGM findings related to factors of reading motivation are presented in Appendix B, as they were considered less directly relevant to the primary focus of this thesis.

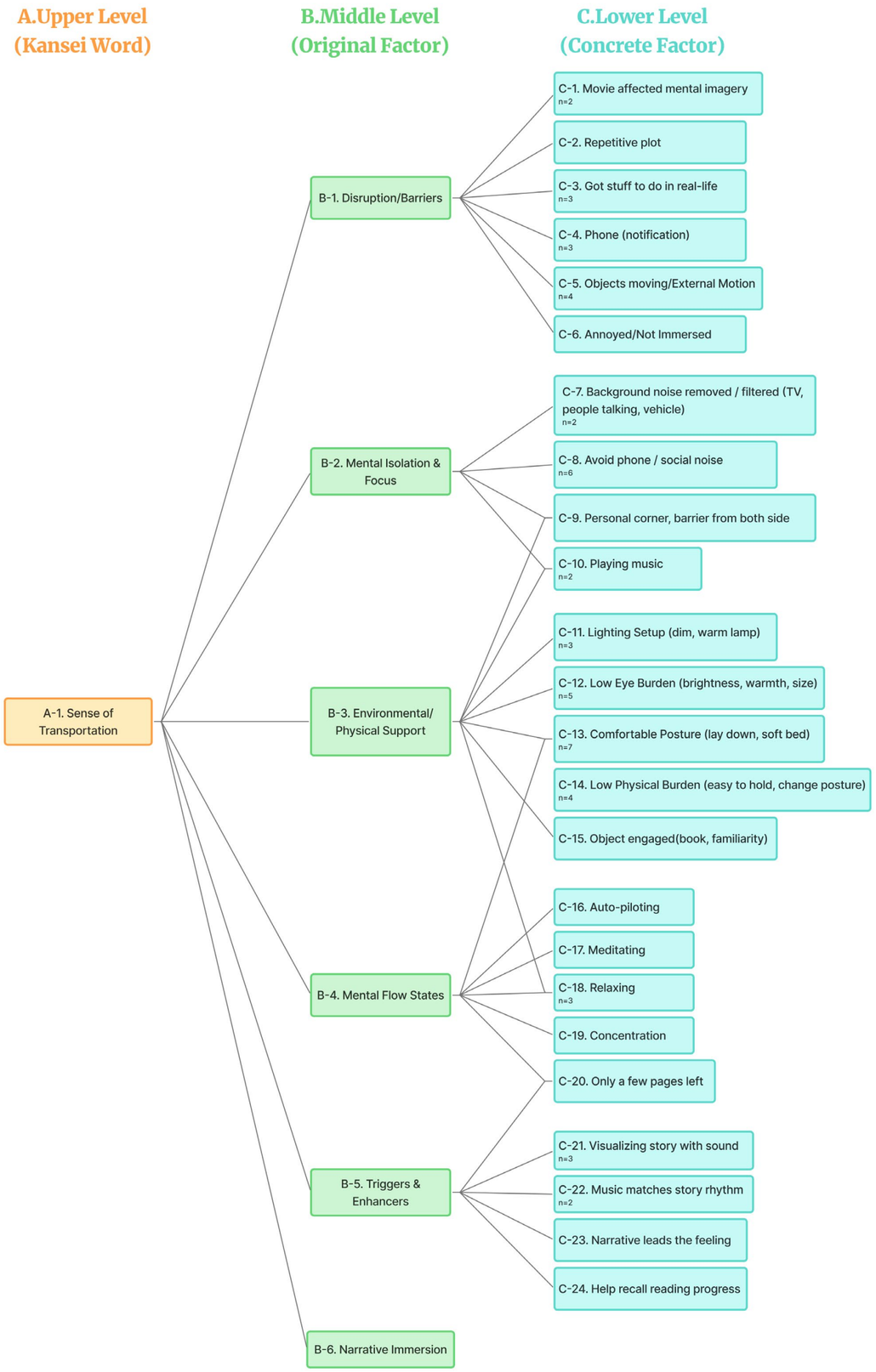


Figure 9. EGM Analysis Result of Sense of Transportation

B-1. Disruption / Barriers

While discussing factors that enhance narrative transportation, many participants also highlighted barriers that hinder their ability to become immersed in a story. The most commonly cited external distractions included **movement in the surrounding environment** and **mobile phone notifications**. In addition, participants mentioned that awareness of upcoming tasks or obligations—such as household chores or the need to disembark while commuting—could interrupt their mental focus and reduce their capacity for engagement.

Beyond external disruptions, some participants identified narrative-related factors that disrupted immersion. For example, **repetitive plot** structures or overused narrative devices were perceived as diminishing the sense of novelty and engagement. Moreover, for novels that had been **adapted into films or television series**, pre-existing visual representations of characters or settings could interfere with the reader's imagination and, for some, lessen the depth of transportation into the fictional world.

These insights emphasize that immersion is not only fostered by positive elements, but can be fragile and easily disrupted by both contextual and content-based factors.

"It [scenario of taking a train] is not like you can completely relax and just read. You still have to pay attention or have to get off at the next stop or something like that."

— P5

"In general, I get distracted by any small noises. If I hear ... like a motorcycle outside my room somewhere, just driving by, then I hear it, I notice it."

— P6

B-2. Mental Isolation & Focus

Building on the barriers identified in B-1, participants also discussed strategies for enhancing narrative transportation by minimizing external disruptions. A common method was the **intentional creation of both physical and psychological isolation** to improve focus during reading. For example, P6 described using noise-canceling headphones to play music and block out ambient noise, helping to establish a mental buffer from the outside world.

However, it is worth noting that this strategy was not universal. Some participants explicitly stated that they preferred not to listen to music while reading, suggesting that the effectiveness of auditory isolation varies by personal preference.

Beyond sound, participants also emphasized the importance of **spatial separation**—creating a personal reading nook or retreat-like corner helped reinforce a sense of environmental detachment, enabling them to mentally transition into the fictional world more easily. This sense of intentional solitude appeared to play a key role in deepening immersion and maintaining sustained attention throughout the reading experience.

"It's like your own corner ... there's nobody coming to disturb you and there's no external distractions from windows or noises or anything ... both the bed and even the couch and such, they have corners where you can sort of wedge yourself into so your you have barriers from 2 sides... So it helps to like really immerse inside the book because there's nothing distracting me."

— P4

B-3. Environmental / Physical Support

Many participants emphasized the importance of creating a personally comfortable environment to enhance their reading experience. This comfort can be categorized into two subtypes: **visual comfort** and **physical comfort**.

Visual comfort includes factors such as lighting preferences and the visual strain associated with reading devices. Several participants expressed a preference for slightly dimmer, warmer lighting, which contributed to a cozy ambiance rather than simply illuminating the reading material. This suggests that lighting does not always serve a purely functional role—it may also contribute to the emotional tone of the environment, thereby enhancing the immersive quality of the reading experience.

In terms of media, readers favored devices that offered **low eye burden**, such as E-ink readers with customizable brightness, warmth, and font size. These features allowed participants to adjust the reading interface to suit their comfort levels, reducing fatigue and enabling longer, more focused reading sessions.

This type of environmental fine-tuning—whether through lighting, visual settings, or ambiance—emerged as an important foundation for sustained immersion and transportation into the fictional world.

"I think if they all contribute to my comfort, it makes me easier to emerge."

— P1

"There's also another light that's on, because otherwise I can't see enough. But this is more for the vibe. For the coziness."

— P3

Physical comfort, on the other hand, refers to bodily ease during reading. Most participants expressed a preference for reading in **relaxed positions**, such as lying down or reclining on a soft bed. Reading was widely described as a low physical burden activity—something that should not require much physical effort or tension.

This sense of comfort was further supported by various **contextual objects** discussed earlier, such as pillows, blankets, or plush toys, which contributed to a calming and restful reading environment. Together, these physical supports helped create a bodily state that made it easier for readers to become absorbed in the story world without distraction or discomfort.

However, it is worth noting that not all participants perceived a strong connection between physical comfort and narrative transportation. Some even suggested that immersion in the narrative could occur independently of the physical environment, including those who otherwise placed a high value on comfort while reading. This points to a potential divergence in how readers experience immersion and highlights that the relationship between bodily comfort and narrative engagement may be more complex than assumed. As such, the role of physical comfort in supporting narrative transportation remains a topic worthy of further investigation.

"So the bed is the only comfortable spot. If I had to read on a chair, for example, I don't like it because it feels too professional."

— P4

"The most important for me is just the position to be comfortable... Like to not move when I'm reading so I can stay in place."

— P6

"Actually, if the book is more gripping, (the way of) sitting doesn't matter for me."

— P7

B-4. Mental Flow States

Some participants associated their experience of narrative transportation with the psychological state of flow. Reading was described as a deeply **meditative** and **relaxing** activity, during which they became fully absorbed and lost track of time—core characteristics of what Csikszentmihalyi defines as a flow state. This alignment suggests that narrative transportation and flow may overlap experientially for many readers.

Interestingly, the perceived **length of a chapter or the number of pages remaining** also influenced participants' ability to sustain this mental flow. When nearing the end of a chapter, some participants found it easier to remain fully immersed, whereas longer or open-ended reading segments could potentially interrupt the sense of progression and flow. This highlights how structural aspects of a book, beyond its content, can shape the depth and continuity of immersion.

"I don't … like register too much anymore outside. I'm it's like meditating almost. I would say … like the transportation … It's almost like you get into this meditative state."

— P6

B-5. Triggers & Enhancers

Certain elements within both the novel itself and the reading environment can serve as triggers or enhancers of narrative transportation. For example, **visual materials** such as book covers, maps, or illustrations help readers build an initial conceptual understanding of the fictional world. These elements support the creation of mental imagery, enabling readers to better visualize the storyline and characters.

However, not all participants relied on mental imagery for immersion. Some reported experiencing a strong sense of transportation even without forming vivid mental pictures—suggesting that imagery may enhance, but is not necessarily essential to, narrative immersion.

An interesting observation from P8 highlighted how visual triggers—particularly the book cover—can also act as memory prompts. Upon returning to a story after a break, the cover could help the reader mentally retrieve the imagined world they had previously constructed.

In addition, **music that matches the story's setting, tone, or language** was also mentioned as an enhancer. When appropriately paired, such auditory elements could strengthen the mood and emotional resonance of the reading experience, further supporting a deeper sense of transportation.

"I like to put on music and that also helps … I do enjoy it quite because it makes it helps me with the transportation into … visualize stuff and having sounds as a background."

— P1

"Because it's impossible to finish the whole book in one sitting, right? So every time you pick it up again, or think, "Oh, I want to continue reading this part," that scene just comes back to mind … When the scene comes to mind, I kind of create a thumbnail image for the novel."

— P8

B-6. Narrative Immersion

Throughout the interviews, participants consistently mentioned that the quality of writing and the structure of the narrative significantly influenced their sense of immersion. Factors such as storytelling technique, pacing, character development, and plot coherence were seen as essential to sustaining narrative transportation. The richness and complexity of these narrative-related insights suggest that they could constitute an independent EGM analysis on their own.

It became evident that the interaction between media-related environmental factors and the intrinsic qualities of the story is deeply intertwined in shaping immersive reading experiences. However, since the primary focus of this thesis is on the reading environmental context and its relationship to transportation, the analysis did not aim to extract direct design insights from the literary content itself.

Therefore, while the findings on narrative quality are valuable, they are documented in Appendix C for reference. These insights may serve as a useful foundation for future research specifically focused on how narrative construction can be leveraged to enhance immersion in both traditional and VR reading environments.

Conclusion from User Study

The EGM analysis method helped the researcher systematically review the user interview data and provided a solid foundation for identifying key insights. Among the factors that emerged, two in particular—B-3 Environmental / Physical Supports and B-5 Triggers & Enhancers—stood out as having rich and promising design potential, which the researcher decided to explore further in the next phase.

Chapter I — Contextualization

4. From Insight to Design

This chapter presents key insights derived from the qualitative analysis of participant interviews, structured primarily through the Evaluation Grid Method (EGM). Building on the literature review and prototype evaluation presented in earlier chapters, this section focuses on the factors that influence the sense of narrative transportation during fiction reading, both in traditional formats and within emerging VR-based experiences.

Rather than offering generalized conclusions, the insights in this chapter aim to surface **recurring themes**, **underlying motivations**, and **contextual conditions** that shape immersive reading. These findings not only help to clarify how transportation occurs, but also reveal design-relevant opportunities and tensions—particularly as reading interfaces evolve beyond the printed page.

Each section highlights one specific insight, supported by participant quotes, EGM references, and reflections from the VR prototype evaluation. Together, these insights form a foundation for the design considerations and implications that will be discussed in the next chapter.

4.1 Comfort is a prerequisite for achieving transportation in reading

Throughout the interviews, participants repeatedly emphasized the importance of creating a **personally comfortable reading environment**. Factors contributing to this comfort included lighting setup, reading location, preferred body posture, involved objects, freedom from external disruptions, and the adjustability of the reading medium itself. Several participants (e.g., P1 and P6) explicitly stated that physical comfort is a prerequisite for entering a transported mental state, regardless of whether they were reading on paper, a tablet, or an e-reader.

This insight is supported by the EGM results, particularly those associated with B-3 (Environmental / Physical Support) and its related lower-level factors (see Figure 10). These findings are especially compelling, as the original literature review and interview protocol focused mainly on the in-the-moment reading experience. It was only through the interviews that the **“pre-reading setup”** emerged as a critical contributor to immersion. This shift in perspective highlights how preparatory actions—such as arranging one’s space and selecting tools—play a key role in facilitating narrative transportation.

When reflecting on the VR reading prototype, participants also expressed concerns about the physical and visual comfort of the VR experience—including issues like headset weight, motion sickness, and the readability of text. These concerns suggest that both visual and physical comfort must be carefully considered in future design iterations aiming to foster immersive reading experiences.

Another important takeaway is the observation that reading experiences are not simply passive acts of consumption, but increasingly seen by readers as collaborative and co-constructed. Participants actively shaped their reading conditions—through environmental arrangement and media preference—to optimize their own readiness for immersion. This suggests that future reading experience design, whether physical or digital, should support users in personalizing their own pathways into immersion.

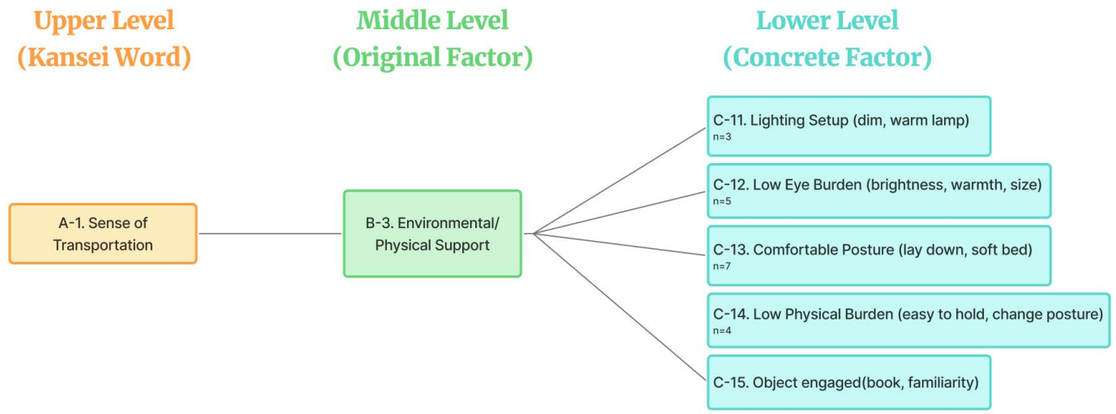


Figure 10. Insight 1 EGM Highlight

4.2 Visual and auditory elements facilitate the sense of transportation

Beyond the written text itself, participants identified various visual and auditory cues—such as maps included in books, cover illustrations, or personally chosen background music—as potential triggers that enhance narrative transportation. These sensory elements help readers better visualize the fictional world described in the novel, resulting in a deeper and richer immersive experience. As P6 described, reading felt like “watching a long movie inside of [his] brain.” The related EGM analysis is shown in Figure 11.

This finding aligns with previous research on multisensory immersion, particularly in the context of VR, where visual and auditory elements are frequently used to enhance presence. What makes this especially interesting is that even outside of VR, participants independently adopted strategies—through lighting, music, or interpretive visuals—to strengthen their own immersive reading experience.

When reflecting on the VR reading prototype, participants appreciated the audiovisual environment as a helpful imaginative base that made immersion more accessible. This suggests that immersive technologies like VR may serve as effective scaffolding for readers who seek a stronger connection to narrative content.

However, a critical concern also emerged. Several participants—regardless of their VR experience—questioned whether the detailed visual and auditory presentation in VR might inhibit personal imagination. For them, one of the greatest joys of reading lies in mentally constructing a unique version of the story world. If these elements are too rigidly defined—whether by designers or AI—the experience may lose its interpretive openness.

This raises an important design question for future exploration: how can VR support narrative immersion without overriding the reader’s creative engagement? Striking this balance will be essential in shaping meaningful and respectful immersive reading experiences.

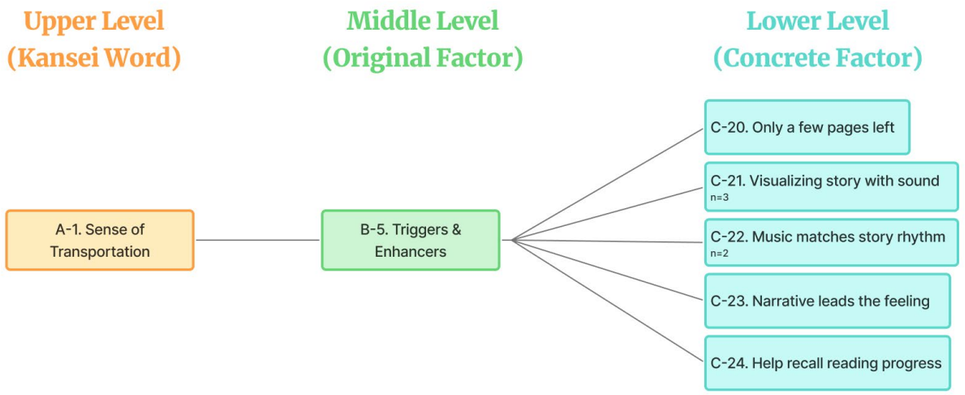


Figure 11. Insight 2 EGM Highlight

4.3 Visual cues help readers re-enter the story world the next time they open the book.

Extending from insight 4.2, Fiction is often read in multiple sittings due to its typical narrative length. As the story progresses, readers gradually build a mental image of the fictional world. P8 mentioned that visual elements provided by the book—such as cover illustrations—help her **recall the imagined world** she had previously constructed, making it easier to re-enter the story when returning to the book.

This is a particularly interesting finding, as it suggests that fiction reading can be seen as a **progressive activity**, where the immersive experience evolves in tandem with the story. In other words, the design of the reading experience does not only concern what happens each time the book is opened, but also how the experience accumulates over time. As the narrative unfolds, readers begin to generate **mental thumbnails**—personal, visual impressions of the fictional world. The book cover or other visual prompts can act as cues to help retrieve these mental representations, making re-immersion into the story smoother.

This idea is also reflected in participants who preferred physical books. One frequently mentioned advantage of the print format was the ability to **easily flip through pages** and revisit previous sections. This allowed them to recap earlier content before resuming their current reading position, helping them re-engage with the story world. This quick visual scanning process may also play a role in reconstructing the narrative memory, working in parallel with the visual recall described above.

Whether there is a deeper connection between **page-turning interaction** and the **activation of mental thumbnails** remains an open question—one that could offer a valuable direction for future research and interface design.

4.4 Summary and Design Direction

The insights gathered from participant interviews offer a nuanced understanding of how narrative transportation unfolds across different phases of the reading experience—**before**, **during**, and **after** the act of reading.

First, the insight that comfort is a prerequisite for transportation highlights the importance of pre-reading conditions. Participants consistently emphasized the role of physical and environmental setup—lighting, posture, location, and the choice of medium—as foundational to their readiness to immerse themselves in a fictional world.

