DECO2300/7230 Digital Prototyping and Extended Reality

XR Kindle Redesign: Final Evaluation Report and Reflection

Prototype 3 Evaluation: VR-Native Spatial Interactions

Main Report: 4 pages (Page numbers: 1-4)
Appendix: 14 pages (Page numbers: 5-18)

Name: Sadhika Sahoo
Student Number: 48723280

Objective and Validation Metrics

This evaluation aimed to test **the intuitiveness and effectiveness of VR-native spatial manipulation (miniaturization, book scaling) and portal-based scene transitions** to discover whether users can successfully interact with non-realistic VR affordances and whether these interactions enhance perceived value compared to real-world simulation approaches tested in Prototype 2.

Success Criteria:

- **Task 1 (Mini Library & Scaling)**: >70% success rate, <60 seconds completion, intuitiveness rating >6/10
- **Task 2 (Portal Navigation)**: >60% successful teleportation, <90 seconds completion
- **User Preference**: >50% favor VR-native approach over realistic simulation
- **Conceptual Understanding**: Users articulate value of VR-specific interactions
- **Text Label Effectiveness**: Labels provide sufficient affordance for first-time users

Testing successfully recruited **5 participants** (P1-P5), addressing the critical recruitment failure from Prototype 2.

Results

Task Performance Metrics

Participant	Task 1: Book Scaling	Task 2: Portal Navigation	Mini Library Rating	Portal System Rating	Overall Interview Rating
P1	✓ Success (~40s)	✓ Success (~70s)	5/5 (Very Intuitive)	3/5 (Neutral)	8.5/10
P2	✓ Success (~35s)	✓ Success (~65s)	4/5 (Intuitive)	4/5 (Intuitive)	8/10
P3	✓ Success (~30s)	✓ Success (~55s)	5/5 (Very Intuitive)	4/5 (Intuitive)	High (no numeric)
P4	✓ Success (~45s)	✓ Success (~60s)	4/5 (Intuitive)	4/5 (Intuitive)	8-9/10
P5	✓ Success (~50s)	✓ Success (~80s)	4/5 (Intuitive)	3/5 (Neutral)	Not provided

Aggregate Performance

- **Task 1 Success Rate**: 100% (5/5 participants) ✓ **EXCEEDED 70% target**
- **Task 2 Success Rate**: 100% (5/5 participants) ✓ **EXCEEDED 60% target**
- **Average Task 1 Time**: 40 seconds ✓ **Met <60s target**
- **Average Task 2 Time**: 66 seconds ✓ **Met <90s target**
- **Average Mini Library Rating**: 4.4/5 (8.8/10) ✓ **EXCEEDED >6/10 target**
- **Average Portal System Rating**: 3.6/5 (7.2/10) ✓ **EXCEEDED >6/10 target**

Task Difficulty Distribution (Survey Data)

Task Component	Very Easy	Easy	Neutral	Difficult	Very Difficult

Finding/Grabbing Mini Books	60% (3)	40% (2)	0%	0%	0%
Scaling Books	40% (2)	60% (3)	0%	0%	0%
Locating Portal Elements	40% (2)	40% (2)	20% (1)	0%	0%
Using Portal System	0%	60% (3)	40% (2)	0%	0%

Interaction Preference: VR-Native vs. Realistic Approach

- **VR-Native Approach**: 20% (1 participant) - P5
- **Realistic Approach**: 40% (2 participants) - P2, P4
- **Both Have Value**: 40% (2 participants) - P1, P3

Preference Target: PARTIALLY MET - Only 20% favored VR-native over realistic, below 50% target, but 40% saw value in both approaches, suggesting hybrid appeal rather than clear superiority.

Text Label Effectiveness

- **Very Helpful**: 80% (4 participants)
- **Somewhat Helpful**: 20% (1 participant)
- **Not Helpful/Confusing**: 0%

Analysis/Insights

Successfully Validated Elements

Mini Library Concept Highly Intuitive	VR-Specific Spatial Manipulation Works	Portal Teleportation Functional but Conceptually Disconnected
The miniaturized book collection achieved 100% task completion with participants averaging 40 seconds - 33% faster than target. P3's response exemplifies the concept's appeal: *"I have these cute mini books in front of me... I wouldn't put new books in it, but I would love to see all my books right there... That would be my personal sanctuary."* The scaling interaction leveraged familiar smartphone pinch-zoom gestures, creating immediate comprehension as P2 noted: *"It's just the same as when you're using a smartphone and you zoom it."*	Participants successfully manipulated impossible physics (miniaturization, dynamic scaling) without confusion. P3's excitement demonstrates engagement beyond novelty: *"I can just, if I am bold and I have space, I can extend the size of it to the room and like read while walking on the book."* This validates that VR-native interactions can feel natural despite lacking real-world equivalents when grounded in transferable interaction patterns.	While 100% of participants successfully used the portal system, interview data reveals fundamental conceptual gaps. P1 articulated the core issue: *"Having the desk, the cube, and the book as separate objects was a bit too much. There was a bit of disconnect there in the interaction... my first thought was to put the book on the portal dock."* Multiple participants (P1, P2, P5) attempted to connect books directly to portals, revealing users expected thematic transportation (book → book's world) rather than generic teleportation.

Critical Design Gaps Identified

Book-World Connection Missing: The separation between book selection and environment access created cognitive dissonance. P1's feedback: *"When you were like, 'oh, just throw the book away, it doesn't mean anything,' it meant that there was no connection with the book."* Users expected narrative coherence - selecting a mystery novel should transport to mysterious environments, not generic forests. This represents a fundamental UX failure where the portal system works technically but fails conceptually.	**Portal Interaction Not Self-Evident**: Despite 80% rating text labels "very helpful," participants consistently needed guidance to understand cube-dock interaction. P5 stated: *"The connection was not intuitive. It is not something that I can do on my own."* P2 suggested: *"Instead of just dropping the cube, I feel like it's more easier or natural if when you have a big teleportation pad, you just walk in."* This indicates the portal metaphor requires either more conventional interaction patterns (walk-through portals) or tighter integration with book selection.	**Book Opening Expectation Unmet**: Four of five participants attempted or mentioned wanting to open books (P1, P3, P4, P5), representing 80% user expectation mismatch. P1's detailed feedback: *"My natural assumption would be I would open the book and either read it or open the book and then I appear in the world, and then maybe closing the book would take me back out of the world."* This reveals users expected book interaction as the primary navigation mechanism, not a separate cube system.

Evaluation of Aims

PRIMARY OBJECTIVE: VALIDATED WITH RESERVATIONS - Users successfully interacted with VR-native spatial manipulations (100% task completion, 8.8/10 average intuitiveness), confirming that impossible physics can be intuitive when leveraging transferable mental models. However, the portal system's conceptual disconnect reveals that technical success is not equal to experiential coherence.	**USER PREFERENCE HYPOTHESIS: INVALIDATED** - Only 20% preferred VR-native over realistic approaches, falling short of the 50% target. The 40% "both have value" response suggests the dichotomy itself was false - users want hybrid systems combining realistic familiarity with VR-specific enhancements, not replacement of one with the other.	**TEXT LABEL EFFECTIVENESS: VALIDATED** - 80% found labels very helpful, confirming that first-time user comprehension was supported. However, labels enabled task completion without achieving intuitive understanding, as evidenced by P5: *"Text helped me do that, and since the platform is a bit raised, so I thought maybe I can stand up."*	**CRITICAL INSIGHT: NARRATIVE COHERENCE IS ESSENTIAL** - The most valuable finding was negative space - what participants expected but didn't receive. The repeated attempts to connect books to worlds (P1, P2, P5) and open books (80% of participants) reveals that VR reading experiences demand thematic integration, not just functional teleportation. Users need stories to guide their spatial journeys.

Reflection

Prototype 3 Analysis

Prototype 3 achieved the most complete technical execution, with 100% task completion and five successful participants. The mini library concept worked exceptionally well as participants intuitively understood scaling through familiar smartphone gestures, confirming Zhang et al. (2022)[1] that spatial manipulation grounded in existing mental models enhances engagement. However, despite flawless technical function, conceptual integration failed; the portal system felt disconnected from book

selection, a UX flaw invisible in metrics but evident in feedback like P1's: "Having the desk, the cube, and the book as separate objects was a bit too much." While motion sickness affected only 20% of [1]users, it revealed an accessibility issue requiring teleportation comfort settings. This iteration taught me that functional polish without narrative or physiological coherence results in hollow XR experiences.

Methodological Reflection
My testing methodology evolved significantly through three prototypes, highlighting iterative learning in XR evaluation. Prototype 1 validated spatial navigation using basic think-aloud methods but lacked structured data for iteration. Prototype 2's technical failures emphasized the need for pre-session validation checklists and having a recovery method. By Prototype 3, a mixed-methods approach combining concurrent think-aloud, structured interviews, and Google Form surveys proved most effective, capturing behavioral, comparative, and reflective data. Pre-scheduling ensured full participation, and the concise five-minute limit encouraged focused inquiry. This evolution demonstrated that strong methodology anticipates failure points and balances depth with efficiency.

Protocol Effectiveness
Think-aloud testing revealed critical design insights, such as P1's confusion linking books and portals, though it occasionally disrupted interaction flow. Future sessions can use retrospective think-aloud for complex spatial tasks to preserve immersion. The Google Form survey successfully gathered nuanced reflections, with 40% of participants valuing both realistic and VR-native designs. Together, these methods validated that mixed data sources capture both surface usability and deeper conceptual understanding essential for XR evaluation.

Concept Evaluation
The XR Kindle concept evolved from realistic simulation to hybrid integration, revealing users' preference for familiar interactions within imaginative VR environments. Early prototypes confirmed that realistic navigation and book handling felt intuitive, while later iterations showed that VR-native mechanics alone lacked emotional grounding. Prototype 3 proved that users value coherence over novelty, 40% preferred "both have value," desiring familiar book interactions inside impossible spatial contexts. This confirmed that successful XR experiences must blend realism's comfort with VR's transformative potential rather than privileging one over the other.

Core Insights and Improvements
Testing validated that familiar gestures (e.g., pinch-zoom) enhance usability, immersive environments add unique value, and narrative coherence is essential. Key refinements include integrating book-world teleportation to strengthen narrative flow, implementing raycast grabs for accessibility, offering teleportation comfort options, and designing satisfying book-opening gestures to align with user expectations. These directly address user feedback and physiological comfort needs, ensuring both usability and immersion.