Second, during the act of reading, visual and auditory elements emerged as powerful enhancers of imagination and emotional connection. Whether through book design features like maps and covers, personally curated background music, or the multisensory environment provided by VR, these sensory cues help to deepen engagement and make transportation more vivid.

Third, in the post-reading phase—or rather, the moments of re-entry into the story—visual cues again play a role in helping readers recall and re-engage with their previously imagined story worlds. This suggests that immersion is not isolated to the moment of reading itself, but can persist and evolve across sessions, supported by memory triggers and spatial interaction with the book or device.

Based on the three-stage insights from the user study, the design goal of this thesis is to:

> Amplify narrative transportation in VR fiction reading experience by leveraging environmental and visual cues beyond the text itself.

Rather than treating reading as a linear, isolated act, this project considers immersion as a continuous process shaped by both anticipation and recall, physical context and emotional tone.

To address this goal, two primary design directions were formulated:

> *Design Direction A explores how the **reading environment** can influence readers' emotional alignment and imaginative presence during the act of reading.*
>
> *Design Direction B investigates how **re-entry** cues can support readers in reconnecting with the fictional world when resuming a paused story.*

Together, these directions aim to position VR not merely as a digital replication of traditional reading, but as an experiential medium that can shape the emotional, spatial, and temporal qualities of fiction engagement.

5. Design Concept Iteration

The design iteration followed a **rapid prototyping process**, which involved swiftly refining design concepts, producing low-fidelity prototypes, and collecting user feedback through quick testing cycles. After completing the initial brainstorming, the iteration process was carried out in two rounds, ultimately leading to a concrete design concept and a set of specific visual configurations used for the final prototype testing and measurement.

5.1 Initial Design Brainstorm

Once the design direction had been clearly defined, the next step was to diverge and explore potential design concepts in response to the key insights identified during the earlier context research phase. Following the methods outlined in the Delft Design Guide, this thesis adopted the 'brainstorming' method (van Boeijen et al., 2014). Brainstorming is particularly suited to the early phases of ideation, allowing designers to generate a wide variety of possible solutions without immediate concern for feasibility. This approach encourages open exploration and provides a rich foundation of ideas to inform and support decision-making in the subsequent stages of the design process.

Before initiating the brainstorm, several key design questions were first identified to guide the ideation process:

? How can readers effectively recall their latest reading progress the next time they open the book?

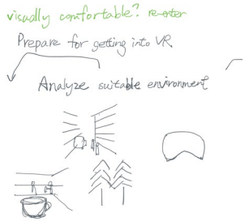
? How can the entry and exit mechanisms of VR fiction reading be designed to enhance narrative transportation?

Figure 12. on the next page illustrates the brainstorming process and the range of early ideas that emerged. The brainstorm yielded a diverse set of concepts, each addressing different aspects of the reading experience.

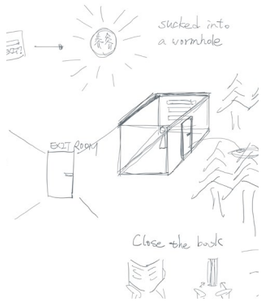
Among the brainstormed ideas, Concept 1 and Concept 6 were selected and combined to form a complete VR reading journey—one that emphasizes both the ***entry into and exit from the fictional world***, offering a reading experience that leverages the unique affordances of the VR medium. This combined concept sets itself apart from other VR reading studies, which often focus on visualizing narrative elements or scenes described in the text (similar to movie adaptations). Instead, this approach proposes a design hypothesis:

By understanding the emotional tone of the story, the system can transport the reader to a real-world location that best aligns with the atmosphere of the novel, thus enhancing narrative transportation.

Additionally, Concept 9 was selected because it directly continues an insight discovered during the earlier user study: readers tend to build a mental thumbnail of a novel based on the book cover and their reading experience, which helps them re-enter the fictional world during subsequent reading sessions. Concept 9 has the potential to serve as a ***recap mechanism*** by generating a personalized visual cue, either through a short questionnaire or AI-generated symbolic representation based on the reader's recent experience.



Concept 1: Transport readers to a location using Google Street View or a 360-degree video background.

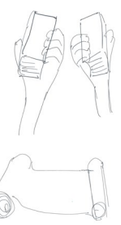


Concept 6: Design the experience of exiting the fiction world to enhance the sense of narrative closure.

Concept 2: Allow readers to choose the emotional tone they want to experience before reading.

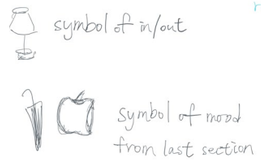
Concept 7: Invite readers to align their current mood with the tone of the upcoming fiction segment.

Concept 3: Track multi-sessional reading locations and visualize them as a progress map.

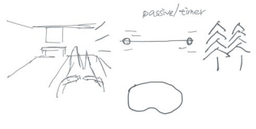


Concept 8: Explore redesigns of the physical VR controller to better match the reading experience.

Concept 4: Create a “memory wall” that helps recap the tone and key moments from the last reading session.



Concept 9: Generate a symbolic object that represents the emotional tone of the last session.



Concept 5: Passively shift the reader’s virtual environment from real-life to an immersive fictional setting.

Figure 12. Brainstorm Section Result

Summary of Brainstorm Section

After determining the design direction, a set of storyboards was sketched to communicate the VR interaction concept both internally and with the supervisory team (see Figure 13 and Figure 15).

Prototype A – Entering the Fictional World via Google Street View

The first prototype, which combines Concept 1 and Concept 6, was designed to simulate a transition into and out of the fictional world through spatial movement in VR. When the user puts on the VR headset, they first find themselves in a minimal, empty starting room. In front of them, several book covers are displayed. Upon selecting a book, the corresponding book cover moves to the center of the room and transforms into a door.

Once the user opens the door, they step directly into a panoramic Google Street View location that serves as the reading environment. The reading UI is already present inside this virtual setting, ready for the user to begin reading.

When the session ends, the user can turn around and walk back through the same door to symbolically exit the fictional world, completing the reading journey.

At the first glance, Prototype A may seem less related to the concept of re-entry. However, both the entering and exiting of the fictional world are integral to shaping the full reading experience. This prototype specifically explores how a spatial metaphor—physically “stepping into” a story world—can support the psychological transition into immersion. By framing the beginning of the reading session as a threshold crossing, and offering a symbolic act of returning at the end, the prototype aims to enhance the reader’s awareness of their movement between reality and fiction.

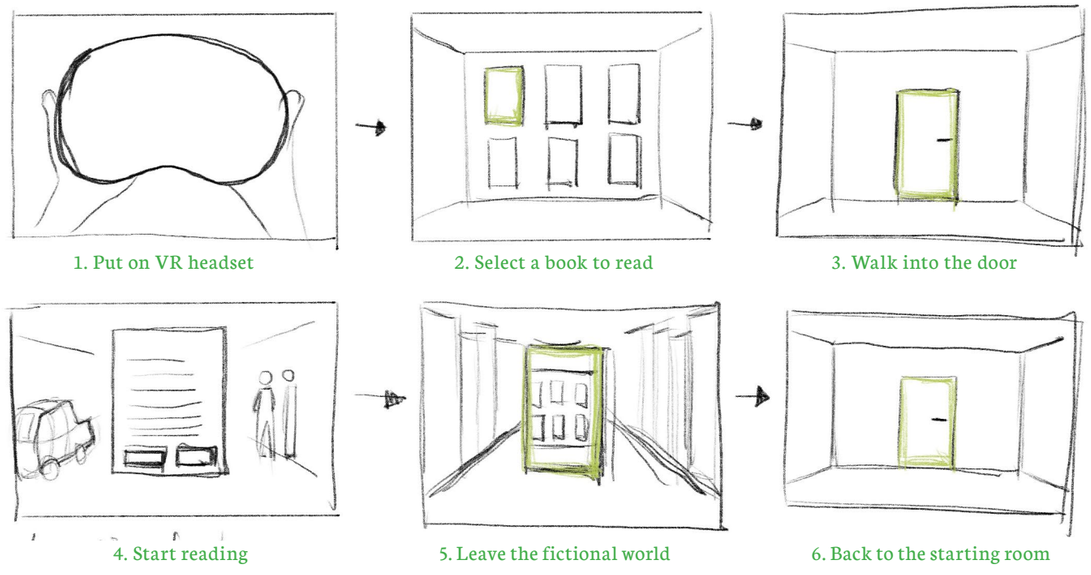


Figure 13. Storyboard Illustrating the Mechanism for Entering and Exiting the Fictional World in VR

To analyze novel content and propose suitable reading locations and symbolic objects, ChatGPT has shown to be a highly promising tool. Its advanced large language model (LLM) architecture is particularly well-suited for processing and interpreting long-form text. During the design process, the researcher found that the **ChatGPT-4o** model could occasionally perform **web searches** to retrieve descriptions of specific locations—from blogs, travel sites, Reddit discussions, and more—to recommend reading environments that align with the novel's context. Furthermore, ChatGPT-4o can generate **Google Street View URLs**. Although the geo coordinates may sometimes be slightly imprecise, the accompanying descriptions of landmarks or local features usually provide enough information for researchers to locate and implement the recommended locations within the VR reading prototype.

In its analysis and recommendation process, ChatGPT performs three primary layers of interpretation:

1. **Semantic Parsing**: to understand the plot structure and character interactions.

2. **Emotional Modeling**: to identify the emotional trajectory and inner conflicts throughout the narrative

3. **Temporal and Seasonal Layer**: to identify the emotional trajectory and inner conflicts throughout the narrative

Once these layers are processed, ChatGPT transforms the insights into realistic environmental suggestions. It does so by matching its textual analysis with a pre-existing knowledge base related to global landscapes, and when needed, by retrieving additional information from the internet. These results are then translated into Google Street View coordinates.

Figure 14 illustrates the step-by-step workflow of the prototype generation process during the recommendation phase.

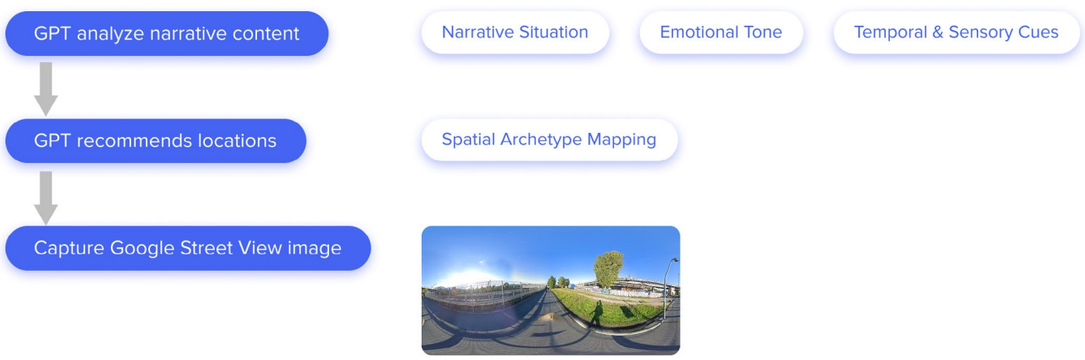


Figure 14. Prototype Flow and ChatGPT Workflow of Prototype A

During the development of Prototype A, the research team discussed several types of VR reading background styles, as illustrated in Diagram 1. The options included: Google Street View images, 360-degree panoramic videos, and fully 3D-modeled virtual environments. Each option was evaluated for its respective strengths and limitations.

Ultimately, this thesis chose Google Street View as the primary source of VR background imagery. The decisive advantage lies in its vast, readily accessible database—any location covered by Google Street View can become a potential reading environment. This enables a design principle of "**the entire Earth as your playground**," offering readers a wide range of real-world settings that can match the tone and context of their fiction.

However, this choice also comes with limitations. The captured weather conditions and time of day in Google Street View are fixed at the moment of recording and cannot be altered. Most notably, street view imagery is almost exclusively taken during daylight, which restricts the ability to represent nighttime or mood-specific environments—potentially diminishing the sense of narrative transportation in stories that rely on such atmospheres.

	Google Street View	360 Panoramic Video	3D Model Environment
Advantage	Enormous coverage of real-world locations; readily available dataset	More vivid and dynamic environments; closer to real-life experience	Highest potential for vividness and interactivity; customizable dynamic elements
Disadvantage	No nighttime scenes; dependent on the fixed time and weather of capture	Limited data variety; less accessible content compared to Street View	Requires advanced technical resources or AI capability to generate

Diagram 1. Benefits and Harms of Variable Background Options

Prototype B – Symbol Objects

Prototype B focuses on the symbol object VR journey, which shares structural similarities with Prototype A, particularly in terms of transporting the reader to a new reading location. However, this prototype adds a narrative-driven entry: before transitioning to the reading environment, the user first encounters a symbolic object generated by AI based on their previous reading session. This object appears on the ground in the initial VR space. Upon interacting with it, the environment gradually transitions into a corresponding Google Street View scene. See Figure 15 for the storyboard visualization of this concept.

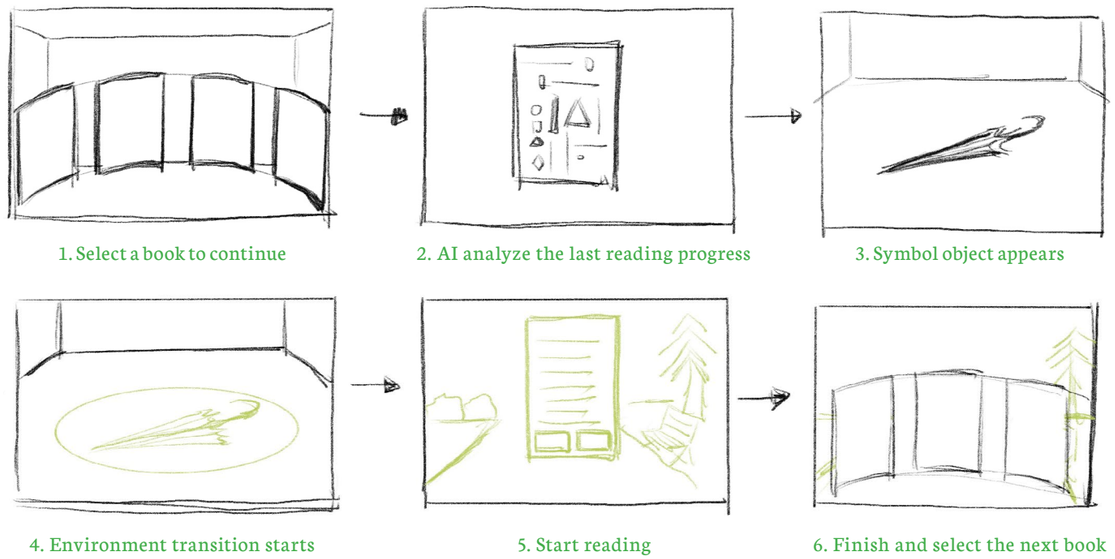


Figure 15. Storyboard Depicting Reader Interaction with Symbolic Objects When Reopening the Novel in VR

The process of symbol object generation follows a similar analytical approach as in Prototype A. ChatGPT first interprets the narrative situation and emotional tone of the last completed chapter. It then translates these into metaphorical keyword clusters, which are used to infer a set of potential symbolic objects that resonate with the story's development and affective state. These metaphor-informed object suggestions aim to visually and emotionally anchor the reader's memory of their previous session, supporting a sense of continuity and re-entry into the fictional world.

For a detailed overview of the prototype workflow and the step-by-step visualization of ChatGPT's generative reasoning process, please refer to Figure 16.

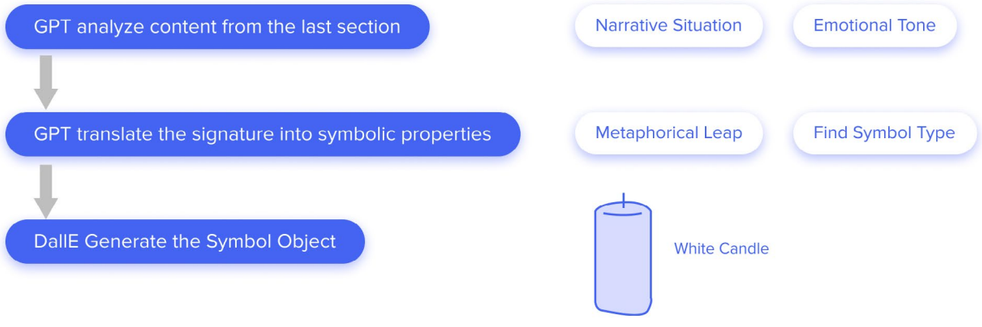


Figure 16. ChatGPT Workflow of Prototype B

5.2 First Round Prototype Test

After finalizing the initial design concept, the researcher quickly developed a basic WebVR prototype and invited two Master's students from the IDE faculty to test it and provide feedback for further iteration.

The prototype was built using Figma to design the basic interface components and interaction logic, and DraftXR, a plugin that converts Figma mockups into WebVR experiences. This allowed for rapid prototyping of a VR reading interface that integrates immersive background environments. However, there were a few limitations: for instance, a red circle indicating the center of the user's vision appeared in the VR view and could not be removed. Despite this visual artifact, it did not significantly interfere with participants' ability to evaluate the experience.

The selected reading material for the prototype test was Chapters 1 and 2 of *Norwegian Wood* by Haruki Murakami. This novel, well-loved by a wide audience, vividly portrays deep interpersonal relationships and is known for its rich environmental descriptions. These qualities make it particularly suitable for the prototype test, allowing ChatGPT to interpret the narrative atmosphere and enabling participants to reflect on how the suggested VR environments relate to the story.

Diagram 2 illustrates the VR reading environments presented to participants during the prototype test. For each chapter, ChatGPT provided a corresponding background along with a rationale for why it would be a suitable environment for reading that part of the story.

	Chapter 1	Chapter 2
Image		
Location	Inokashira Park, Tokyo	Gleisdreieck Park, Berlin
Reason	*An open space tinged with a sense of solitude, perfectly echoing the scene where Naoko and Watanabe take a walk across the grass.*	*Converted train yard with open paths and city noise in the distance.*

Diagram 2. Results of Recommended Google Street View Background by ChatGPT for the First Prototype Test

Prototype Test Setup

- Place: IDE Project room
- Participants: 2 Female IDE Master Student with little VR Experience.
- Apparatus:
  - Meta Quest 3: main interaction device
  - Bluetooth speaker: play sound effect of the prototype
  - Laptop: for real-time monitor participant's view in VR
- Reading Material: Norwegian Wood by Haruki Murakami, Chapter 1 & 2

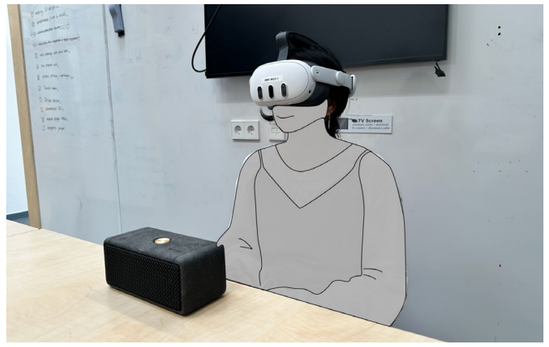


Figure 17. Prototype Test Setup

Test Procedure

1. Participants were invited to try the WebVR prototype, which was preloaded on the VR headset.
2. They were asked to follow the on-screen instructions and could ask questions at any time during the test.
3. After completing the prototype, participants were asked to give feedback on the experience.

Figure 18. Prototype A Starting Room Screenshot

Figure 19. Prototype A Reading Section Screenshot

Participant Feedback Summary

The first round of testing involved two IDE Master's students with limited VR experience. Their feedback highlighted both technical and conceptual aspects of the prototype that required refinement. The main insights are summarized into the following key points:

Scene Division Mechanism

Participants observed that VR scene transitions occurred across different pages, yet these transitions were not aligned with the narrative flow. They suggested that:

- Scene changes should be driven by reading progress, **not tied to chapter boundaries**.
- Segmenting the story based on **narrative progress** could support better synchronization between environment and plot.