Future Extensions
Next steps involve exploring AR passthrough to connect physical and digital reading, allowing users to point at real books for digital previews and transitions into VR reading spaces. A cross-platform mini library, persistent across VR environments, could position XR Kindle as an ambient enhancement rather than a standalone app. This hybrid vision aligns with user preferences for familiar yet expanded experiences, demonstrating that meaningful XR design balances technical precision with human-centered narrative coherence, creating environments users intuitively understand, emotionally connect with, and physically enjoy.

---

[1] Zhang, J., Dong, Z., Bai, X., Lindeman, R., He, W., & Piumsomboon, T. (2022). Augmented perception through spatial scale manipulation in virtual reality for enhanced empathy in design-related tasks. *Frontiers in Virtual Reality*, 3, 672537. https://doi.org/10.3389/frvir.2022.672537

APPENDIX

This appendix contains:
- **Testing Plan of the session**
- **Think Aloud Protocol and Post Interview Transcripts**
- **Google feedback form results**

Testing Plan

XR Kindle Redesign: Prototype 3 Testing Plan - Advanced VR Interactions

Project Pitch

This project is Amazon Kindle but using XR for leveraging VR's boundless spatial capabilities to create portable pocket libraries where users can manipulate miniaturized book collections, dynamically scale reading materials to preferred sizes, and teleport between immersive reading environments through portal-based scene transitions that transcend physical world limitations.

Research Summary

Recent research demonstrates that VR's spatial manipulation capabilities significantly enhance user engagement with digital content through embodied interactions. Zhang et al. (2022) demonstrated that spatial scale manipulation in VR enhances perception and empathy in design-related tasks, showing that dynamic scaling of virtual objects creates stronger cognitive engagement and improved task performance compared to fixed-scale interfaces. Portal-based navigation systems have been validated by Bowman and McMahan (2007) as effective locomotion methods that reduce motion sickness while maintaining spatial presence, particularly when combined with clear visual affordances. Furthermore, Dourish (2001) established that tangible interactions with physical manipulation of digital objects create stronger mental models than abstract UI controls, a principle that applies to VR's ability to simulate real-world object manipulation at impossible scales. These findings support the design decision to implement miniaturized libraries with scalable books and portal-based environment switching, as they exploit VR's unique affordances while maintaining intuitive interaction paradigms grounded in physical world understanding.

References:

- D. A. Bowman and R. P. McMahan, "Virtual Reality: How Much Immersion Is Enough?" in *Computer*, vol. 40, no. 7, pp. 36-43, July 2007, doi: 10.1109/MC.2007.257.
- Dourish, P. (2001). *Where the action is: the foundations of embodied interaction*. MIT Press.
- Zhang, J., Dong, Z., Bai, X., Lindeman, R., He, W., & Piumsomboon, T. (2022). Augmented perception through spatial scale manipulation in virtual reality for enhanced empathy in design-related tasks. *Frontiers in Virtual Reality*, 3, 672537. https://doi.org/10.3389/frvir.2022.672537

Testing Objective

From my above concept, I have identified **the intuitiveness and effectiveness of VR-native spatial manipulation (miniaturization, scaling) and portal-based scene transitions** that needs testing. This test aims to discover **whether users can understand and successfully interact with non-realistic VR affordances (pocket library, scalable books, portal teleportation) and whether these interactions enhance the perceived value of immersive reading preparation compared to real-world simulation approaches**.

Testing Methodologies

This testing plan uses controlled task-based usability testing with side-by-side think-aloud protocol, immediate post-task interview questions, and follow-up digital survey to evaluate a functional VR prototype made in Unity with Meta SDK integration running on Meta Quest headsets.

Prototype Description/Requirements

The prototype was designed to **test VR-specific spatial interactions that exploit impossible physics unavailable in real-world contexts**. It **features a study space library environment with a miniaturized book collection on a desk that users can grab and scale to readable sizes, a PortalCore (interactive cube) and PortalDock (teleportation pad) system that enables scene transitions by placing the cube on the dock, and a forest reading environment with ambient scenery and furniture for immersive reading preparation**. Text labels identify key interactive elements (Mini Library, PortalDock, PortalCore) to support first-time user comprehension.

Data Collection Method

During the testing process, I will be conducting concurrent think-aloud observations with verbal prompts, logging task completion success/failure and time using stopwatch, documenting interaction attempts and confusion points in observation notebook, conducting brief 2-question post-test interviews immediately after VR session, and distributing QR-coded Google Form survey for extended feedback collection to document comprehensive quantitative and qualitative results within time constraints.

Testing Setup

- Meta Quest 2/3 headset fully charged with prototype pre-loaded
- Stopwatch/timer for task duration tracking
- Observation form with task checklist prepared
- Audio recording device for think-aloud capture
- QR code for post-test survey distribution
- Backup headset with identical build deployed

Testing Process (Schedule/Time: 5 minutes per participant)

Pre-Test Briefing (30 seconds)

1. **VR Safety & Consent** - Fit headset, confirm comfort, explain think-aloud expectations
2. **Concept Introduction** - "You'll explore a VR library with miniature books and portals to different reading environments"

Task Execution Phase (3 minutes)

Task 1: Mini Library Discovery & Book Scaling (75 seconds)

Instructions: "Explore this study space. Find the Mini Library and try to prepare a book for reading."

Success Criteria:

- User locates miniaturized book collection on desk
- Successfully grabs a mini book
- Scales book to larger readable size
- Demonstrates understanding of scale manipulation gesture

Metrics: Discovery time, grab success, scaling completion, number of attempts

Think-Aloud Prompts:

- "What do you notice about the books?"
- "How would you make this book readable?"

Task 2: Portal Navigation System (105 seconds)

Instructions: "Find the PortalCore and use it with the PortalDock to travel to a different reading environment."

Success Criteria:

- User locates PortalCore (cube)
- Successfully grabs and transports cube to PortalDock
- Places cube on dock to trigger teleportation
- Experiences scene transition to forest environment
- Understands return mechanism

Metrics: Portal system discovery time, placement accuracy, teleportation success, bidirectional navigation comprehension

Think-Aloud Prompts:

- "What do you think this cube does?"
- "How would you use these elements together?"
- "How would you return to the library?"

Post-Test Interview (60 seconds)

Q1: "On a scale of 1-10, how intuitive was interacting with the miniature library and scaling books? What felt natural or confusing?"

Q2: "Did the portal system make sense to you? How clear was the connection between the cube and the teleportation pad?"

Q3: "Compared to the realistic book-grabbing from a shelf, did this 'VR-only' approach feel more engaging or just different? Why?"

Survey Distribution (10 seconds)

- **Provide QR code** for extended feedback survey
- "Please scan this QR code when you have time to share additional thoughts"

Success Metrics & Evaluation Criteria

Quantitative Benchmarks

- **Task 1 (Book Scaling)**: >70% success rate, <60 seconds completion
- **Task 2 (Portal Navigation)**: >60% successful teleportation, <90 seconds completion
- **User Preference**: >50% favor VR-native approach over realistic simulation
- **Intuitiveness Ratings**: Average >6/10 for mini library and portal systems

Qualitative Indicators

- **Conceptual Understanding**: Users can articulate why mini library is useful in VR
- **Comparative Value**: Users identify specific advantages/disadvantages vs. Prototype 2 approach
- **Engagement**: Positive verbal feedback during exploration
- **Discoverability**: Users locate interactive elements within timeframes without excessive guidance

Critical Assumptions to Validate

1. Scale manipulation feels natural despite lacking real-world equivalent
2. Portal metaphor communicates teleportation purpose without extensive explanation
3. Text labels provide sufficient affordance for first-time users

4. VR-native interactions provide value beyond novelty compared to realistic simulations

APPENDIX

Google Form Survey Questions

Section 1: Interaction Effectiveness

How successful were you in completing the following tasks? (Scale: Very Easy / Easy / Neutral / Difficult / Very Difficult)

- ○ Finding and grabbing mini books
- ○ Scaling books to readable size
- ○ Locating PortalCore and PortalDock
- ○ Using the portal system to teleport

Rate the intuitiveness of each interaction (1-10 scale)

- ○ Mini Library concept
- ○ Book scaling gesture
- ○ Portal teleportation system

Section 2: Comparative Assessment

Which interaction style do you prefer for VR reading preparation? (Select one)

- ○ Realistic approach (grabbing full-size books from shelves)
- ○ VR-native approach (miniature portable library with scaling)
- ○ Both have value for different contexts
- ○ Neither - suggest alternative: _____

What made the VR-native interactions (mini library, portals) valuable or problematic? (Open text)

Section 3: Design Feedback

Were the text labels (Mini Library, PortalDock, PortalCore) helpful for understanding the system?

- ○ Very helpful
- ○ Somewhat helpful
- ○ Not helpful - I figured it out without them
- ○ Confusing - they didn't match my expectations

What would you change to improve these interactions? (Open text)

If you could add one feature to this VR reading preparation experience, what would it be? (Open text)

Think Aloud Protocol and Post-Interview Transcripts

Participant 1 Transcript

Interviewer: Please explore the study space and find the library. Try to prepare a book for reading. What do you notice about the books and how would you make them readable?

Participant 1: Okay, so do I just use the movement controls?

Interviewer: Yes, movement controls.

Participant 1: Cool. Alright, so I see some things over there that look like shelves and I don't see anything else. I presume that over here are my bookshelves, the three little ones. I notice they're hanging in the middle of the air. I don't see book titles on them. They do look like books, but there's no title. There's something on that one.

Interviewer: Okay, so how do you prepare that book for reading? What do you think the interaction can be?

Participant 1: So the first bookcase is here. I am just going to reach out and grab it. Get myself in the right position. It's very not sensitive. Alright, so I'm going to reach out and grab one of the books, pull the trigger.

Interviewer: It's a small book, tiny book.

Participant 1: So make it bigger. I've made it big. It's about the size of a normal book. And then I'm going to try...

Interviewer: Yeah, it's not open, but you can grab it. Okay, so you have found the book and made it to readable size. Now can you grab the book in one hand and find the portal core?

Participant 1: The...

Interviewer: Sorry, portal core. Can you see there is text hanging?

Participant 1: I see a green box over there. I think it says portal core.

Interviewer: Yeah. So, find the portal core and use it with the portal dock to travel to different reading environments.

Participant 1: So tapping it doesn't work. I'm going to grab the cube and I'm going to smush them together in the world in front of me.

Interviewer: I don't think that works. Okay, so there is a portal dock there. What do you think? How can the cube work with that?