Transportation Works (Initial Only)

- The prototype was successful in generating a **strong initial sense of transportation**, especially at the beginning of the experience.
- **Background music** was noted as an effective aid in establishing emotional tone and immersion.
- However, this effect **faded quickly** as the reading progressed, indicating the need for sustained or adaptive engagement strategies.

Unclear Symbolism: Door & Symbol Objects

- Participants **did not grasp the intended metaphorical meaning** of the "door" as a passage between the real world and the fiction world. This may be due to the lack of visual or animated cues guiding interpretation.
- Similarly, the purpose and symbolism of the symbolic object at the beginning of the second session were **unclear**.
- One suggestion was to enhance contextual framing by **adding the chapter title and a sentence** from the previous session to help anchor meaning.

5.3 Second Round Iteration

After gathering feedback from the first concept, the first thing we realized was the need for clearer instructions within the prototype—specifically, to communicate to the reader that the VR environment is not meant to directly reflect the story content. Some participants expected the VR surroundings to match the narrative—for example, when Norwegian Wood opens with a scene at Hamburg Airport, they found it confusing to be placed in a park instead. However, this is not the intended effect of the concept.

The goal of this concept is to let users experience how the visual characteristics of the environment can **evoke emotional responses** that influence their sense of transportation into the story—**not to recreate specific scenes or characters** from the novel.

VR Background Design Implementation

To support this intention, **clearer textual guidance** during the experience is necessary. In the iterated storyboard (Figure 23), a new status display is added above the door, indicating whether the door is currently interactive. This improvement builds on feedback from earlier versions and aims to make the transition between environments smoother and more understandable for users.

In addition, this iteration introduces a new layer of **user autonomy** by allowing readers to choose the atmosphere they wish to experience before entering the reading environment. Instead of providing a single recommended reading location, ChatGPT now generates three distinct scene options, each reflecting a different emotional tone that corresponds to the story.

For example, based on the first chapter of Norwegian Wood, ChatGPT suggests three VR settings with accompanying mood descriptions as shown in Figure 20.

Soft Nostalgia

A gentle sense of distance from the past—ideal for quietly revisiting memories as they surface.

Suggested location: Inokashira Park, Tokyo

Hazy Distance

A faintly disconnected, unfocused feeling—highlighting emotional estrangement and atmospheric silence.

Suggested location: Chemin Vert (Skywalk), Paris

Frozen Intimacy

An emotional pause within a warm setting—capturing moments when closeness is expected but words remain unspoken.

Suggested location: Arthur's Seat (mid-slope path), Edinburgh

Figure 20. Prototype A Reading Section Screenshot

This approach not only personalizes the reading context but also supports emotional alignment between setting and story, reinforcing the reader's narrative immersion through deliberate spatial and affective choices.

Additionally, after collecting the recommended Google Street View locations from ChatGPT, the researcher began to explore an alternative approach: **using AI-generated panoramic images** as VR reading backgrounds. One significant advantage of using AI-generated visuals is the ability to overcome limitations found in Google Street View, such as the lack of nighttime scenes or specific atmospheric conditions.

By using similar prompts, AI-generated images could better **capture the passage of time**—for instance, gradually shifting the background from dusk to night—thereby simulating a feeling of "reading through time" as the narrative progresses.

As a result, the idea of **"walking into the story world through a door"** was extended to support multiple combinations of visual styles, incorporating both Google Street View imagery and AI-generated panoramas. Participants were then asked to test these varied combinations to evaluate how different styles influence their reading immersion.

Please see Figure 21 for a detailed breakdown of the visual style categories and how they correspond to different "door" entries in the prototype.

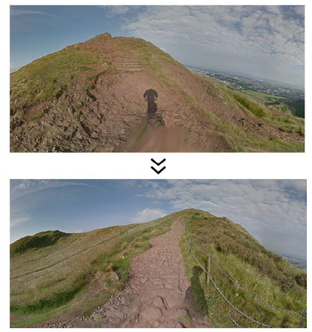
	Soft Nostalgia	Hazy Distance	Frozen Intimacy
Image			
Image Transition	✕	Simulate from Dawn to Morning	Simulate walking on a path
Image Style	Google Street View	AI-generated	Google Street View
Note	Readers will remain in a fixed panoramic environment throughout an entire chapter.	As the reader turns the pages, the background subtly changes to reflect the passage of time—e.g., transitioning from a quiet park entrance at dawn to the sunlit center of the park. This style aims to simulate a temporal shift.	The background updates progressively to create the illusion of moving through space, as if the reader is walking through the story world while reading. Each page turn reveals a new angle or location along a continuous path.

Figure 21. Description of the Visual Styles in the Iterated VR Background

Symbol Object Design Implementation

In this iteration, the concept of symbol objects has been refined and integrated into the book cover design at both the beginning and end of the VR reading experience. Responding to previous prototype feedback—where participants found the sudden appearance of a standalone symbol in the VR scene to be abrupt and lacking contextual relevance—the new design overlays symbolic elements onto the original book cover. As the reader progresses through the novel, the book cover evolves, with additional symbol objects being gradually embedded into the design.

The underlying design hypothesis is that this dynamic cover—serving as a visual recap of the story's emotional tone and narrative trajectory—can help reinforce the reader's sense of transportation upon re-entering the VR reading experience. When the user next opens the book in VR, the transformed cover provides a subtle but meaningful cue to reconnect them with the fictional world they previously engaged with.

Additionally, the end-of-session symbol object is no longer a passive visual element. The updated concept allows readers to **actively select the object** that best represents their interpretation of the chapter they just read. This added layer of personalization enhances the user's sense of agency and strengthens the emotional connection with the story. The end-of-session survey and the demonstrated new book covers based on the three options is shown below as Figure 22.

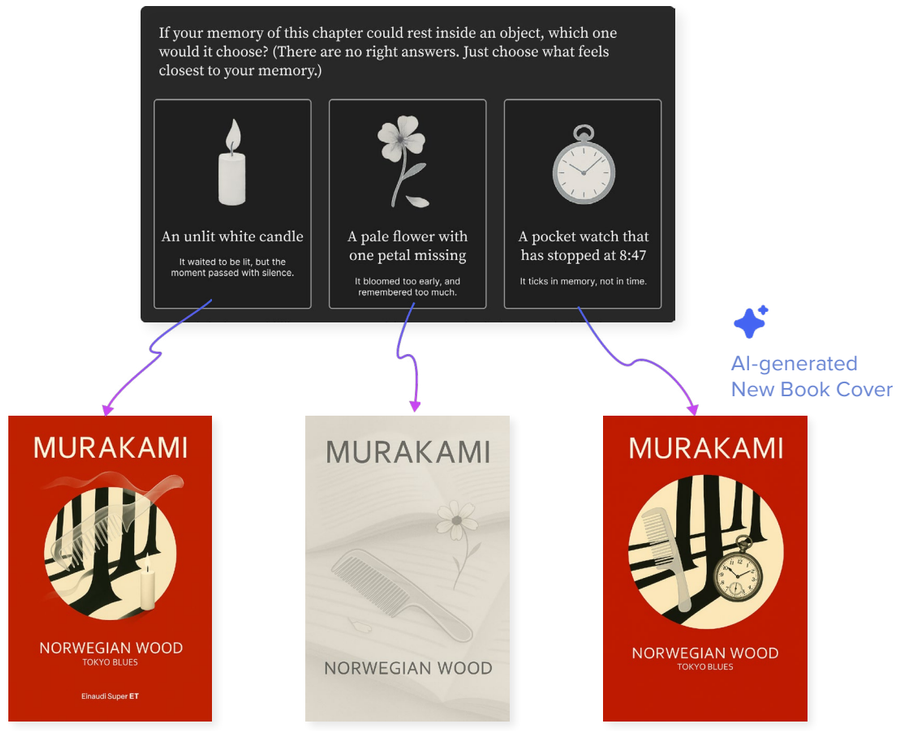


Figure 22. AI-personalized book cover demonstration for the second prototype test

Summary of the Second Round Iteration

In summary, in this latest prototype iteration, the concepts from the earlier Prototype A and B have essentially been merged into a unified experience, combining environmental transition, symbolic interaction, and user-driven navigation into a single flow.

Figure 23 shows the storyboard of the journey walkthrough of the unified VR reading prototype.

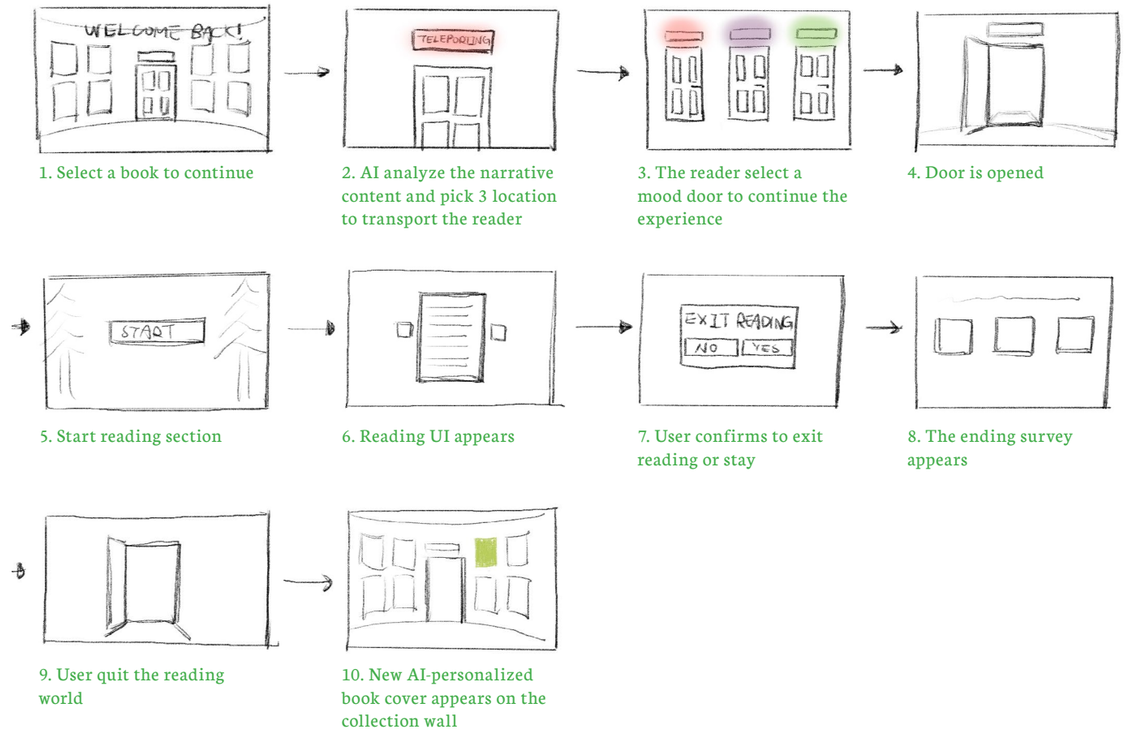


Figure 23. Storyboard illustrating the convergence of the symbolic object and portal mechanism concepts.

5.4 Second Round Prototype Test

The second round of prototype testing involved a new group of participants, including Master's students from the IDE faculty and one PhD candidate. These participants were different from those in the first round. The primary goal of this session was to gather qualitative feedback and identify themes most relevant to the thesis research question, in order to guide further design iteration.

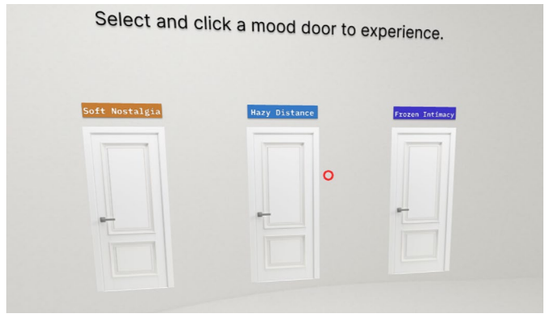
The reading material remained the same as in the first test session: Chapter 1 and Chapter 2 of Norwegian Wood. For details regarding the VR reading background, please refer to Figure 24.

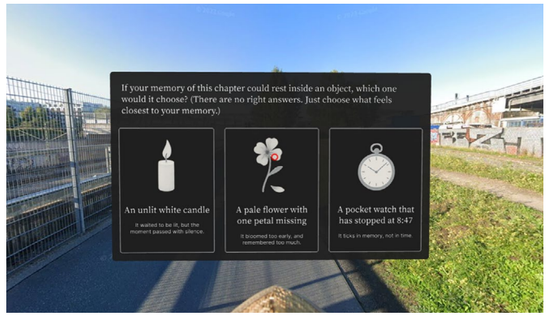
Prototype Test Setup

- Place: IDE Project room
- Participants: 1 Male & 1 Female IDE Master Student, and 1 Female PhD.
- Apparatus:
  - Meta Quest 3: main interaction device
  - Bluetooth speaker: play sound effect of the prototype
  - Laptop: for real-time monitor participant's view in VR
- Reading Material: Norwegian Wood by Haruki Murakami, Chapter 1 & 2

Test Procedure

[Remains the same as Prototype Test 1]





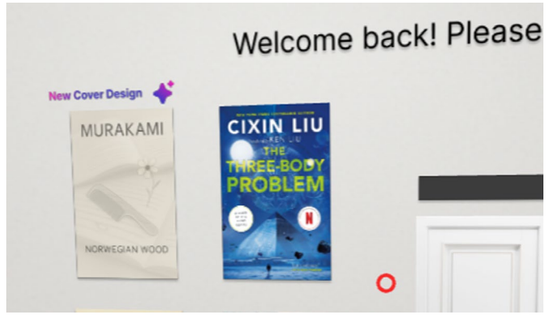


Figure 24. Screenshot from the Second Round Prototype Test

Participant Feedback Summary

Participants reported varied subjective experiences of narrative engagement depending on the type of location transition:

- Sequential and Single-Location Transitions elicited **different levels of immersion** compared to AI-generated and Realistic Environments.
- The impact of selecting symbolic artifacts on the reading experience was **not yet clearly observable** due to time constraint for prototype sessions.
- AI-generated environments using Google Street View require better **filter settings**, such as:
  - Avoiding crowded areas
  - Avoiding roads or high-traffic locations
  - Ensuring the environment feels safe and enclosed (e.g., not placing users on exposed mountain peaks)
- Transition effects and operational flow were found to be clunky, slightly reducing the overall experience quality—though this was considered a non-priority issue at this stage.
- Due to time constraints during the prototype test, participants were unable to complete the full story, which limited their narrative immersion.

Conclusion from Design Iteration

In summary, experiencing either sequential or single-image backgrounds in VR led to distinct differences in narrative immersion. Participants noted that AI-generated backgrounds appeared more abstract and therefore held greater potential as tools to support the reader's imagination. When using ChatGPT to recommend reading locations, it is important to apply filtering criteria to ensure that the selected environments evoke a sense of psychological safety for readers.

Due to time constraints in the prototype sessions, participants only skimmed through the narrative content, making it difficult to assess the actual effectiveness of symbolic objects in supporting re-entry into the fictional world. However, several participants mentioned that the final questionnaire prompted them to reflect on and recall their VR reading experiences more consciously.

Additional feedback related to usability and somewhat clunky scene transitions was received, but these aspects fell outside the primary research scope of this thesis and were therefore not prioritized in this phase.

Chapter II — Ideation

6. Final Research Prototype

6.1 UI Design Details

6.2 Prototype Development

Based on the insights gathered from previous user interviews, this project has identified two key factors that influence the sense of transportation in VR-based fiction reading: (1) the style of the visual environment and (2) the entry mechanism that helps readers dive into the story world. These insights have been translated into two primary design experiments.

Both design directions align with the design goal: to enhance the sense of transportation in VR fiction reading. The first design concept focuses on how the reading environment influences immersion into the story world, while the second centers on how the experience of “re-entering” the reading activity affects engagement.

After discussions with the supervisory team, the next step was to revisit the overall research framework of this thesis and analyze how the final evaluation test could be structured to align with the initial research question. This thesis first investigates the sources of narrative transportation in VR reading, and then explores how experience design can be applied to enhance this sense of transportation. By revisiting the research rationale and integrating the outcomes from the design iterations and collected feedback, two final design concepts were developed—that can be measured and evaluated in alignment with the research aims.

The AI model used for analyzing the novel content, providing geo-location recommendations, and generating image prompts was ChatGPT-4o. The image generation was conducted using DALL·E. For a complete overview of the AI prompts employed in this study, see Appendix D.

(1) Visual Style of the Environment

As introduced in the previous chapter with Prototype A, one of the key ideas was to use ChatGPT to suggest real-world locations via Google Street View or to generate panoramic images using prompts in DALL·E. Both single still images and sequentially changing images were considered to test different background dynamics. The design hypothesis, as discussed earlier, suggests that transporting the reader into different environments during VR reading has the potential to enhance the sense of narrative transportation—by matching the visual elements of the environment with the story’s content and emotional tone.

In the final design concept, this idea was divided into two experimental variables:

1. Real v.s. AI-generated Background

2. Static v.s. Dynamic Background

For the detailed explanation of the two design variables, see Figure 25. on the next page.

Variable 1 — Real v.s. AI-generated Background

		Advantages	Disadvantages
Real Street View Images		• Extensive image data available via Google Street View • Realistic visual style preferred by some readers • Ability to resonate with actual geographic locations (e.g., tied to personal memories)	• Overly vivid or detailed environments may distract from the reading experience
AI-generated Images		• More abstract visuals that may better support readers' imagination of the fictional world • Possibility to depict non-Earth environments, enhancing emotional tone alignment	• Lower image resolution due to current AI generation limitations • Misaligned edges in 360° images often require further processing in Photoshop

Variable 2 — Static v.s. Dynamic Background

		Advantages	Disadvantages
Static		• Reduces potential distraction from background transitions • Maintains a stable visual focus	• May feel unengaging for some readers
Dynamic		• Enhances interactivity and novelty within the VR reading context • Enables "walking while reading" effects and simulates a passage of time	• Scene transitions must align with the story's narrative flow and emotional rhythm • Poorly timed or mismatched transitions may break immersion

Figure 25. Design Variables Explanation and Hypothetical (Dis)advantages Concluded Based on the Previous Prototyping Feedback.

(2) AI-Personalized Book Cover

Building on the previous chapter's Prototype B, at the end of the reading session, readers are presented with a small questionnaire window in VR that invites them to reflect on their reading journey. Based on their responses, the system generates a personalized book cover tailored to their experience. As previously discussed, the design hypothesis behind this concept is that: seeing a visual trace of the last reading session before starting a new one can help reconstruct a mental thumbnail, thereby enhancing the sense of transportation into the fictional world in the upcoming session. AI Prompts for generating the symbol objects are included in Appendix E.

During the subsequent prototype evaluation, a simplified 2D version of the ending survey was used to streamline the testing procedure, as shown in Figure 26. Despite the simplification, the core idea of the AI-personalized book cover design was preserved. More details about the evaluation setup are presented in the following chapter.