Participant 1: Well, I'm going to try and put the book on the dock first. So I presume the portal core and the portal dock smushed together and then... Oh, okay. I'm in a new world.

Interviewer: Yeah. Awesome. So now you are there in the living room over there. How would you return to the library?

Participant 1: How would I return? Well, I can see it over there. So I would initially try to walk over there, but that will fall into the void.

Interviewer: No, it won't. But still, you know, an easier way. What do you think it can be?

Participant 1: Well, the easy way is when we go back here, I see the same dock that I used before. I still have my book and my cube.

Interviewer: Yeah. I mean, you can just leave the book as well if you want. It's fine.

Participant 1: Put it in my face. Grab my cube, go over. It was on there, so now I want to put it back on the dock to go back.

Interviewer: Awesome.

Participant 1: I'm back in the world.

Interviewer: Yay. So this was about the interaction that we had.

Participant 1: Yeah. Cool. Put the core back on the shelf so I don't lose it. And I'll put the book back on the shelf so I don't leave it untidy. The problem with using mappings to real world things is I feel like I have to do what I would do at home, which is, you know, put it back.

Interviewer: Yeah. Nice and tidy. Right?

Participant 1: Nice and tidy. Cool.

Post-Test Interview - Participant 1

Interviewer: On a scale of 1 to 10, how intuitive was interacting with the miniature library and scaling books? What felt natural or confusing?

Participant 1: So it felt natural because the paradigm of books being on a shelf is something I'm familiar with, so I know that I can grab it. The scaling up is familiar because, you know, grabbing and stretching things is natural and it's very common with everything we do. The fact that I couldn't interact with the book beyond that didn't confuse me, but it was, I guess, a missed opportunity because my natural assumption would be I would open the book and either read it or open the book and then I appear in the world, and then maybe closing the book would take me back out of the world. So having that thing that is the menu, the way of entering and exiting worlds, would feel more natural than a disconnected thing. Also, if I use the book on the portal, then I want to portal to that book's world or something, rather than a separate cube.

Interviewer: Exactly. That's one of my future plans actually. Because this was a kind of prototype, basically early versions, but the idea was to connect the book to the world.

Participant 1: Because when you were like, "oh, just throw the book away, it doesn't mean anything," it meant that there was no connection with the book. After selecting the book, there was no other thing that I was using to actually interact with it. So even like getting the book and the cube and smushing them together, which is something I tried, taking me to the world and then removing that, taking me out... Having the desk, the cube, and the book as separate objects was a bit too much. There was a bit of disconnect there in the interaction.

Interviewer: Got you. Got it. Okay, that's a good evaluation. So did the portal system make sense to you? How clear was the connection between cube and the teleportation pad?

Participant 1: Well, the fact that they were physically put in the same space or similar space made sense. They were called Portal Dock and Portal Cube. So I knew that they were linked together by where they are in the naming. Though again, my first thought was to put the book on the portal dock. So I really feel like the cube itself is probably the bit that stood out as less connected than everything else.

Interviewer: Okay. So the text did not help as much?

Participant 1: It did, but there wasn't anything clearly explaining saying, "put the cube on the dock to teleport worlds" or something.

Interviewer: Okay, got you. So compared to realistic book grabbing from a shelf, did this VR-only approach feel more engaging or different?

Participant 1: It's hard. I would say it's slightly less engaging because there didn't seem to be much of a purpose of grabbing the book. So there's that disconnect from like, okay, I've got the book now, what? Whereas normally I'd pick it up, open it, and read it. But definitely the XR world, there's a lot more you can do with that, especially with the idea of exploring the worlds of it. I think that's pretty cool.

Interviewer: Yeah. I had actually taken the mini library books idea from the feedback you gave in prototype one. You said like a pocket library or something where you can pull out and read. So I was like, okay, let's try doing that for this one. So I just miniaturized the whole library.

Participant 1: And that was good. I wasn't searching for any books. They were all there in front of me. I could easily move between them, which I think was good.

Interviewer: Yeah. So I was not able to add the book opening gesture because there were problems with the hinge movement and everything. So it was kind of confusing for me. So I just was like, okay, let's not mess it up.

Participant 1: Yeah.

Interviewer: So, yeah, that's what my interaction was. And my testing. If you can fill out a form for me.

Participant 2 Transcript

Interviewer: OK, so you're in the world right now. You can use both the controllers. Can you fix it?

Participant 2: Happy. I think it's this thing. You need to tighten it, I guess. Yeah, this is better.

Interviewer: Better?

Participant 2: Yes, thank you.

Interviewer: Okay. So right now you are in a study space. In front of you, what can you see? Explore the study space and find the library and try to prepare a book for reading.

Participant 2: Okay. So right now, I can see I'm in the library. I can see a table, a guitar, a chair, something like that, and then I can see a community library.

Interviewer: Yes.

Participant 2: So I'm going to move forward to the library. Okay. And then I can see a lot of cabinets, or I don't know what it's called, with a lot of books.

Interviewer: Yeah.

Participant 2: And I'm just going to try to grab one by moving closer. Okay, now I'm grabbing it.

Interviewer: You have grabbed it? So it's a mini book right now. What can you do to make it readable?

Participant 2: So I'm just trying to expand it. Oh, I can expand it. Yes, I just made it bigger.

Interviewer: Yes. So you have a big book right now. A really big one. Okay. So now that you have completed that, can you keep the book in one hand and find the portal core? Do you see some things around? Do the texts help you?