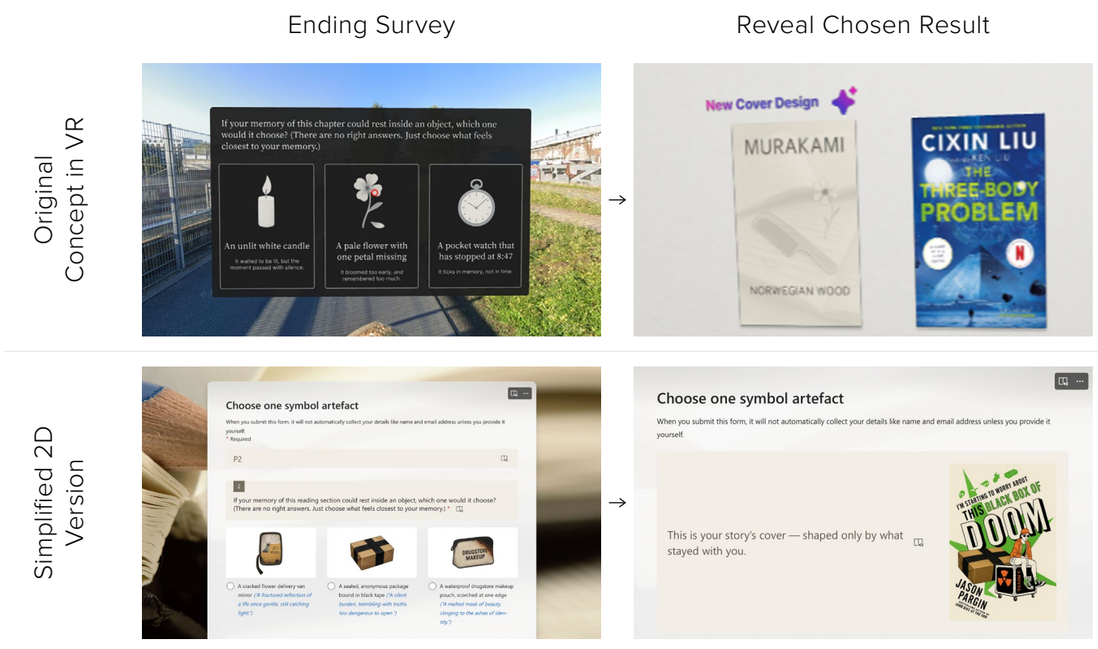


Figure 26. Simplified 2D version of the ending survey was used during the prototype evaluation.

It is worth noticing that during the iteration and testing process, the researcher discovered that the generation of AI-based book covers and symbolic object options was constrained by ChatGPT's policy. If the novel content involved elements such as violence or explicit themes, ChatGPT was unable to generate corresponding images.

6.1 UI Design Details

Reading novels in VR involves a long period of text consumption, making the design of the reading UI particularly critical. High readability helps reduce the influence of visual or interactive discomfort on participants' assessment of transportation.

The text reading UI in this thesis draws upon several prior research findings on VR reading. For example:

- Semi-transparent reading panels have been found to enhance the reading experience. In addition, white text on a black background is shown to provide better readability than the reverse(Jankowski, 2010).
- For long-form reading tasks in VR, text should be fixed within the VR world rather than attached to the user's head movement, in order to improve comprehension(Rzayev et al., 2021).
- In long text reading situations in VR, the presentation of long text paragraphs significantly affects aspects of UX. Gabel et al. studied the recall and UX of reading long texts in VR using discrete and continuous display modes. Results showed that the discrete display method had better user experience due to better usability of pagination button than scroll bar (Gabel et al., 2023).

Following these research insights, the reading interface in this thesis is shown in Figure 27. The panel transparency is set to nearly zero, based on the researcher's subjective judgment during design iteration—any noticeable transparency significantly decreased legibility. Left and right pagination buttons were adopted, and the text window was world-fixed (rather than head-fixed) to enhance readability for long-form narrative content.

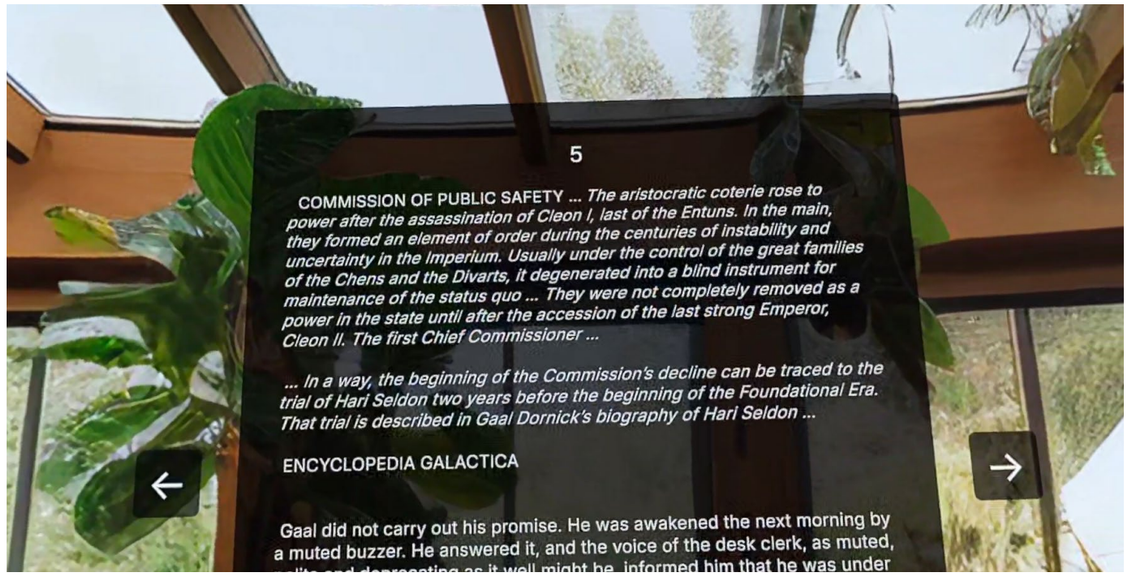


Figure 27. Screenshot from Unity Prototype

6.2 Prototype Development

During the design iteration phase and the early stage of the final evaluation test, the prototypes were developed using **Figma** combined with the **DraftXR plugin** for testing. However, frequent issues were encountered during testing, including system crashes and unresponsive buttons. The researcher suspected that these problems were caused by the high memory usage of WebVR, which often led to lag or application failure after extended use of the VR headset.

To address this, the prototype concept was later rebuilt using **Unity**, which significantly reduced the occurrence of crashes and unresponsive behaviors. For all subsequent prototype evaluation sessions—except for the first three experiments—the improved Unity-based prototype was used.

This revised version not only eliminated the distracting red circle (present in the WebVR prototype) but also increased the overall system stability. Furthermore, Unity's XR Interaction Toolkit provided built-in support for hand gesture detection, enabling participants to interact with the interface using either VR controllers or hand gestures.

7. Prototype Evaluation

The concept of VR reading as a means to enhance narrative transportation was established. In the subsequent research activity, it became essential to validate whether the proposed design concept could meaningfully influence readers' sense of transportation.

The objective of the prototype evaluation includes:

- To know if the reading environment affects sense of transportation;
- To know which visual style of the VR reading environment can enhance transportation;
- To know if the mechanism of AI-generated book covers enhances transportation.

7.1 Research Design

The prototype test was divided into two parts:

1. to explore how different VR reading background styles influence the sense of transportation during reading;
2. to examine whether AI-generated book covers affect re-entry immersion when readers return to the VR reading experience.

For the second part, the experimental design was intentionally **split across two separate days** to simulate a more realistic fiction reading habit. In daily life, readers typically do not resume reading a novel immediately after finishing a session; instead, they usually return after a few days. This time gap was replicated to better understand how visual cues—such as the book cover—might support narrative re-engagement.

During participant recruitment, we targeted frequent fiction readers whose reading habits fell within the **daily to weekly** range. Once participants were confirmed, the researcher asked them to share the title of the novel they were currently reading and the most recent progress point in the story. This was essential to ensure participants would continue reading from their actual, first-time reading progress in VR—rather than re-reading a section (which could influence immersion and skew the results).

Participants were also asked to **pause reading** their selected book after sharing their current progress to allow the VR prototype content to align with their narrative continuity. To minimize inconsistencies in initial immersion levels, we avoided starting participants mid-chapter—especially during narrative climaxes or turning points that could disproportionately heighten transportation. Thus, once enrolled, participants were instructed to **complete their current chapter**, ensuring that their VR reading session would begin at the start of a new chapter.

After receiving the book title and progress information, the researcher purchased the Kindle eBook version from Amazon, copied the relevant text into the VR prototype, and then used an AI tool to analyze the content and generate a suitable reading environment.

Evaluation Test Setup

This research was conducted onsite at TU Delft, either in the IDE Faculty or TU Delft Library, depending on room availability. Since the experiment aimed to measure participants' sense of transportation during fiction reading, it was essential to set up an environment that participants would perceive as **comfortable and natural for reading**.

Insights gathered from earlier user studies indicated that readers often associate comfort with settings that include cozy furniture (e.g., sofas or beds), snacks, and beverages. Therefore, most of the experiments were held in the Multi-Sensory Lab at IDE Faculty, which resembles a living-room-like environment (see Figure 28). Two sessions were relocated to project rooms at TU Delft Library due to lab scheduling constraints. To simulate a realistic reading context and provide a small token of appreciation, snacks were also offered at the experiment site.

Figure 28. Research Environment Setup

Upon arrival, participants were first asked to sign the TU Delft informed consent form. They were then introduced to the concept of "sense of transportation" in narrative reading, helping them develop a clearer understanding of the subjective state they would later be asked to self-assess.

Next, participants were given a VR quick guide outlining how to interact with the prototype using hand controllers. In the updated prototype built with Unity after P3's test in Round 1, a gesture-based page-turning option was also provided for participants to try.

After familiarizing themselves with the VR interactions, participants wore the VR headset to begin reading their chosen novel.

- In the **first round** of testing, participants read within **four different background styles**: Static Real Image, Static AI Image, Dynamic Real Image, and Dynamic AI Image. The sequence of background styles varied between participants to avoid bias caused by order effects.
- In the **second round**, since the main focus was to evaluate how an **AI-personalized book cover** affected re-entry transportation, the VR environment was intentionally kept neutral—a panoramic living room background (see Figure 29) unrelated to the narrative content—to reduce environmental interference.

Throughout the session, participants were prompted within the VR experience to remove the headset and complete a short self-assessment form. These prompts appeared after each background change in the first round. This approach was chosen because scene transitions already interrupted the experience, and the short five-item questionnaire took less than 30 seconds to complete. Moreover, since the questions required participants to rate their current immersive state, collecting responses immediately after each segment minimized memory distortion and improved data accuracy.

After completing the VR reading in both sessions, participants engaged in a brief post-test interview. These semi-structured interviews were designed to collect qualitative feedback on aspects such as the impact of the VR medium on reading immersion and preferences among the different visual background styles.

At the end of the first session, participants were also asked to complete an online form where they selected a symbolic object that best represented their reading journey. The

Figure 30. Evaluation Process

form then presented an AI-generated book cover integrating their chosen object. This image was shown to participants to help them remember it, and it reappeared at the beginning of the second session, displayed inside the VR environment.

Finally, participants were asked follow-up questions in the second session's interview, focusing on whether this symbol-object-based cover contributed to their sense of re-entry or transportation when they resumed reading the story.

For the visualized overview of the evaluation process, please see Figure 30.

Figure 29. Neutral VR Background for 2nd Round Prototype Test

Content of Reading

In previous studies on VR reading, researchers often assigned fixed reading materials to participants in order to reduce potential confounding variables such as differences in narrative structure or writing quality. However, this study argues that in the context of leisure reading, participants' genuine interest in the story is crucial. If the selected novel does not engage the reader, it could significantly distort their evaluation of transportation.

Given the small sample size and the study's qualitative focus, allowing participants to read their current self-selected novels did not introduce analytical complications. On the contrary, it enabled more authentic feedback and provided valuable cross-device insights by allowing participants to compare their usual reading medium with the VR experience.

The novels chosen by participants were:

- P1: *Avatar: The Last Airbender – The Shadow* of Kyoshi by F.C. Yee & Michael Dante DiMartino
- P2: *I'm Starting to Worry about This Black Box of Doom* by Jason Pargin
- P3: *The Long Way to a Small, Angry Planet* by Becky Chambers
- P4: *Foundation* by Isaac Asimov

These selections cover a variety of genres: P1 selected **fantasy fiction**, P2 chose a **thriller**, while P3 and P4 read **sci-fi** novels. Based on these distinct narrative worlds, the AI-generated reading environments varied significantly for each participant. Please refer to Appendix F for a detailed overview of the corresponding reading environments assigned to each participant.

7.2 Participants

Four bachelor and master students from TU Delft participated in this study. Half of the participants were from the Industrial Design Engineering (IDE) faculty, which aligns with the disciplinary context of this thesis, while the other two came from different faculties. The gender distribution included two females, one male, and one participant who preferred not to disclose their gender. Participants ranged in age from 20 to 27 years old (M = 24.0, SD = 2.9).

In terms of reading habits, all participants reported reading fiction with a frequency ranging from daily to weekly. Their preferred reading mediums varied, but printed books were the most commonly used. Digital formats—including mobile phones, tablets, and e-ink readers—were mentioned less frequently within this participant group.

7.3 Data Collection

Pre-test data collection included basic demographic and contextual information from participants, such as gender, age, book title, fiction reading frequency, and prior experience with VR. These details were used to screen for suitable participants—particularly those with higher fiction reading frequency—and to support demographic analysis.

To evaluate the effect of the VR reading environment and the re-entry mechanism on participants' sense of transportation, each participant was asked to complete a self-assessment form based on the Story World Absorption Scale (SWAS) developed by Kuijpers et al. Only the transportation dimension of the scale was used, as the other components were beyond the scope of this thesis. The scale used in the evaluation is displayed as Figure 31.

At the end of each experiment session, a brief semi-structured interview was conducted with participants. The interviews were voice-recorded to facilitate transcription and subsequent thematic analysis. In addition, at the end of the first-round test, participants were asked to complete a symbol object form, selecting one object that they felt best represented their reading experience. This information was used to generate AI-personalized book covers for the re-entry condition in the second-round test.

Importantly, no screen recording or observation of participants' reading activity inside the VR environment was conducted. This decision was made to reduce potential feelings of surveillance and help participants feel at ease while reading. Before the test, participants were also informed that researchers would not monitor their in-VR reading screens through the prototype's external display. A researcher was present throughout the session to ensure participants' safety—particularly because of the enclosed nature of VR headsets—and to provide technical support if any issues arose during the experiment.

1st Section Self-assess Sense of Transportation Scale

Q1: When I was reading the story it sometimes seemed as if I were in the story world too.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

Q2: When reading the story there were moments in which I felt that the story world overlapped with my own world.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

Q3: The world of the story sometimes felt closer to me than the world around me.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

Q4: When I was finished with the reading section, it felt like I had taken a trip to the world of the story.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

Q5: Because all of my attention went into the story, I sometimes felt as if I could not exist separate from the story.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

Figure 31. 7 Point Transportation Measurement Scale Based on Kuijpers et al.'s Study

7.4 Data Analysis

Due to the small sample size (N = 4), this study adopted a **mixed-method approach** for analysis. To enhance the interpretation of self-assessed transportation scores, direct quotes from participants were used to complement and contextualize the quantitative results. The main objective of the quantitative analysis was to identify common patterns across participants, while the qualitative data provided insights into how participants perceived and responded to different visual style variables during VR reading.

For the quantitative scores, participants rated their reading experience using five 7-point Likert-scale items after reading each segment. A score of 1 indicated “strongly disagree”, and 7 indicated “strongly agree.” The average score across the five items was calculated for each segment, and the results were visualized through charts. See Figure 32 for the detailed calculation method.

For qualitative analysis, the interview transcripts were analyzed using ATLAS.ti, an online qualitative analysis tool. A thematic analysis was conducted, in which quotes were coded and grouped into categories to reflect recurring themes and patterns. These coded themes were then used to support and explain the quantitative findings, offering a more comprehensive understanding of participants’ reading experiences.

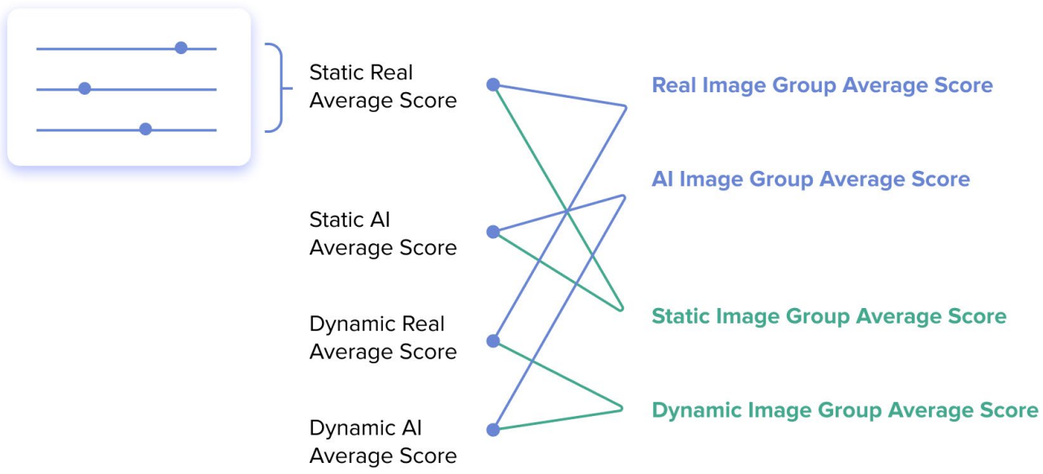


Figure 32. Quantitative Analysis Process

7.5. Results from Prototype Evaluation

The evaluation combined both qualitative feedback and self-assessed transportation scales, allowing for a multi-dimensional understanding of how users engaged with the VR reading environment. Key themes emerging from the results include the impact of visual background relevance, the pacing and logic of environmental transitions, and the limited effectiveness of symbolic visual cues in supporting narrative re-entry. The following sections organize these insights according to the core design concepts tested during the final evaluation.

Variable 1: Real / AI Image Background

The first variable compared real images and AI-generated images to examine which background type better supports transportation in VR fiction reading. For each condition (e.g., Static Real and Dynamic Real), the average transportation scores were first calculated and then grouped by image type. These grouped results were presented in a column chart for visual comparison.

As illustrated in Figure 33, the data reveals a clear and consistent pattern: **all participants rated the AI-generated background images as eliciting a stronger sense of narrative transportation** compared to the real-image condition using Google Street View.

This consistent preference can be attributed to participants’ shared perception that **AI-**

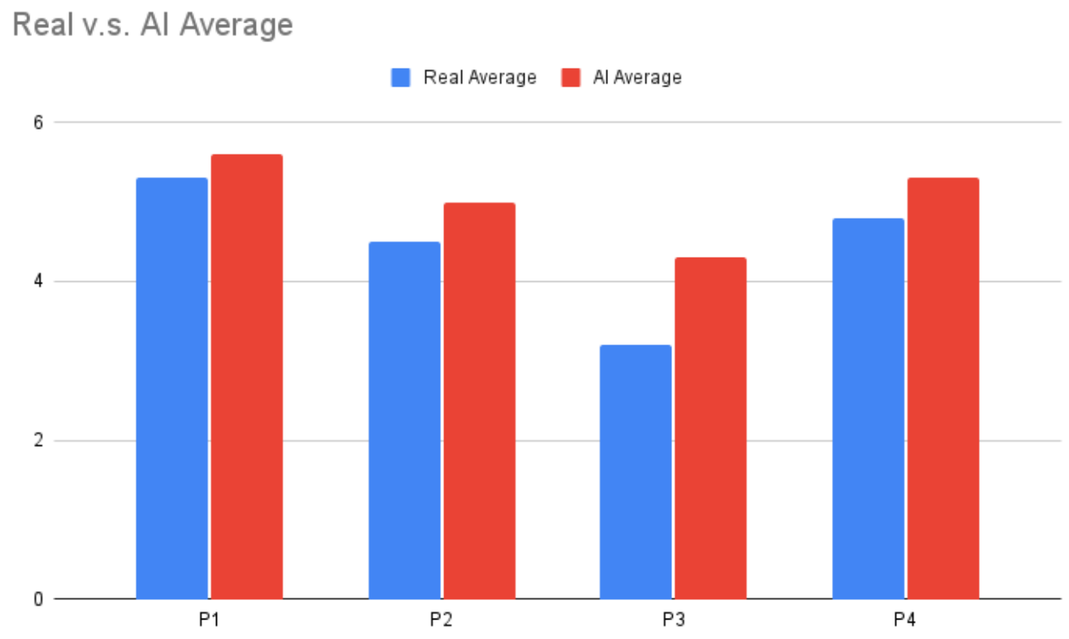


Figure 33. Average Score Distribution of Real v.s. AI Image Background among Four Participants

generated visuals were more capable of reflecting the narrative mood and setting—for example, by adjusting environmental lighting (e.g., day, dusk, or night) and incorporating key symbolic elements mentioned in the story. These adaptive features made the AI-generated scenes feel more narratively relevant and emotionally resonant, thereby enhancing the immersive reading experience.

It [The story itself] was mentioning like a truck or something and there was a truck there, which was not the same color, yellow but with different leathers ...

— P2

Because with that [AI-generated image], you can match the environment as closely as closely as you can to ... the page that you're reading at the time.

— P4

Participants also noted that **AI-generated backgrounds were better suited for depicting the temporal and civilizational settings of the story**. Since readers often begin with a basic understanding or mental image of the novel's fictional world, AI-generated visuals can enhance this foundation by introducing specific visual elements that are difficult—or even impossible—to find in real-world locations. This includes settings such as ancient civilizations or futuristic space cultures, where the unique atmosphere and environmental cues play a crucial role in strengthening narrative immersion.

Also, because it's an Avatar book and it really felt like Avatar. So ... I know ... There's quite a specific visual language that we already know because of the series. So it was nice to see it again.

— P1

They're in space, hyper travel like gravitational lifts. Yeah, that's a bit hard to show on there [Google street view] ... Like ever increasing man-made structures like sky stretching like uniform grayness is ... just perfectly described as this [AI images].

— P4

However, it is important to note that the AI-generated panoramic backgrounds or suggested Google Street View locations sometimes **failed to match the fictional worlds readers had constructed in their minds**. All participants in the experiment pointed out this issue, indicating that the visual environments provided by the AI—either through generation or real-world recommendations—occasionally did not align with the narrative progression of the story or the mental imagery they had previously formed while reading.

This one [Dynamic Real] was better than the first one [Static Real], I would say, but still a little bit of the real world and ... in the story there, it's like a castle ground and it doesn't really feel like a castle ground.

— P1

... It didn't match the character which was portrayed in the book, and also it was quite dark and I wasn't sure if it was really dark or daylight actually. So that interferes a lot.

— P2

Variable 2: Static / Dynamic Image

The second variable aimed to compare the impact of static versus dynamic VR background images on reading transportation. As with the previous comparison, the average scores for each condition across participants were calculated and visualized in Figure 34.

From the results in Figure 34, an unanimous pattern emerged again: **dynamically changing VR backgrounds led to a higher sense of transportation**. In contrast, static backgrounds that remained the same throughout the reading experience generally resulted in lower transportation scores.

This consistent result across participants can be attributed to the alignment between scene transitions and key turning points in the story. When the **background changes in VR reading are timed to coincide with narrative shifts**—such as new settings or plot developments—they can effectively enhance immersion and facilitate transportation into the story world. However, the current mechanism for syncing page turns with environmental changes is still imperfect. Several participants pointed out a mismatch between scene transitions and story progression, indicating the need for further refinement in this area.

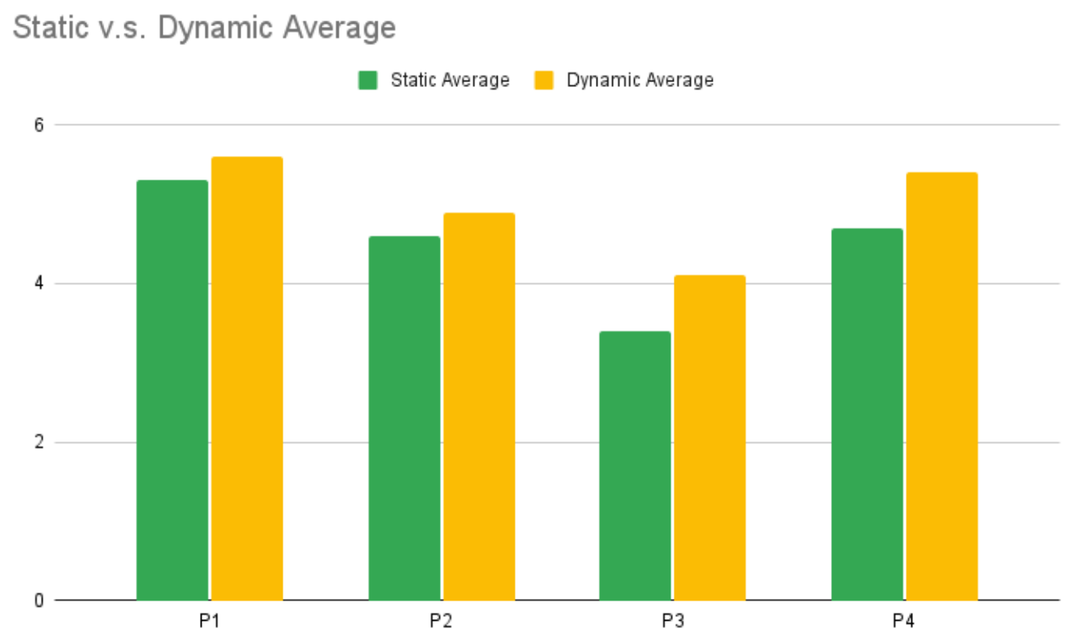


Figure 34. Average Score Distribution of Static v.s. Dynamic Image Background among Four Participants

the protagonist is also moving from environment to environment ... And then, the next one he got out of the lift to like an observation station. And it was described like this picture ... basically described in the page. So it actually looked kind of similar.

— P4

So it began as a daytime, sort of orange light, and then it turned into night. Yes, but in the story, like in the writing, the time has not changed.

— P3

It is worth noting that in the Dynamic Real condition, where background changes mimicked Google Street View-style transitions with subtle image shifts, participants responded differently. While some, such as P1, noticed these changes and commented on the gradual shift in setting, others remained unaware of the background transitions as they were deeply focused on reading the text. This suggests that the subtlety of environmental changes may sometimes go unnoticed when readers are fully immersed in the narrative, raising questions about how noticeable or necessary such changes are for enhancing transportation in VR reading experiences.

And what I also liked about the 3rd[Dynamic Real] and the 4th[Dynamic AI] is that you also kind of walk through the places.

— P1

I didn't even notice it was changing background, to be honest. But the last one[Dynamic Real], yeah, only with the last one I didn't notice. Because ... the last one felt very generic Google Maps.

— P2

Preference Ranking

At the end of the first-round interview, participants were asked to rank their preferences among four different visual styles based on their reading experience. A weighted ranking system was used: the top choice received 4 points, while the least preferred received 1 point.

As shown in Figure 35, both Dynamic AI and Static AI backgrounds received the highest total scores, while the two real image-based styles were consistently ranked lower. This indicates a strong participant preference for AI-generated visuals—especially the dynamic presentation.

This outcome aligns with the results of the transportation scale, where both Dynamic AI and Static AI also received higher average scores in self-assessed narrative immersion. In contrast, Static Real not only ranked lowest in preference but also scored the lowest in perceived transportation, suggesting that a static, photographic VR environment—where the reader remains in a single unchanging scene—may reduce immersion and be the least favored option in the context of VR reading.

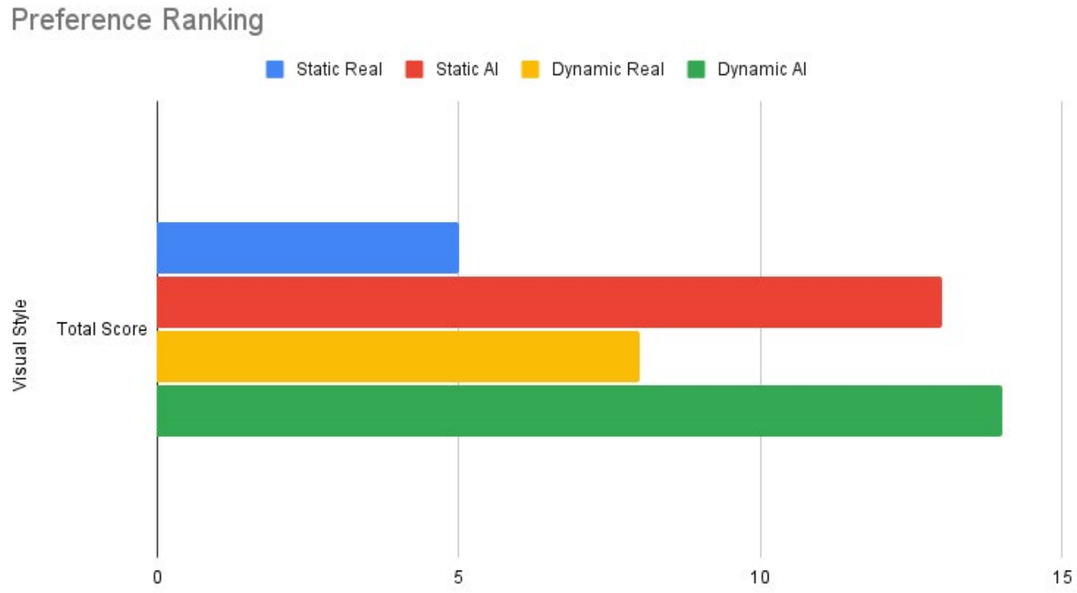


Figure 35. Total Score of Preference Ranking from Four Participants

Average Transportation Score

Figure 36 and Figure 37 present the average transportation scale scores given by all participants, including the additional data from the second round of prototype testing shown in the far-right column. Figure 36 uses a stacked bar chart to illustrate the overall distribution across visual styles, while Figure 37 provides a more detailed view, showing the individual score distribution for each visual style across participants.

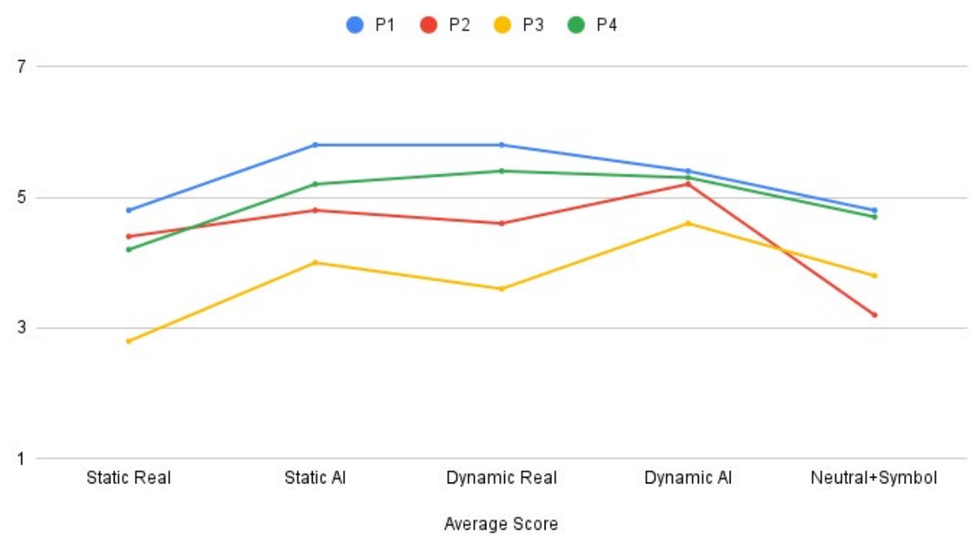


Figure 36. Line Graph Illustration of Average Transportation Score

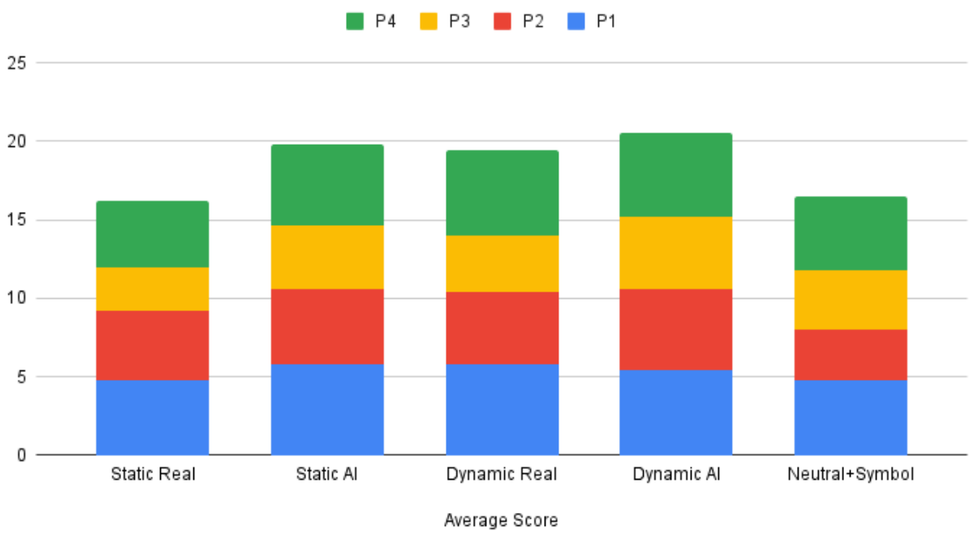


Figure 37. Bar Chart Illustration of Average Transportation Score

Among the visual styles, Dynamic AI received the highest overall average score, suggesting it is the most effective in enhancing narrative transportation during VR reading. Static AI and Dynamic Real followed closely, with only minimal differences in their scores, indicating that both styles may also offer positive immersive reading experiences.

In contrast, Static Real received significantly lower average scores compared to the other styles. This result suggests that being placed in a static, unchanging Google Street View environment leads to a less engaging reading experience in the context of VR.

The visual style that combined a personalized book cover with a neutral environment yielded moderate average scores. However, based on interview responses, participants generally attributed their ratings to the neutral background rather than the book cover. All participants reported that the personalized book cover was merely a fleeting image that did not influence their reading expectations or experience. P1 and P3 speculated that the AI-modified cover may have looked too similar to the original design, making it less memorable. P3 also noted that a book cover would only affect the reading experience if it contained clues relevant to the story—such as in detective fiction—which might prompt readers to examine it more closely.

I did remember when I saw the cover like, oh yeah, I did this last time before ending the visitors. This while reading? No.

— P1

To be honest, I just thought that was ... what we discussed last time and then forgot about it for that ... Unless it's some mystery thriller thing or in general has some mystery and I'm trying to solve something and I am trying to gather all the clues that are already there.

— P3

The neutral background, such as a living room-like setting, was generally perceived by participants as unrelated to the story content, which led to lower transportation scores. However, this does not necessarily mean that neutral environments are unsuitable for VR reading contexts.

As shown in Figure 36, participant P2 displayed a notable drop in transportation scores during the second-round test featuring the Neutral background + symbol object book cover prototype. Interestingly, P2 mentioned that despite the lower score, they actually preferred this type of background over the previous four visual styles. They felt that the neutral setting allowed them to concentrate more on the core activity of reading, without being distracted by highly detailed or story-specific visuals.

But I did like it because it did feel like I was relaxing... That really felt like I took a moment in the day to kind of relax and then take it off again, even though I was not immersed in the story... It's just the activity that I want to make it ... some time for myself and also when I read before bed...

— P2

However, there were also participants who held an opposing view. They preferred the VR reading scenes used in the first-round test, which were more closely related to the novel content. Otherwise, they felt that the experience would become too similar to reading with traditional media.

I would rather read a book with dynamic images... There [Neutral Environment] were no distractions. And apart from the notification but. It was still normal phased into the book ... with the previous session, I feel like I went kind of a bit further...

— P4

But I feel like those (Round 1 background) were more rewarding to look around because it has more clear details.

— P1

General Attitude toward VR Reading Experience

Reading fiction in VR remains a novel and relatively unexplored concept for most fiction readers. Therefore, it is crucial to collect participants' perspectives after they experienced reading their own books within a VR environment. The results were analyzed using a thematic analysis approach, in which codes were assigned to identify recurring themes across participants' responses.

Positive – Immersion and Connection

Participants found that the VR headset effectively fostered an immersive reading experience by eliminating external distractions. Beyond the inherent enclosure provided by the headset, the AI-generated backgrounds tailored to the story context further enhanced immersion. These AI-generated environments successfully increased the sense of narrative transportation by analyzing story content and generating visuals that aligned with the storyline. As a result, readers reported a stronger sense of connection with the fictional world.

That is a really strong atmosphere and that's. Felt quite nice to read like that … I think that one [Static AI] felt the most immersive.

— P1

… Whereas right now when I was reading, it was only the page in front of me. And sure there were other things, but nothing is moving… And the last one [Static AI] was inside[the spaceship in the story]. So that felt more in connection to the story and therefore made me feel more immersed…

— P3

Negative – Against Imagination

During the ideation phase, the original intent behind using AI to 'recommend' a suitable reading location on Earth was based on a design hypothesis: that shifting the reading environment in VR—rather than simply visualizing exact narrative scenes—could also enhance the sense of transportation. This concept was grounded in insights from the contextual interviews conducted in Phase 1, where it was noted that overly literal visual representation might diminish the reader's imagination. Additionally, some participants reported a habit of reading in outdoor settings such as parks, which inspired the idea of letting AI analyze the emotional tone of the text and suggest corresponding real-world locations (e.g., via Google Street View) or generate immersive background imagery.

However, even though AI-generated visuals received higher transportation scores compared to real-world street view backgrounds, several participants expressed concern that these images worked against the purpose of fiction reading. Some felt that the AI-produced visuals contained too many elements, and these visual details often did not align with the reader's own mental imagery of the story. This mismatch between AI interpretation and personal imagination reduced their preference for AI-generated backgrounds in VR.

And when you have the surroundings, for example, generated by AI already, it's kind of like … maybe a story book or like a movie, which is not the purpose of my reading.

— P2

Interestingly, some participants held an opposite view. P4 found the AI-generated backgrounds helpful as a foundation for imagination rather than a limitation. According to his feedback, the visual scenes provided by AI served as a foundation to enrich their own mental visualization of the unfolding narrative. Instead of replacing imagination, the AI background supported and extended it.

However, this reaction may also be related to the difference in reading progress. P4 had just begun the story and may not have fully formed a personal mental image of the fictional world, whereas P2 was already midway through the novel and had developed stronger internal visualizations, making mismatches with the AI-generated scenes more noticeable.

AI ones I think are still better. Yes, they are different from your imagination, but everybody's imagination is different. And you can imagine on top of them instead.

— P4

Negative – Physically Demanding and Contradictory to Reading Habits

Participants also mentioned that reading in VR felt more physically demanding compared to reading on paper or e-readers. Due to the nature of the VR headset, users are required to remain seated and wear a relatively heavy device, which might not align with their usual reading habits—such as lying down or adopting a more relaxed posture.

P2 pointed out that reading is normally a moment for them to disconnect from electronic devices, but reading in VR is the opposite: "Your entire body and senses are heavily surrounded by technology." This contradiction made VR reading feel less natural and even somewhat burdensome for certain users.

Energy wise for me, at least, this is more tiring to read as opposed to a book, partly because I am sitting up. I think I usually read a book lying down, so if I was doing this lying down as well, it might have been similar.

— P3

Neutral – VR Reading Requires More Commitment

Participants also noted that reading in VR demands a higher level of commitment compared to traditional reading. This is closely related to the physical constraints of the hardware—wearing the headset for an extended period—and the fact that VR creates a strong sense of separation from the surrounding environment.

Due to this immersive isolation, users felt they had to be fully prepared before starting the VR reading session, ensuring that all external needs (like grabbing water or checking messages) were addressed in advance. This added mental preparation made VR reading feel less spontaneous and more like a planned activity.

Reading on VR would be like a lot. More of a commitment … But with VR, you have to set it up, do everything, cut kind of outside of the real world in a way too … Also, if you don't have any distractions, because like at some point my phone … had a notification that … brought me back a bit.

— P4

Neutral – The Effect of Background Fades Over Time

This feedback opens up an important area for further discussion. Since none of the participants had ever read a novel in VR before, their initial experience was likely influenced by the novelty effect. Compared to users who are more familiar with the technology, first-time users might be more easily drawn to the visual and spatial features of the environment.

However, as the reading session continued, some participants noted that the influence of the background on their sense of immersion gradually faded. What remains unclear is whether this decline in impact is due to an increased focus on the reading itself, or simply a result of users becoming accustomed to the

VR setup. This raises questions that warrant deeper investigation in future studies.

So the first immersion is sort of the environment itself, but after couple of pages, it's the story that's creating the emotion.