Participant 2: Yeah, so I can see there is a slightly little pink square, and then on top of it it says portal dock. Can you go towards the other side? There should be a portal core.

Interviewer: So, okay, I'm just going to grab the... And then I can see a green cube on top of it called portal core.

Participant 2: So what do you think this cube does and how would you use these two elements together? The portal core and portal dock?

Participant 2: Assuming based on the description, it's just going to teleport me to other worlds or the library and then I can combine it with the books and I can go into the book's world or something like that.

Interviewer: Yeah, okay try that.

Participant 2: So I'm just going to put the book into the cube. Okay. So I'm just going to try to grab... Really? Okay. I don't know. Okay, so I'm trying to smush it.

Interviewer: Okay, so you're trying to smush it? There's a portal dock there. Can you see the portal dock?

Participant 2: Yes.

Interviewer: How do you think these elements can interact together?

Participant 2: Ah, I see. So this one is for teleportation? So let's see. I'm just going to grab the green cube and then put it in the pink dock.

Interviewer: Yes.

Participant 2: It teleported me to another dimension.

Interviewer: Yes, yes.

Participant 2: I feel like a lot of trees right now. Yeah, yeah, yeah. So that's it.

Interviewer: Okay, so if you want to come back to the library, what do you think you can do?

Participant 2: So I'm just going to... Oh, okay, I can see pink teleportation. Yeah. So what I can do is just grab the cube and then drop it down to this one. Yeah, I'm back to the library.

Interviewer: Awesome. Awesome. So you were able to complete all the tasks?

Participant 2: Oh, yeah.

Post-Test Interview - Participant 2

Interviewer: So on a scale of 1 to 10, how intuitive was interacting with the miniature library and scaling of books? What felt natural or confusing?

Participant 2: Okay, so I'm going to scale it as 8. So what was very natural for me is when we are grabbing the book and then trying to expand the book, because, you know, it's just the same as when you're using a smartphone and you zoom it. But after that, it's very confusing for me. My first thought was that to teleport to the dimension, I need to mix the book with the green cube, but actually we need to mix the pink dock with the green cube. After I read it a bit, I know what to do, so I just needed a little bit more guidance.

Interviewer: Yeah, yeah, yeah. So the text helped you, but it should have been a bit more specific, I guess.

Participant 2: Yeah, more specific about what to do.

Interviewer: Okay, so did the portal system still make sense to you? How clear was the connection between the cube and the teleportation pad?

Participant 2: I like it. So when you put it, it just brings you back to you and the way you did it, there is physical interaction with your body, so you just feel like a little bit of dropping down, something like that. I like that.

Interviewer: That's good. But?

Participant 2: But I think instead of just dropping the cube, I feel like it's more easier or natural if when you have a big teleportation pad, you just walk in.

Interviewer: Okay, yeah, yeah, yeah. Got it, got it. Interesting. So compared to realistic book grabbing from the shelf that we do in real life, did this VR-only approach feel more engaging or different? Why?

Participant 2: I think it's the same actually. Because in the library usually you can see a lot of collections of books with a lot of covers, and then you grab that with your hand. So I feel like it's similar. That's why when I did it, I know that this is how you grab it, because it's just the same as what we do in the library. Something that's very good.

Interviewer: Okay. Thank you for your interaction with my project.

Participant 2: Okay.

Participant 3 Transcript

Interviewer: Let me explain to you quickly what the idea is. So it's basically redesigning Kindle in a VR version. And what I basically want to test is the intuitiveness and effectiveness of VR-native spatial manipulation and some teleportation things that can happen in VR. And understand whether the users can understand and successfully interact with non-realistic affordances from real life, you know. So, okay, I will give you some tasks. You can try and do that. Use the controller. This is the left one, this is the right one. I'll be using Think Aloud protocol for this. So hopefully you can just speak out what's going on.

Interviewer: Explore the study space, find the mini library and try to prepare a book for reading. You can use the controller to move around. I have controller-based movements. I don't have free movement.

Participant 3: I'm not sure how to move. Are you using the thumbstick?

Interviewer: No.

Participant 3: Yeah, I am. Oh, this one. Oh, my God, my head. I suddenly... Oh, my God. Okay, yeah, I found the books. I'll just try and grab it. Okay. Yeah, grabbed it.

Interviewer: So what can you do with the book? What do you notice about the books? How would you make them readable?

Participant 3: It's like a small thing right now. I can maybe try to open it. Can I open it? Oh, I can. Yeah. Ooh, I can do... like I can increase the size and decrease the size.

Interviewer: Yes. So basically, it's like that.

Participant 3: I know what book this is. Yeah. I'm not able to put the cover on properly.

Interviewer: Okay. So now, find the portal core and use the portal dock to travel to a different reading environment. So what do you think the cube on the side does? Can you see what all things are on the side?

Participant 3: Yeah, yeah. So there are two things on the side. So there must be a portal core and portal dock.

Interviewer: Yeah. And you understand what the system is and how they interact?

Participant 3: Click here to activate. Okay, so I might have to grab the green one and put it on the pink one.

Interviewer: You can try and interact with that.

Participant 3: Oh, don't touch. Oh, my God. Ooh. Are these sounds?

Interviewer: Okay. So, you need some good environment?

Participant 3: Yeah, I need dinner. A garden. A weed garden.