— P3

Neutral – Seeking Unique Interaction Experience in VR

As a medium known for providing high levels of immersion, VR naturally raises user expectations for more engaging and novel interactions—such as enhanced page-turning animations or gesture-based controls while reading fiction.

In the current prototype, page-turning is achieved through simple left and right buttons. This design choice was intentional, as the focus of this iteration was primarily on narrative immersion rather than usability. However, participant feedback suggests that interaction design may indirectly affect immersion, especially when the operation feels unintuitive or disrupts the flow.

This highlights a potential direction for future development: exploring more interactive and context-aware input methods to enhance the sense of presence and continuity in the VR reading experience.

And maybe something like it would be nice to have like the experience of flipping through a book. Maybe if you do this [waving her hand].

— P2

Summary of Result Analysis

The primary goal of this prototype test was to investigate how different visual styles and the AI-generated personalized book cover for re-entry influence the sense of transportation during VR reading. Additionally, the test aimed to gather participants' perspectives on experiencing VR as a novel medium for fiction reading.

From the self-assessment form analysis, clear trends emerged:

- AI-generated images resulted in a higher sense of transportation than Google Street View images.
- Dynamically changing backgrounds that aligned with story progression enhanced immersion more than static backgrounds.
- Neutral backgrounds, which were unrelated to the story, offered only limited support for transportation. However, they showed potential as a background option that allows readers to focus purely on the narrative itself, without interfering with their imagination.

As for the AI-generated personalized book cover, created at the end of the reading journey based on the user's selected symbolic items, it did not appear to significantly impact participants' sense of re-entry into the story or their anticipation for the next reading session. Participants reported recognizing the cover as the one they previously chose, but described it as a fleeting image—something they didn't think about once they began reading. This result suggests that the concept of using an AI-generated personalized recap to support re-entry may need further evaluation and redesign.

To summarize the insights from the previous sections, Figure 38 illustrates the key factors that influenced transportation in the VR reading experience. These results were structured around the thesis's core research focus and derived from participants' feedback, serving as a conclusion to this round of prototype testing.

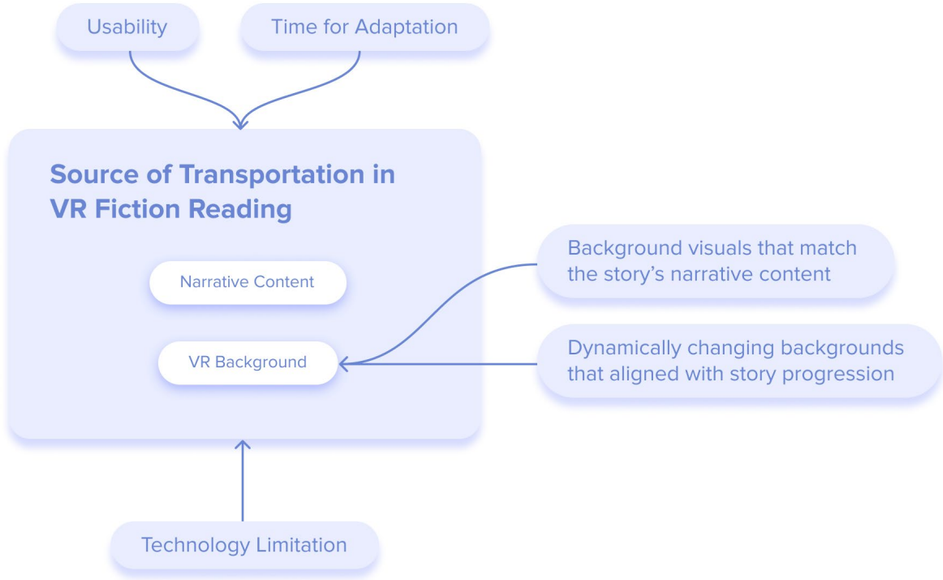


Figure 38. Clustering Result for Identifying Source of Sense of Transportation in VR Reading

Firstly, as previously discussed, Figure 38 highlights that factors influencing mid-reading transportation include not only the narrative content itself but also the VR environment background. In addition, some participants mentioned usability issues that slightly affected their immersion during reading. These included the lack of chapter progress indicators, unclear UI presentation for text and buttons, and VR controllers that felt somewhat redundant. Some participants also needed time to adapt to the VR environment. However, they emphasized in the interview that these issues did not significantly disrupt their overall reading experience.

Moreover, several technical limitations encountered during the prototype test may have influenced participants' sense of transportation. First, the weight of the VR headset was mentioned as uncomfortable by some participants, especially after 20 minutes of reading—which is still relatively short compared to typical fiction reading sessions, according to findings from the previous user interviews. In addition, the current image and text resolution in VR was sometimes perceived as too low, and motion sickness emerged as a recurring concern that needs further design iteration.

Chapter III — Evaluation

8. Discussion and Design Recommendations

text text text

8.1 Discussion

This sub-chapter reflects on the key findings, revisits the design assumptions, and explores the broader implications of integrating immersive and personalized elements into fiction reading—within VR and potentially beyond.

The Role of AI Imagery in Enhancing Transportation

Based on the results of this thesis, both the self-assessed transportation scores and preference rankings indicate that AI-generated background images were more effective in enhancing narrative transportation during VR reading. These findings suggest that the thematic relevance between the visual background and the narrative content plays a key role in fostering a sense of transportation.

This result suggests that **when the VR background resonates with the story content, it can significantly enhance the reader's narrative immersion**. This aligns with Kumzová et al.'s "scenic reading" approach, which highlights how semi-abstract yet narratively meaningful VR settings can support deeper reading engagement. Moreover, as Green et al. have argued, in traditional reading media, accompanying images can provide direct visual cues that support readers in constructing mental imagery, thereby enhancing their sense of transportation. From this perspective, AI-generated visuals in VR can be seen as having a similarly positive impact—helping to strengthen both immersion and the reader's ability to envision and emotionally connect with the narrative world.

However, contrary to the initial design hypothesis—which assumed that emotional tone conveyed through background imagery would enhance transportation—the results reveal that **participants were more sensitive to the semantic match between the background and the narrative**. Rather than merely absorbing the atmosphere of the environment, readers actively evaluated whether the background visuals corresponded to the fictional world being described. This suggests that the design approach of using real-world imagery, such as Google Street View, to provide open-ended environmental cues may not be sufficient for supporting immersive reading in narrative-heavy genres.

It is worth noting, however, that this result may also be influenced by the type of novels selected by participants. Among the four participants in this study, three chose works in the science fiction or fantasy genres—categories typically characterized by distinct world-building and imaginative settings. For such genres, AI-generated backgrounds may be better suited to conveying otherworldly environments than real-world images. That said, further research is needed to determine which types of fiction benefit most from AI-generated environments versus realistic panoramic photography.

The Impact of AI Imagery on Imaginative Engagement in Fiction Reading

Are images that closely resemble the story world always more effective? Or can less representational visuals, at times, enable deeper narrative immersion? This question runs throughout the entire arc of this thesis—from the initial user study to the design rationale and prototype evaluation.

Even though the AI image generation prompt clearly stated that "High-fidelity reproduction of the scenes is not required—the key is to match the emotional tone," not all participants embraced the resulting visuals. Some readers expressed a preference for the neutral VR living room setting, as they felt it better preserved the act of reading itself and allowed them to savor the pleasure of engaging with the text without external visual imposition.

This observation echoes findings from Kumzová et al., who noted that when VR imagery conflicts with a reader's internal imagination, some interpret the dissonance as a cognitive challenge, while others find it disruptive to their narrative immersion. In VR-based reading experiences, visuals and narrative co-exist in a symbiotic relationship. The background environment actively shapes the reader's mental imagery—one of the key components influencing transportation.

Together with the scholarly literature, this thesis highlights how AI-generated visuals can elicit divergent responses among fiction readers. While AI holds significant potential as a tool to enhance narrative immersion, the timing and manner of its use require careful consideration. Future work may explore which genres or types of narrative content are most compatible with AI-adapted backgrounds, and which might benefit from more neutral settings. It may also be valuable to examine how different reader profiles respond to varying levels of visual abstraction in VR reading contexts. Alternatively, AI imagery might find new forms of integration within VR storytelling—beyond just the environmental backdrop.

Limitations of Symbolic Cues for Narrative Re-Entry

Building on the insights from the initial user study, this thesis explored how personalized visual cues might support narrative transportation during re-entry into a VR reading session. The proposed concept involved generating an AI-personalized book cover based on a symbolic object selected by the reader at the end of the previous session. The hypothesis was that encountering a familiar, personally meaningful visual element would help readers reconnect with the fictional world and enhance subsequent transportation.

However, findings from the prototype evaluation suggest that this mechanism had little observable impact on participants' sense of transportation. Although participants recognized the updated book cover and associated it with their previous choices, they reported that the effect was fleeting and quickly diminished once they entered the immersive reading environment.

Visualized narrative elements can indeed enhance a reader's ability to re-engage with a fictional story. For instance, Green et al. (2008) found that watching a film adaptation of a story beforehand can support readers in constructing a more vivid mental imagery, thereby strengthening narrative transportation during subsequent reading. However, research specifically examining the impact of personalized visual cues on transportation—particularly during re-entry points in the reading journey—remains limited. Future studies should further explore how such personalized visuals might not only influence in-the-moment immersion, but also affect engagement at various stages across the broader fiction reading experience.

It is also important to note that due to time constraints, participants only experienced one re-entry session during the second prototype test. The long-term effectiveness of personalized book covers in supporting memory recall and immersive re-engagement remains an open question for future research. Further studies that allow for repeated re-entry experiences could better evaluate the symbolic and affective potential of this design approach.

Exploring the Unique Affordances of VR in Fiction Reading

The findings of this thesis raise an important question: what unique interactive experiences can VR offer to fiction readers? As a medium known for its high level of immersion, VR carries the potential to reshape how narratives are experienced—yet this potential must be intentionally designed for.

Some participants observed that using Google Street View as a reading background felt no different from simply reading a book in a park. This suggests that when readers choose VR as their reading medium, they may hold certain expectations for how it can enhance or transform their experience. If the VR implementation does not offer affordances beyond those of traditional media—such as printed books or e-readers—it risks losing its distinctiveness.

One unique affordance of VR fiction reading is its ability to synchronize spatial environments with narrative progress. The experiment showed that dynamic environmental transitions—not just fixed immersive backdrops—helped reinforce readers' sense of story progression and reduce cognitive fatigue. Interestingly, participants responded more positively to narrative-aligned transitions than to the intended "walking-through-space" metaphor, suggesting that thematic rhythm may be more important than spatial continuity. This opens up new design directions: how might environmental changes be timed not just by user interaction (like page turns), but by narrative beats?

What can VR uniquely contribute to the fiction reading experience? It may be the vivid spatial presence of the story world, novel forms of human-computer interaction like gesture-based navigation, immersive soundscapes, or even future applications of haptic feedback. Each of these possibilities points to untapped design opportunities that deserve further exploration. In shaping future VR reading experiences, researchers and designers alike should consider how to leverage these capabilities to support deeper narrative transportation and richer emotional engagement.

Extending the Design Concepts Beyond VR

While this research focuses on understanding and enhancing narrative transportation within VR reading experiences, the design concepts explored here may also hold potential for adaptation to other reading formats.

For instance, the idea of displaying a personalized book cover at the start of a new reading session—generated based on previous reader input—could be applied beyond VR to more conventional mediums such as e-books, tablets, or desktop displays. Although the prototype results suggest that current VR interactions offer limited added value to transportation, this concept might be more effective on devices that already afford tactile interaction, such as e-ink readers or smartphones. The use of device sensors, like a gyroscope, could introduce playful elements that foster engagement. Alternatively, the concept of gradually revealing projected visual elements based on a reader's narrative journey may be reimagined and better integrated into non-VR reading contexts.

However, the application of VR background-related findings to non-VR media requires further consideration. Translating the immersive qualities of AI-recommended geo-locations or panoramic imagery into a 2D format or print medium presents several challenges. How can the emotional and thematic resonance of such backgrounds be meaningfully conveyed without spatial immersion? At present, there is no definitive answer—but this remains an exciting area for future research to explore how AI-generated visual environments can support narrative engagement across diverse reading platforms.

Societal Implications of Immersive VR Reading

In an era of declining sustained reading habits and increasingly fragmented information consumption, encouraging young people to engage with fiction has become a growing challenge. As discussed in the introduction, the rise of audiovisual media has significantly reduced people's motivation to choose time-intensive reading as a form of leisure. Yet fiction reading plays a critical role in literacy development and cognitive growth, and remains a key focus within many national education systems that are actively seeking new ways to revitalize interest in reading.

Immersive VR reading experiences may offer a promising solution. As Pianzola et al. have shown, VR can enhance narrative transportation and empathy, ultimately increasing readers' intention to continue reading. This thesis explores a design strategy that uses AI to generate adaptive visual backgrounds—providing a spatial canvas for readers to imagine the fictional world. If further refined, especially in the precision of AI prompting, this approach could support a more immersive reading journey.

Beyond individual readers, this research highlights broader implications for other stakeholders. Educational institutions, for instance, could play a key role in integrating such VR reading tools to boost students' reading motivation through multimedia-enhanced fiction material. For publishers, AI-generated background recommendations could reduce the burden of producing highly customized content, enabling scalable yet meaningful extensions of fiction texts into immersive formats. However, the question of how authors perceive AI analyzing and interpreting their literary work remains an open issue that warrants future ethical and creative discussion.

Additionally, as discussed in the literature review chapter, current limitations of VR—such as digital eye strain and headset weight—pose significant challenges for text-based activities in immersive environments. These concerns are also aligned in the findings from the prototype evaluation. While today's VR headsets may still fall short for prolonged fiction reading sessions, the continual advancement of VR hardware holds potential in significantly lowering the barrier to entry for immersive reading experiences. Future developments may include applications in Mixed Reality environments, where textual content could seamlessly interact with the user's physical surroundings. Furthermore, as VR HMDs become more lightweight, ergonomic, and mobile, immersive fiction reading may no longer be confined to the user's home. Instead, it could extend into other common reading contexts—such as on trains or airplanes—where readers already engage with long-form content.

8.2 Limitation

This thesis explored narrative transportation in VR reading by first examining immersion through currently available and commonly used reading media. Since VR fiction reading has yet to become a mainstream activity, it was not possible to recruit participants who already have an established habit of reading novels in VR.

Participants' individual reading speeds varied considerably, which resulted in differing durations of the VR reading experience. If time permits in future studies, a pre-test to assess reading speed could be conducted to help normalize the experience duration across participants.

To avoid disrupting narrative flow mid-scene, the researcher aimed to end each VR reading session at the end of a chapter or subchapter. However, chapter lengths vary between novels, and in some cases, it was necessary to stop the reading session in the middle of a chapter due to time constraints. This may not reflect participants' natural reading behaviors or preferences.

In addition, the chosen novel itself could influence participants' self-assessed transportation scores. Variability in content across different stories likely introduced another layer of subjectivity to immersion assessments.

8.3 Design Recommendations

Personalized AI-Generated Prompts

Future iterations of this prototype could allow the AI to learn from reader preferences—possibly collected through a questionnaire—to gradually tailor background generation prompts. For example, users could specify whether they prefer environments with or without human figures, or indicate their stylistic preferences for visual objects. This personalization may further enhance narrative transportation.

Enhancing Narrative Re-entry Through Personalized Visuals

The current personalized book cover had minimal impact on reading re-entry transportation. Future designs could consider presenting these personalized visual cues at different moments throughout the reading journey—such as subtly reintroducing the symbol object within the background during reading, rather than only at the entry point. Additionally, the symbolic object could be more deeply integrated into the cover using techniques such as stencil buffering, 3D visual layering, or interactive animation effects. These enhancements may encourage readers to spend more time with the cover and strengthen their emotional connection to the story world.

Expanding Multisensory Design

Future iterations of this prototype could allow the AI to learn from reader preferences—possibly collected through a questionnaire—to gradually tailor background generation prompts. For example, users could specify whether they prefer environments with or without human figures, or indicate their stylistic preferences for visual objects. This personalization may further enhance narrative transportation.

Refining Background Transition Mechanisms

The current background transition was based on page progression, which may not align with shifts in narrative setting. Readers sometimes encountered a delay between the story's scene change and the corresponding environmental shift in VR. Future systems could integrate eye-tracking technology to trigger background transitions in real time, or restructure pagination so that different narrative scenes are clearly segmented by page. This would reduce cognitive dissonance and better synchronize visual and textual elements.

Application in Other Reading Contexts

This thesis specifically focused on fiction reading in VR, with the assumption that, due to current hardware limitations—such as weight and safety concerns—VR reading primarily takes place in individual private spaces. However, as VR technology continues to evolve and headsets become more lightweight and portable, there is potential for immersive fiction reading to extend into public contexts. That said, such expansion would also need to address users' concerns about losing environmental awareness and the sense of safety while being immersed in narrative content. Exploring how immersive reading experiences can be meaningfully adapted to different physical contexts and interaction patterns remains a promising direction for future research—particularly in reimagining how reading might be revitalized in this era.

9. Conclusion & Reflection

This thesis was carried out through a design research approach. A VR fiction reading prototype was developed based on insights gathered from the initial user study, and the design concept was broken down into variables to examine how each aspect influenced narrative transportation. While the final deliverables of this thesis did not result in a high-fidelity VR prototype, it proposes a promising interactive reading experience that integrates either AI-generated backgrounds or AI-recommended Google Street View imagery into VR—a particularly promising direction in this rapidly evolving era of AI. As generative models become more sophisticated and large language models improve their capacity to interpret and reflect on narrative texts, future research can explore how to more meaningfully integrate these tools into immersive reading experiences in VR.

VR fiction reading remains a largely unexplored domain. As immersive technologies continue to advance, it's exciting to envision how engaging reading experiences may encourage people to rediscover the joy of reading. This thesis contributes to the research community by offering both empirical insights into readers' habits and an evaluation of a VR fiction reading prototype. Yet this work is only a first step toward the broader development of immersive reading. Beyond the design recommendations outlined in the previous chapter, future research could explore more diverse reader profiles, new modes of interaction in various reading contexts, genre-specific design strategies for VR reading environments, or even the potential of mixed reality (MR) to blend immersive storytelling with physical-world interaction.

It's also worth noting that in the early stages of this thesis, I explored the Evaluation Grid Method (EGM) to analyze the sources of narrative transportation. Applying this method—originally designed to extract abstract user experiences—presented both advantages and limitations in this context. Because few people currently have experience with VR fiction reading, it was difficult to directly investigate the sources of transportation from readers who were already familiar with this medium. As a result, translating transportation factors from traditional reading into a VR context still contains some grey areas. Future research might explore more direct and grounded methods for identifying the drivers of transportation in VR fiction reading.

Ultimately, the main outcome of this thesis was a working VR prototype and a set of design recommendations—fulfilling the ambition I set for myself at the beginning of this project, and even further back, when I first entered TU Delft two years ago with a personal goal of designing a spatial interface in VR before graduating. While the final prototype is relatively simple in terms of interaction, I'm grateful to have had the opportunity to explore this space and take a meaningful step into the world of immersive experience design.

References

Busselle, R., & Bilandzic, H. (2009). Measuring narrative engagement. *Media Psychology*, *12*(4),321–347.DOI:10.1080/15213260903287259

Chen, J., Pyla, P. S., & Bowman, D. A. (2004). Testbed evaluation of navigation and text display techniques in an information-rich virtual environment. *IEEE Conference Publication* | IEEE Xplore.
https://ieeexplore.ieee.org/document/1310072

Clark, C., & Rumbold, K. (2006). Reading for Pleasure: A research Overview.
https://eric.ed.gov/?id=ED496343

Clark, C., Picton, I., & Cole, A. (2025). Children and young people's reading in 2025. National Literacy Trust.
https://literacytrust.org.uk

Csikszentmihalyi, M., Abuhamdeh, S., & Nakamura, J. (2014). Flow. In *Springer eBooks* (pp. 227–238).
https://doi.org/10.1007/978-94-017-9088-8_15

Demir, S. B., & Büyükbaykal, A. C. I. (2024). Investigating book reading experiences in VR. *Journal of Librarianship and Information Science*. https://doi.org/10.1177/09610006241252659

Dodell-Feder, D., & Tamir, D. I. (2018). Fiction reading has a small positive impact on social cognition: A meta-analysis. *Journal of Experimental Psychology General, 147*(11), 1713–1727.
https://doi.org/10.1037/xge0000395

Hodges, G. C. (2010). Reasons for reading: why literature matters. *Literacy, 44*(2), 60–68.
https://doi.org/10.1111/j.1741-4369.2010.00552.x

Gabel, J., Ludwig, M., & Steinicke, F. (2023). Immersive Reading: Comparison of Performance and User Experience for Reading Long Texts in Virtual Reality. In *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems (CHI EA '23)*, 1–8.
https://doi.org/10.1145/3544549.3585895

Green, M. C., & Brock, T. C. (2000). The role of transportation in the persuasiveness of public narratives. *Journal of Personality and Social Psychology, 79*(5), 701–721. DOI: 10.1037//0022-3514.79.5.701

Green, M.C., Brock, T.C. & Kaufman, G.F. (2004) Understanding media enjoyment: The role of transportation into narrative worlds. *Communication Theory*, 4, 311–327. DOI: 10.1111/j.1468-2885.2004.tb00317.x

Green, M. C., Kass, S., Carrey, J., Herzig, B., Feeney, R., & Sabini, J. (2008). Transportation across media: repeated exposure to print and film. *Media Psychology, 11*(4), 512–539.
https://doi.org/10.1080/15213260802492000

Green, M. C., Chatham, C., & Sestir, M. A. (2012). Emotion and transportation into fact and fiction. *Scientific Study of Literature, 2*(1), 37–59.
https://doi.org/10.1075/ssol.2.1.03gre

Green, M. C., & Appel, M. (2024). Narrative transportation: How stories shape how we see ourselves and the world. *Advances in experimental social psychology, 70*(1).
https://doi.org/10.1016/bs.aesp.2024.03.002.

Gruber, A., & Kaplan-Rakowski, R. (2022). The impact of High-Immersion Virtual Reality on foreign language anxiety when speaking in public. *SSRN Electronic Journal*.
https://doi.org/10.2139/ssrn.3882215

Hirzle, T., Fischbach, F., Karlbauer, J., Jansen, P., Gugenheimer, J., Rukzio, E., & Bulling, A. (2022). Understanding, addressing, and analysing digital eye strain in virtual Reality Head-Mounted Displays. ACM Transactions on Computer-Human Interaction, 29(4), 1–80.
https://doi.org/10.1145/3492802

Imbanova Entertainment. *Andromeda* [VR application]. Steam.
https://store.steampowered.com/app/457660/Andromedum/

Jankowski, J., Samp, K., Irzynska, I., Jozwowicz, M., & Decker, S. (2010). Integrating text with video and 3D graphics: The effects of text drawing styles on text readability. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '10)*. Association for Computing Machinery.

Johnsson-Smaragdi, U., & Jönsson, A. (2006). Book Reading in Leisure Time: Long- Term changes in young peoples' book reading habits. *Scandinavian Journal of Educational Research, 50*(5), 519–540.
https://doi.org/10.1080/00313830600953600

Kang, X., Yang, M., Wu, Y., & Ni, B. (2018). Integrating evaluation grid method and fuzzy quality function deployment to new product development. *Mathematical Problems in Engineering*, 2018, 1–15.
https://doi.org/10.1155/2018/2451470

Kaplan-Rakowski, R., & Gruber, A. (2023). An experimental study on reading in high-immersion virtual reality. *British Journal of Educational Technology, 55*(2), 541–559. https://doi.org/10.1111/bjet.13392

Kidd, D. C., & Castano, E. (2013). Reading literary fiction improves theory of mind. *Science, 342*(6156), 377–380.
https://doi.org/10.1126/science.1239918

Kim, E., & Shin, G. (2020). User discomfort while using a virtual reality headset as a personal viewing system for text-intensive office tasks. *Ergonomics, 64*(7), 891–899.
https://doi.org/10.1080/00140139.2020.1869320

Kojić, T., Ali, D., Greinacher, R., Möller, S., & Voigt-Antons, J. N. (2020). User experience of reading in virtual reality—finding values for text distance, size and contrast. In *2020 Twelfth International Conference on Quality of Multimedia Experience (QoMEX)* (pp. 1-6). IEEE.

Kuijpers, M. M., Hakemulder, F., Tan, E. S., & Doicaru, M. M. (2014). Exploring absorbing reading experiences. *Scientific Study of Literature, 4*(1), 89–122. https://doi.org/10.1075/ssol.4.1.05kui

Kunzová, N., Štěpánek, A., Echeverri, D., Langlois, D. K., & Kriglstein, S. (2024). Stories with style: Narrative virtual and imaginary spaces of reading fiction in virtual reality. *Proceedings of the International Conference on Mobile and Ubiquitous Multimedia (MUM '24)*, 36–50.
https://doi.org/10.1145/3701571.3701601

Kunzova, N., & Echeverri, D. (2023). BookWander: From Printed Fiction to Virtual Reality—Four Design Approaches for Enhanced VR Reading Experiences. In *Lecture notes in computer science* (pp. 309–328).
https://doi.org/10.1007/978-3-031-47655-6_19

Kuzmičová, A., Schilhab, T., & Burke, M. (2018). m-Reading: Fiction reading from mobile phones. *Convergence the International Journal of Research Into New Media Technologies, 26*(2), 333–349.
https://doi.org/10.1177/1354856518770987

Loh, C. E., & Sun, B. (2022). The impact of technology use on adolescents' leisure reading preferences. *Literacy, 56*(4), 327–339.
https://doi.org/10.1111/lit.12282

Mack, N. A., Schümmer, F., Rose, M., & Tobias, M. (2024). Evaluating Text placement in Information-Rich Virtual Environments: A User Study on Controller-Anchored Text. *Nordic Conference on Human-Computer Interaction*, 1–10.
https://doi.org/10.1145/3679318.3685400

Mangen, A. (2008). Hypertext fiction reading: haptics and immersion. *Journal of Research in Reading, 31*(4), 404–419. https://doi.org/10.1111/j.1467-9817.2008.00380.x

Mohammad, A., & Pedersen, L. (2022). Analyzing the use of Heuristics in a Virtual Reality learning Context: A literature review. *Informatics, 9*(3), 51. https://doi.org/10.3390/informatics9030051

Nagamachi, M. (1995). Kansei Engineering: A new ergonomic consumer-oriented technology for product development. *International Journal of Industrial Ergonomics, 15*(1), 3–11. https://doi.org/10.1016/0169-8141(94)00052-5

Nagamachi, M. (2002). Kansei engineering as a powerful consumer-oriented technology for product development. *Applied Ergonomics, 33*(3), 289–294. https://doi.org/10.1016/s0003-6870(02)00019-4

Pianzola, F., Bálint, K., & Weller, J. (2019). Virtual reality as a tool for promoting reading via enhanced narrative absorption and empathy. *Scientific Study of Literature, 9*(2), 163–194. https://doi.org/10.1075/ssol.19013.pia

Picton, I., & Clark, C. (2015, December). The Impact of ebooks on the Reading Motivation and Reading Skills of Children and Young People. National Literacy Trust. https://literacytrust.org.uk/research-services/research-reports/impact-ebooks-reading-motivation-and-reading-skills-children-and-young-people/

Rabbani, S. A., Ahmed, M., & Zahid, A. H. (2023). E-Ink; revolution of displays. *MATEC Web of Conferences*, 381, 02003. https://doi.org/10.1051/matecconf/202338102003

Rzayev, R., Ugnivenko, P., Graf, S., Schwind, V., & Henze, N. (2021). Reading in VR: The Effect of Text Presentation Type and Location. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21)*. https://doi.org/10.1145/3411764.3445606

SCHLEICHER, A. (2018) PISA 2018: insights and interpretations. https://www.oecd.org/pisa/PISA%202018%20Insights%20and%20Interpretations%20FINAL%20PDF.pdf

Şimşek, B., & Direkçi, B. (2022). The effects of augmented reality storybooks on student's reading comprehension. *British Journal of Educational Technology, 54*(3), 754–772. https://doi.org/10.1111/bjet.13293

Suggate, S. P. (2023). Does it kill the imagination dead? The effect of film versus reading on mental imagery. *Psychology of Aesthetics Creativity and the Arts*. Advance online publication. https://doi.org/10.1037/aca0000651

Tabone, W., & De Winter, J. (2023). Using ChatGPT for human–computer interaction research: a primer. *Royal Society Open Science, 10*(9). https://doi.org/10.1098/rsos.231053

van Boeijen, A., Daalhuizen, J., Zijlstra, J., & van der Schoor, R. (2014). *Delft design guide: Design strategies and methods* (Revised edition). BIS Publishers. https://www.bispublishers.com/delft-design-guide-revised.html

Zunshine, L. (2006). *Why we read fiction: Theory of mind and the novel*, 29-33. Ohio State University Press. http://www.jstor.org/stable/j.ctt1kgqwk8

Appendices

Appendix A. VR Fiction Reading Perspective from User Study

Immersion & Imagination

The most frequently mentioned theme was the immersive quality of the VR environment. Participants emphasized that the rich visual design and carefully crafted soundscape in the prototype provided a sensory foundation that supported imagination and made narrative transportation easier. The multisensory elements of VR were seen not only as enhancing the realism of the fictional world but also as strengthening emotional empathy toward the story and its characters.

Participants with prior VR experience further noted that one potential advantage of VR reading is its ability to reduce external distractions. The sense of enclosure and isolation offered by VR was viewed as conducive to deep, uninterrupted engagement—something often challenged in traditional reading environments.

"Normally it's like I have a book and the book is the gateway to the fiction world, but by having a VR headsets, then you are in the like physically feels like you are in the fictional world. So in that sense, I think the transportation that happens is a lot more easy."

— P3

"There like that is more easily achieved if like you have a base for where you can imagine on."

— P6

However, an important point of tension emerged in the discussion of imagination within VR reading. While many participants acknowledged that VR offers a strong imaginative base through visual and auditory cues, several also expressed skepticism or concern about this very feature. These participants argued that a core pleasure of reading fiction lies in the active use of one's own imagination to construct the narrative world. In contrast, they felt that VR's pre-rendered visuals and soundscapes could diminish the creative autonomy of the reader.

From this perspective, the immersive media elements—though powerful—were seen as potentially undermining the essence of reading itself. As one participant put it, the act of reading is not just about experiencing a world, but about building it internally. VR, by visualizing too much, might override this imaginative process and reduce the reader's role in shaping the narrative experience.

"I don't think I'd want to use a technology like this. Honestly, I don't think it's going to help me … When you look at this and somebody else is making the environment for you kind of defeats the purpose. Because if you …just read the text, you could have found a different image, very different from what is being shown over here in the head(set)."

— P5

Cognitive Control & Flow

Participants expressed a range of concerns regarding reading interaction in VR, particularly around the issue of page-turning control. One key question was whether the progression of the story should be user-driven (active) or system-controlled (passive). Most participants voiced concerns about passive control over reading pace, feeling that it could disrupt their sense of agency and flow. However, this concern was likely influenced by the limitations of the current study's prototype format, and thus requires further investigation in future research with more interactive prototypes.

In discussing the journey design of VR reading, participants saw potential in integrating VR-specific interaction models—such as navigating through different rooms to progress the story, or using eye-tracking to trigger content and interactions. These methods were perceived as promising ways to create a seamless and immersive reading experience while maintaining user control.

Nevertheless, participants with more extensive VR experience, such as P8, offered critical suggestions. They emphasized the need to provide users with an adaptation period at the beginning of the experience, as well as a clearly defined exit mechanism. In their view, the pacing and frequency of transitions or events in the VR environment should be carefully designed to avoid cognitive fatigue. Too many visual or narrative shifts in a short span could overwhelm the user and break the immersive flow.

"Reading is about engaging with text using your eyes, but once you enter VR, it becomes sensory—there are all kinds of stimuli. So there needs to be a moment where users can adapt and feel ready to start focusing seriously on the content… It takes a lot of adaption. Personally, I think the way content is presented really matters. If you've used VR at home, you'll know that once it goes beyond 10 minutes, it gets tiring… I also think the exit mechanism in VR is quite important…"

— P8

Physical Interaction and Comfort

Participants with prior VR experience raised concerns about the physical comfort of prolonged VR use. Based on their experiences, factors such as the weight of the headset and the increased visual-cognitive demands posed significant barriers to sustaining a long reading session in VR. This feedback highlights a critical consideration for the future design of VR reading experiences: comfort and usability must be prioritized to support extended engagement.

Beyond physical strain, some participants also reflected on the psychological aspects of immersion. For instance, P7 noted that fully diving into a fictional world in VR felt like a complete disconnection from the real world, which, for him, could trigger a sense of insecurity or vulnerability. This reveals that the feeling of safety and presence in one's physical environment may still play a role, even in virtual immersion.

Conversely, P1 raised a more personal and practical concern—suggesting that if the VR reading experience could accommodate a lying-down posture, it would better align with her preferred reading habits. This input underscores the importance of adaptability in VR reading interfaces, not only in terms of narrative flow and interaction, but also in supporting individual physical preferences and needs.

"I know where I'm sitting … like in my room. I know that the window is open, the lights are being on. Like if I'm in VR for example, I don't know if someone is in my room, so that might be in my back."

— P7

Visual Experience and Comfort

One of the most prominent concerns regarding visual comfort in VR reading was the issue of motion sickness. During the VR prototype demo video, one participant explicitly mentioned feeling dizzy due to the camera movement and visual instability. However, this reaction may have been influenced by the nature of the demo itself—participants were passively watching a recording rather than actively navigating the VR environment, potentially leading to perceptual mismatch and increased discomfort.

Participants also raised concerns about specific visual design elements within the VR reading environment. Some noted that the scene appeared too dark, while others mentioned that text size was too small to read comfortably. These issues point to the importance of fine-tuning lighting and typography in VR reading interfaces. Nonetheless, given the limitations of the interview setup—including the use of a 2D screen to view a 3D experience—it remains unclear whether these concerns were entirely due to design flaws or were partially caused by the method of presentation. Further investigation with fully immersive, interactive VR prototypes will be necessary to validate these observations.

"When I watched this video, the only thing I felt was dizzy. It kept spinning."

— P2

Focus Point

Participants responded positively to the rich visual environment created in the VR reading experience, noting that it enabled moments of sight wandering—a natural and even enjoyable part of immersive engagement. The inclusion of a clearly defined UI text background bubble was also appreciated, as it helped readers quickly identify the focal point of the reading task and ensured that they did not get lost trying to locate the text.

However, this visual richness also raised concerns for several participants. About half of them questioned whether the surrounding visual elements might ultimately become distracting, drawing attention away from the text and reducing their ability to stay focused on the narrative. This feedback underscores the need for a careful balance between environmental immersion and cognitive clarity, ensuring that ambient visuals support rather than compete with the core reading experience.

"The setup is too distracting for me. OK, I feel like there's just so many visuals. There's so many sounds and I think instead of helping me feel immersed."

— P5

AI Generated Content

Participants expressed interest in the potential integration of AI generative technologies into VR fiction reading experiences. Given the rich visual possibilities that VR affords, they saw AI-generated visuals or contextual elements as a promising way to further enhance immersion. Specifically, participants envisioned AI being used to dynamically create imagery related to the story, such as environments, characters, or symbolic visuals, based on the narrative progression. This capability could allow for a more adaptive and personalized visual layer, making the fictional world feel more vivid and responsive to the reader's journey.

"AI generated stuff. If it's lowish quality, it doesn't have to be high quality, but if it fits the text. Like yeah fixed fix like you have here like cutouts from the story, right?"

— P6

Usage for Specific User Group

An interesting perspective was brought up by P5, who associated the visually rich VR reading experience with the design of children's books. This comparison highlights the potential of VR as a tool to enhance immersion and motivation, especially through the integration of interactive and multisensory elements.

While participants acknowledged the appeal of such experiences, they also noted that further research is needed to determine which user groups are best suited for this type of reading format. The unique qualities of VR may offer particular benefits for certain populations—such as young readers, reluctant readers, or individuals with specific learning needs—but the appropriateness and accessibility of the medium require deeper exploration in future studies.

"A good technology for children like children's books and all they use a lot of visuals. So I think for them it would be like a very exciting thing, yeah."

— P5

Does Prior VR Experience Affect Their Perspective Toward VR Reading?

In general, whether participants had prior experience with VR did not directly determine the positivity or negativity of their views toward VR fiction reading. All participants—regardless of their background—expressed both support and concerns about the development of VR as a reading medium.

Participants with VR experience were often able to connect the demo video to concrete interactions and anticipate potential usability considerations. For instance, P1 mentioned wanting the ability to read while lying down in VR, suggesting the importance of physical flexibility in interface design. P8, who had volunteered at a VR-based art exhibition, shared several nuanced observations. These included the need to provide users with an adaptation period, the physical limits of wearing a headset for extended durations, and the necessity of a clear exit mechanism once the VR session ends.

On the other hand, participants without prior VR experience tended to respond based on first impressions, with some expressing initial confusion or skepticism. For example, P2 initially mistook the VR prototype video for a holographic projection, highlighting unfamiliarity with the medium. Meanwhile, P5 openly stated that he would not choose to read fiction in VR, as he felt the core value of reading lies in using one's imagination to visualize the story—something he feared might be diminished by the technology.

Appendix B. EGM Result of Reading Motivation

E-1 Escape & Expansion

One of the key reasons participants expressed for enjoying fiction reading was its ability to provide an escape from the real world. Many described reading as a way to let their minds temporarily drift into a fictional world—an opportunity to mentally step away from daily life and explore societies, cultures, or experiences that are otherwise inaccessible. In addition to this escapist function, participants also valued the expansiveness of fiction as a medium. Compared to film or television, novels were seen as offering greater narrative variety and fewer creative constraints, allowing for the exploration of a wider range of genres, themes, and perspectives.

"It's an escapism. I would say cause I feel like sometimes you don't feel like to be in this world, and fiction books allows you to be in a different world ... It's like watching a movie but not watching it."

— P1

"Novels aren't as limited. There can be so many different topics. With screen adaptations—especially remakes—you can really feel how restricted visual media can be sometimes."

— P2

E-2. Emotional Meaning Making

Participants also expressed that one of the reasons they enjoy reading fiction is the opportunity to witness how authors transform seemingly mundane or everyday scenes into emotionally meaningful moments for the characters. Through narrative techniques and detailed scene construction, readers are able to experience these instances of meaning making—moments where the emotional or symbolic weight of a situation becomes clear and impactful.

"So I think it's also a thing that I like about reading in general. A very simple moment can be transformed into a very meaningful moment, like as soon as it can be just a sunset. It can also be. A turning point in a character's life. Or something like this."