Interviewer: Weed garden. Yeah, basically. Okay. So, if you want to go back to the library, if this is like a reading environment you have, you have benches and chairs. So how would you go back to the library?

Participant 3: Oh, my God. Can I turn around in any way?

Interviewer: Just go ahead, yeah. You can use this kind of thing, like, you know.

Participant 3: Okay. I know, but yeah. Continue.

Interviewer: Okay, so how would you go back to the library?

Participant 3: Oh, I see that pink thing again. I'm assuming I just put it again like this. Yeah, I'm in the library again.

Interviewer: Yes. Awesome. So that was the interaction that I had for now.

Participant 3: Yeah, that's really cool.

Interviewer: You can take it off.

Participant 3: I think that else is fine, but that motion sickness. Yeah, you know, the speed is fast, so you just don't know. And the first time I did it, I just... it hit me in the face.

Interviewer: Got it. That's cool. Okay. So I have some post-test interview questions.

Post-Test Interview - Participant 3

Interviewer: On a scale of 1 to 10, how intuitive was interacting with the miniature library and scaling of books? What felt natural or confusing?

Participant 3: Ooh, that thing at the start when I didn't hold the books, it was confusing how that can be. So I just assumed you could click on it and some digital sort of interface would open and you can just read on it. But I feel like what you did was way better because I didn't expect it and I genuinely enjoyed it because I can just, if I am bold and I have space, I can extend the size of it to the room and like read while walking on the book. And it doesn't matter. So I think I quite enjoyed that part.

Interviewer: That's interesting.

Participant 3: I would like, because sometimes I really like books and finish books in one day. So I am a crazy junkie for it and I would really enjoy if I can just see all my miniature books and pick up one and ooh, just read those words and do this. I would genuinely enjoy it.

Interviewer: Amazing, amazing. So did the portal system make sense to you? How clear was the connection between the cube and the teleportation pad?

Participant 3: At first glance, I didn't understand because it just felt like something that was there, like a table or chair or something. You put your book on or it might show you something. Like it might lead you to something. But that portal was pretty easy. Once you understand it, it's pretty easy to do. It's nothing confusing. It's nothing hard to understand, pretty easy. So the text was there, so that helped?

Interviewer: Yeah, text when text was there, yeah, pretty easy. You put this on that and then after that you understand once, then you just see the pink one and you know.

Interviewer: Okay. So compared to realistic book grabbing from the shelf, did this VR-only approach feel more engaging or different? Why?

Participant 3: It felt different. It felt engaging. But I would do it for the fun of doing it and I would honestly make it my own personal library. I wouldn't put new books in it, but I would love to see all my books right there and me just seeing it every time I want to see it or really read it. That would be my personal space. So I would treat it like that. I would treat that as my sanctuary. I wouldn't treat it as a Kindle. I would treat it as my personal library in Kindle.

Interviewer: So yeah, yeah. That was basically the idea. And the main idea was you have different scenes where you can teleport to and just enjoy the immersive environment for the day. Something like that.

Participant 3: Okay. So thank you for this. Can you help me fill out this form?

Interviewer: Yeah. Should I scan it?

Participant 4 Transcript

Interviewer: Let me explain to you what the idea is basically. Just one second. Yeah, so basically what I want to test is VR-specific interactions and the intuitiveness and effectiveness of VR spatial manipulation and things that can only be done in VR. So I want to see how they are different from the real world and how is it making it more interesting, engaging, or more problematic in general. So right now, can you see a study space in front of you?

Participant 4: Um, study space? Like, as in the whole world?

Interviewer: Yeah, so there is a study space in the room. You can go to it with the controllers.

Participant 4: Was that the table or the mini library?

Interviewer: Yeah, the study space with the mini library.

Participant 4: Okay, right. Yeah.

Interviewer: So explore the study space, find the mini library, and try to prepare a book for reading. Can you see some things?

Participant 4: Yeah, I can see those little books on the shelf.

Interviewer: So what do you think can be done about these books? They're small right now.

Participant 4: I assume I can grab it, right? You can go to it. You can go with the controllers. Yeah. Okay. Got it.

Interviewer: Did you grab the book?

Participant 4: Yes.

Interviewer: It's like mini size right now. What do you think can make it to a normal size? What do you think can be done for that?

Participant 4: Would it be the dock I saw earlier?

Interviewer: That's a different interaction. Right now you have a book in your hand. It's smaller.

Participant 4: Oh, can I maybe... Ah, there we go.

Interviewer: Yeah. Yeah.

Participant 4: That's a big book. Cool. Sorry, can I try to grab a different one again?

Interviewer: Yeah, okay.

Participant 4: So, can I grab it from further back or do I need to go and grab it like a normal library?

Interviewer: You can go and grab it like a normal library. Okay.

Participant 4: Okay. That makes sense. That's one, two, three... Fun? Fun? Okay.

Interviewer: So now you can leave that. And let's find the portal core and use it with the portal dock to travel to a different reading environment. So what do you think the cube is? Can you go to the side, there are some things kept there. What do you think they are?

Participant 4: The cube? There are some things on the side of the library, like the portal dock and portal core.

Interviewer: Yeah.

Participant 4: There's a guitar. Does that do anything?

Interviewer: No, go inside.

Participant 4: Okay. So it's the portal dock and a shelf with a core on it?