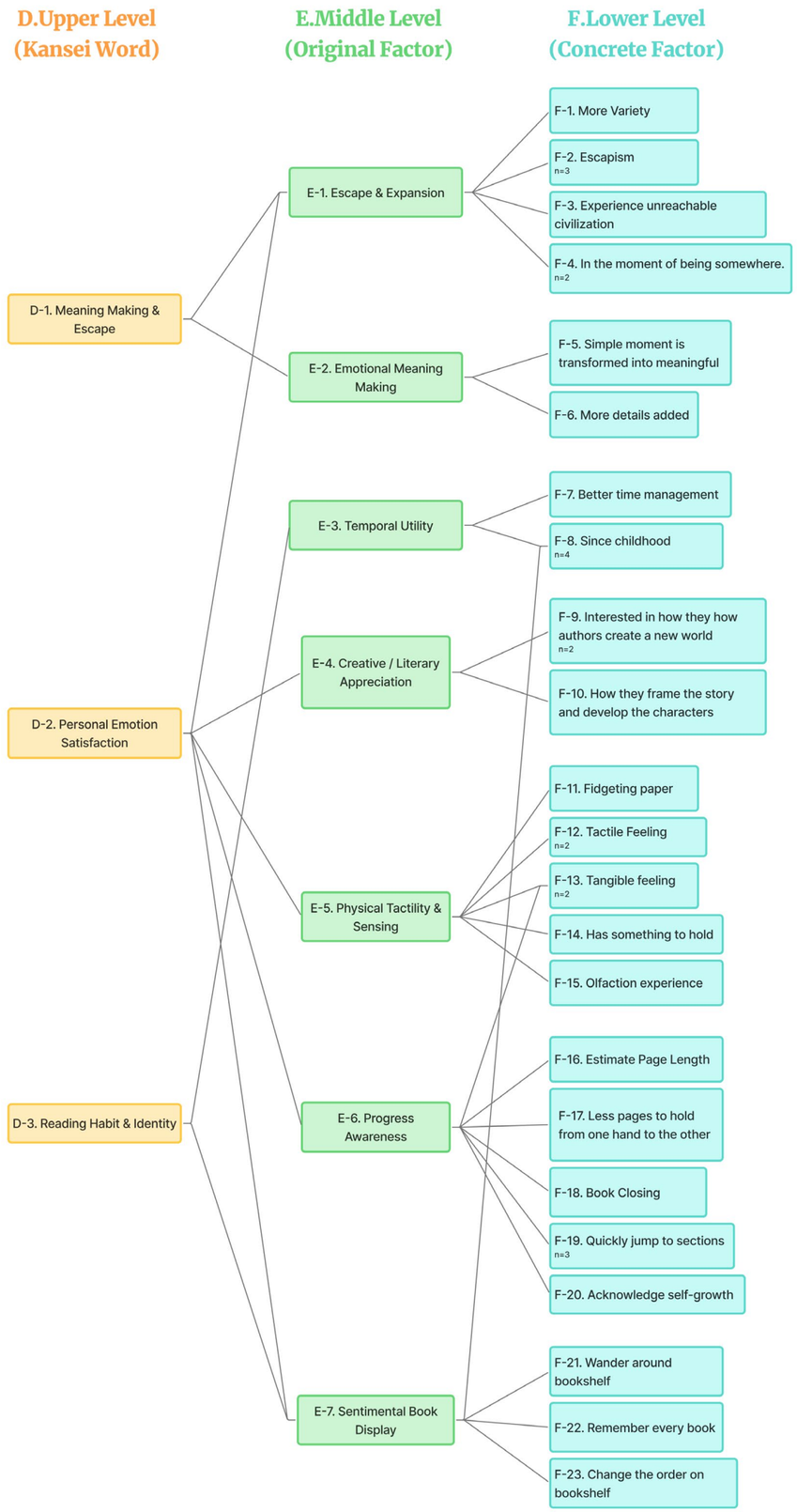
— P3

E-3. Temporal Utility

Reading was also perceived by participants as a valuable way to make use of time. Many described it as a productive and fulfilling activity that helped them fill idle moments or give meaning to otherwise unstructured time. Whether during short breaks or longer periods of downtime, reading offered a sense of purpose and engagement. Four participants also mentioned that reading had been a long-standing habit developed since childhood. However, this study did not explore in depth the factors that contributed to the early development of their reading habits.

"For more serious books, I prefer to read when I have a longer uninterrupted period. But for web novels, I might read during short breaks—like five minutes between classes."

— P2



E-4. Creative / Literary Appreciation

Some participants expressed that their enjoyment of reading stemmed from a deep appreciation of the author's craftsmanship in constructing fictional worlds. They admired the creative skill involved in shaping unexpected plot developments and delivering moments of surprise. This appreciation was not necessarily tied to emotional engagement with the story, but rather a recognition of the literary creativity and narrative intelligence behind the fiction.

"I know how the real world works, but to create a fancy world. You have to have like all sorts of different world buildings and like, create a whole new world to yourself. Umm, so I'm interested in how they how authors create a new world."

— P3

E-5. Physical Tactility & Sensing

Despite differences in their preferred reading devices, all participants acknowledged certain irreplaceable qualities of physical books. While some participants chose digital formats—often due to practical reasons such as affordability, portability, or long-term stays abroad—they still recognized the unique sensory experience that paper books provide.

Participants highlighted the tactile sensations of holding a book, touching the texture of the paper, and flipping through pages with their fingers. Some also mentioned the smell of paper as an element that enriched their reading experience. These sensory aspects contributed to their enjoyment of reading and were often cited as something digital reading could not yet replicate.

"Why I prefer reading book is that I need something to hold my hands when I'm reading."

— P7

E-6. Progress Awareness

Several participants found motivation in being aware of their progress while reading. This sense of progress awareness made the reading experience more satisfying, as it provided a tangible or psychological sense of advancement. For example, physically observing a thick book gradually thinning as they read, or the act of closing a book to mark the end of a session, gave readers a sense of closure and accomplishment. In some cases, this awareness also carried an introspective element, where participants reflected on their personal growth through reading.

"Quickly more do like scroll through the back or when there is a map scroll to the ... go to the front."

— P1

E-7. Sentimental Book Display

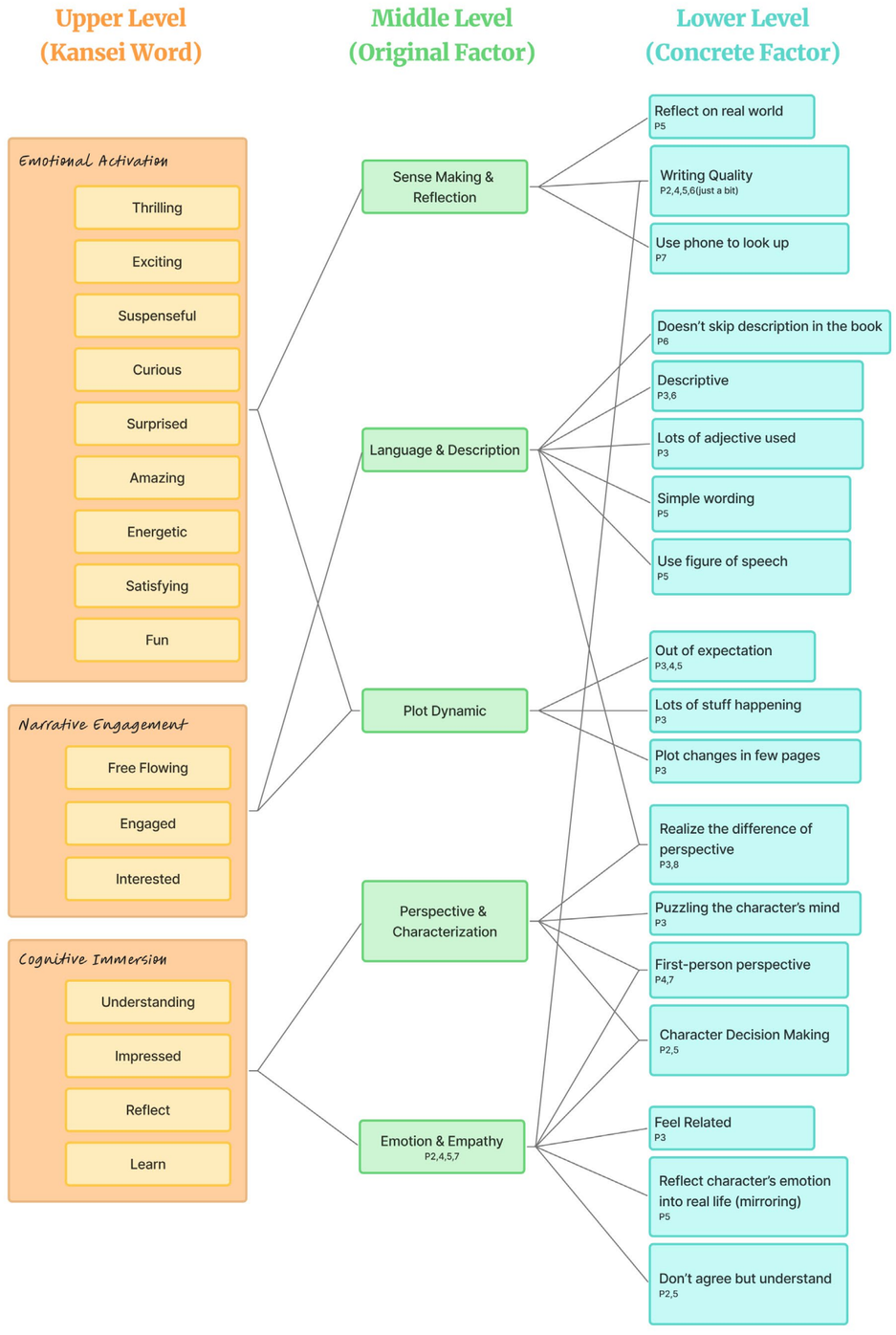
The presence of physical books as visible, sentimental objects was another factor that contributed to participants' love of reading. This included experiences such as browsing books in a bookstore, revisiting previously read titles on their personal bookshelf, or reorganizing books as a form of reflection or memory-making. These acts created a personal and emotional bond with books beyond their narrative content.

Participants described how the visual and material presence of books in their living space served as meaningful reminders of past reading experiences. In this sense, books were not only tools for reading but also artifacts that held sentimental value and contributed to the atmosphere of one's home or identity as a reader.

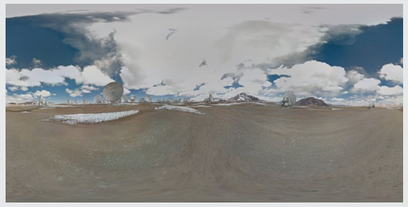
"Just surfing the books and just looking at it like I can spend hours and hours in a bookstore and not buy anything ..."

— P7

Appendix C. EGM Result of Source of Transportation — Narrative Immersion



Appendix D. Steps for Prompting ChatGPT to Generate/Recommend VR Backgrounds

	Step 1	Step 2	Step 3
Static Real	Next, you will be asked to analyze the content of the novel read by the next interviewee and find out what kind of google street view real location is suitable for him to experience reading in VR. Analyze the location based on narrative, emotional tone, temporal and seasonal clues.	 Download the Google street view image via the URL provided by GPT with software [Street View Download 360].	
Static AI	Next, I would like you to give DallE a prompt to generate a 360-degree equirectangular image based on the content of the new novel. It is used for reading in the panoramic environment of VR. Analyze the location based on narrative, emotional tone, temporal and seasonal clues. Exclude figures from the image.	 Paste the prompt to Dall-E(I use the 'Panorama Pro' custom GPT). Then download the result.	 Put the downloaded image into Photoshop. Then, use the 'Generative Expand' function to fill it into a 2:1 image with a prompt "Equirectangular".
Dynamic Real	(Same as Static Real's prompt)	(Same as Static Real's approach)	
Dynamic AI	Next, I'd like to ask you to generate DALL·E prompts for panoramic images. Based on the following novel content, please propose suitable panoramic background images for VR reading that reflect the narrative, emotional tone, and temporal and seasonal cues. The images should form a continuous sequence in both space and time (e.g., walking while reading, with time gradually passing). High-fidelity reproduction of the scenes is not required—the key is to match the emotional tone. Exclude figures from the image. --1st page– [Fiction Content]... –2nd page– [Fiction Content]...	(Same as Static AI's approach)	(Same as Static AI's approach)

Appendix E. ChatGPT Prompt for Generating Symbol Objects and Book Covers

	ChatGPT Prompt	Outcome
Step 1	Next, I would like you to analyze the new novel paragraph and use this question: If your memory of this chapter could rest inside an object, which one would it choose? (There are no right answers. Just choose what feels closest to your memory.). Please suggest three suitable symbols, and also provide one short description sentence for each symbol: [Fiction content...]	[three symbol objects title and their description]
Step 2	Can you generate a transparent background png image for the symbol [paste the title of the symbol object]. The image style needs to suit this story style.	 [a PNG image to be implemented in the ending survey]
Step 3	Can you combine the book cover and the symbol as a new design book cover? You can rearrange the layout of the original book cover if it's needed. Please make the symbol merge into the book cover more naturally. [Upload the original book cover with this prompt]	 [a PNG image to be implemented in the ending survey]

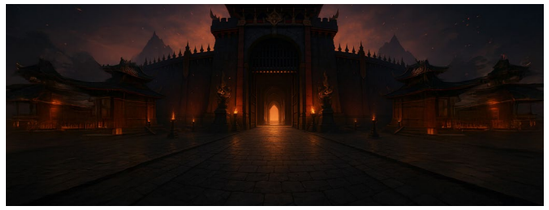
Appendix F. VR Reading Background Assigned for Participants in Prototype Evaluation

P1

- Book Title: Avatar, The Last Airbender: The Shadow of Kyoshi
- Reading Progress: Chapter 'Reunion' - Chapter 'Cultural Diplomacy'

Static Real

Static AI



Dynamic Real

Dynamic AI

P2

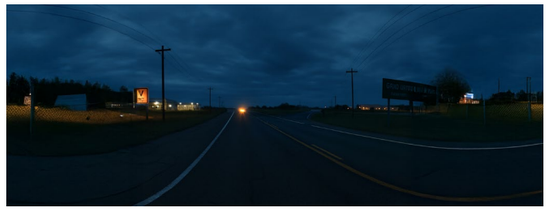
- Book Title: I’m Starting to Worry about This Black Box of Doom
- Reading Progress: Chapter ‘Malort’ - Chapter ‘Hunter’

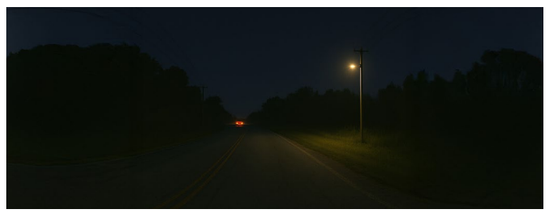
Static Real

Static AI

Dynamic Real

Dynamic AI



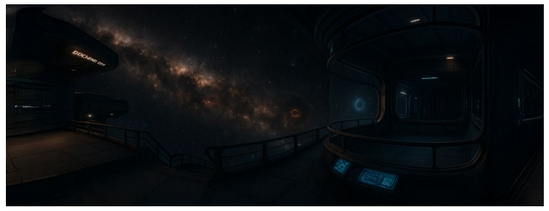


P3

- Book Title: The Long Way to a Small, Angry Planet
- Reading Progress: Chapter ‘The Job’ - Chapter ‘Port Coriol’

Static Real

Static AI



Dynamic Real

Dynamic AI

P4

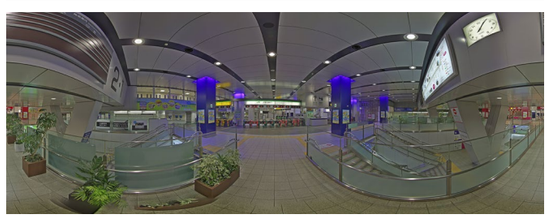
- Book Title: Foundation
- Reading Progress: Chapter ‘Part 1 - Psychohistorian, Sub-chapter 1-6’

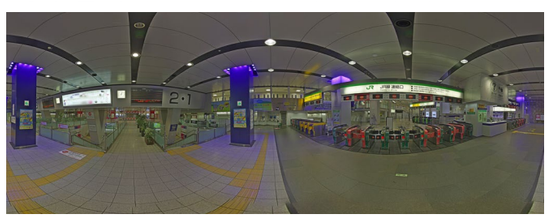
Static Real

Static AI

Dynamic Real

Dynamic AI





Appendix G. Graduation Project Brief

DESIGN FOR our future

TU Delft

Personal Project Brief – IDE Master Graduation Project

Name student Po-Cheng Chen **Student number** 5,953,596

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT
Complete all fields, keep information clear, specific and concise

Project title Designing VR Reading Interfaces: Enhancing Reading Experience With Leveraging Generative AI

Please state the title of your graduation project (above). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

Introduction

Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)

VR is a multi-sensory medium that enhances user engagement through immersion, sence of presence, and interaction (Mohammad & Pedersen, 2022). These features are widely applied in entertainment and education.

A well-designed UI is essential for enhancing the VR reading experience because reading is a fundamental way to acquire new knowledge. In VR, reading helps users understand contextual information, and many VR applications require good reading experience, whether for educational purposes, gaming, or instructional content, and more (Rau et al., 2018). A review of existing literature highlights key aspects to consider in research and design, including: readability, usability, text attributes, comfort, emotional response, and presentation style (Rzayev et al., 2021; Wang et al., 2021; Kojić et al., 2020).

On the other hand, the length and readability of the text also affect the reading experience. AI can enhance reading by summarizing text, extracting key information, and adapting text style and complexity to user needs, improving engagement and learning outcomes in educational setting(Ademola, 2024). While AI-VR integration holds great potential for enhancing reading experiences, effectively facilitating AI-generated text and interactions requires well-designed UI to optimize the overall user experience.

The findings of this research are highly relevant and important to various VR applications. As VR technology continues to develop, universal design guidelines for reading interfaces have yet to be established. This thesis contributes to the academic discourse on VR reading experiences by using a familiar reading context as a test medium to comprehensively explore how UI design influences user engagement and comprehension, as well as the potential benefits of AI-driven reading interactions.

space available for images / figures on next page

Personal Project Brief – IDE Master Graduation Project

Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.
(max 200 words)

Building on the introduction, This thesis explores the role of UI design in VR reading experiences and the potential of AI-assisted text features. However, research that fully integrates VR's interactive potential into reading experiences remains a gap. Currently, most VR applications present text as static paragraphs, lacking interactive elements. This might lead to user fatigue, reducing engagement and ultimately diminishing the overall reading experience. Additionally, while researchers have examined AI's positive impact on reading experiences, how AI can be integrated into VR reading and its specific effects remain underexplored, leaving a significant research gap.

Therefore, the main research question is: How does VR reading UI design influence users' reading experience when reading AI-facilitated content? To improve reading experience in VR, two key opportunities emerge:
(1)Leveraging VR's ability to create highly interactive environments to design more engaging reading UI.
(2)Integrating AI-driven interactions to enhance reading experience and support readers more effectively.

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence) As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:

Design multiple reading interfaces integrating with AI in VR to evaluate the impact of different UI designs on overall reading experience for individual VR user.

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

The project framework follows the DfI Exploring Interaction course, consisting of three phases: Conceptualization, Ideation & Iteration, and Evaluation. This approach helps analyze existing interactions, refine design directions through rapid iterations, and compare outcomes with the original design.

In the Conceptualization phase, I will first evaluate the usability challenges of the reading experience using the existing VR street exploration app, Wander. After narrowing down the scope and defining the user testing objectives and plan, I will conduct user interviews and perform qualitative analysis to synthesize key insights and refine the design direction.

In Ideation & Iteration, I will brainstorm solutions, develop low-fidelity prototypes, and conduct iterative user evaluations. In Evaluation, I will create a high-fidelity prototype, test it with users, analyze the results, compare them with Phase 1, and provide final design recommendations.

Project planning and key moments

*To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a **kick-off meeting**, **mid-term evaluation meeting**, **green light meeting** and **graduation ceremony**. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).*

Make sure to attach the full plan to this project brief.
The four key moment dates must be filled in below

Kick off meeting	21 Feb 2025
Mid-term evaluation	22 Apr 2025
Green light meeting	25 Jun 2025
Graduation ceremony	23 Jul 2025

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	✔
For how many project weeks	6
Number of project days per week	4,5

Comments:
one individual-work elective course in Q3

Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.
(200 words max)

(1)This project begins from my personal interest in digital reading, particularly in the immersive and interactive experiences that VR offers. As a field still in its early stages, it holds significant academic potential and remains an area with considerable room for exploration and contribution.

(2)Through this graduation project, I aim to gain hands-on experience in designing for VR environments. Beyond my enthusiasm for VR technology, I see spatial design evolving with technological progress, creating new research opportunities. Executing a full-scale VR project also aligns with my original goal when entering DfI.

(3)Lastly, I expect to conduct complete and rigorous data collection and analysis, particularly regarding UX and cognitive load, to establish data-driven, human-centered design principles for HCI research and practice.

TU Delft

Future Reading Experience: Exploring Narrative Transportation in VR Fiction Reading

Po-Cheng Chen | Master Thesis