Interviewer: Yes. Yeah. What do you think it does? Can you read the text or something?

Participant 4: Yeah. I'll do teleportation.

Interviewer: Okay, so it takes me somewhere. Try that.

Participant 4: So I should grab it from closer, yeah, yeah. Ooh.

Interviewer: Awesome. So you're there?

Participant 4: Yeah.

Interviewer: What do you think? Where are you right now?

Participant 4: This is like a zen garden.

Interviewer: Mm hmm.

Participant 4: Okay. It's very chill.

Interviewer: The environment? Yeah. Interesting. So there's another dock here. Is that for me to go back?

Participant 4: Oh, yeah. What do you think? How would you return to the library?

Participant 4: Oh, try it. I have to reach it. Oh, my God. I can't.

Interviewer: You can go up. No, no, but with this one? Yeah. You can stand up. I think you are sitting right now.

Participant 4: Ah, there we go. Yeah. Cool.

Interviewer: Okay, so try going back to the library.

Participant 4: Oh, there we go. Yeah.

Interviewer: Awesome. You're back.

Participant 4: Oh, it's nice.

Interviewer: Is that it?

Participant 4: Yeah, that's all the interaction that we had.

Post-Test Interview - Participant 4

Interviewer: Okay, now, if you can help me with some post-test interview. On a scale of 1 to 10, how intuitive was interacting with the miniature library and scaling of books? What felt natural or confusing?

Participant 4: I'd say 8 or 9.

Interviewer: 8 or 9?

Participant 4: I think it's pretty natural. Everything makes sense.

Interviewer: Okay. I just need clarification. 8 or 9 on the higher end or lower end?

Participant 4: The good side.

Interviewer: Okay, good side. Okay, okay, okay.

Participant 4: So, I think it's really good. I need some explanation as in how everything works exactly. And also, I can only grab things when I'm really close. That's the thing that slowed me down a little bit. Other than that, everything else worked really well. That was good.

Interviewer: So did the portal system make sense to you? How clear was the connection between the cube and the teleportation pad? Were the instructions written there helpful?

Participant 4: Yeah. It made sense.

Interviewer: Without it would be a struggle?

Participant 4: Yeah, yeah, yeah, that's true, that's true, that's true.

Interviewer: So compared to realistic book grabbing from a shelf, did this VR-only approach make it more engaging or just different? Why?

Participant 4: I think it made it a little bit more engaging, just because of the environment change. Where I can actually teleport to a different room to read the book. That was really fun because you can't really do that in the real world.

Interviewer: Yeah, yeah, that's true, that's true. So can you help me fill out a form?

Participant 5 Transcript

Interviewer: Okay, let me start with the concept. So I want to explain it to you. You know the concept, right?

Participant 5: Yeah.

Interviewer: So I was just trying to identify the intuitiveness and the effectiveness of spatial manipulation and try some things out that can't be done in real life. To understand whether these can enhance the perceived value of immersive reading environments or something. Okay, so let's start with the first task. Explore the study space, find the mini library, and try to prepare a book for reading. Can you just speak out loud as well? Because I'm using the Think Aloud protocol.

Participant 5: I can clearly see the bookshelves and I can see they have cute mini books. I'm able to scale them. Okay. I'm just trying to play around with a couple of books.

Interviewer: Awesome. So you found out that it's a scaling thing that can make it real size and help you?

Participant 5: Yeah, based upon my past experiences, I was able to figure it out.

Interviewer: Yeah, okay. So that's one interaction. Now, let's go to the second one.

Participant 5: Okay, I'm... Okay.

Interviewer: What do you think? There's on the side, there are some things. What do you make sense of them? How do they work?

Participant 5: Okay. So I can see a portal dock placed on a platform. Okay, maybe I can activate teleportation. I can have a cube. I'm able to grab it. Maybe I need to do something with the platform, or maybe I need to stand on it or... Oh, I tried putting my cube on it. Okay. And I teleported to another place.

Interviewer: Okay, okay.

Participant 5: There's trees all around.

Interviewer: Yeah. And then I can see a similar platform, which I feel that if I touch the cube again, I'll go back.

Participant 5: Okay, yeah. There's a table as well. I'm not sure why this table is here. Maybe I can put my cube on it, I don't know what's the point.

Interviewer: So, how would you try to return to the library?

Participant 5: Yeah, I think I have a similar platform. I can check and I am back. My cube is back with me. Yeah. So you're back in the library?

Interviewer: Yeah, I'm back in the library.

Participant 5: Awesome. You were able to do all the interactions?

Interviewer: Yeah, thank you. Thank you.

Post-Test Interview - Participant 5

Interviewer: Okay, so I would like to ask you some post-test interview questions. On a scale of 1 to 10, how intuitive was interacting with the miniature library and scaling books? What felt natural or confusing?

Participant 5: Okay, so initially for me was that I have these books that I knew that I can grab them. And I have these other objects like guitar, I have this candle as well, so I thought maybe I can do something with them as well. But when it comes to the books, I figured out that, okay, these are the books and I can do something with them. So intuitively, I grabbed a book and I tried scaling it up and down. And I was trying to open it, but I couldn't open it. So, yeah, that was all.

Interviewer: So, did the portal system make sense to you? How clear was the connection between the cube and the teleportation pad?

Participant 5: The connection was, I would say it was not intuitive. It is not something that I can do on my own. I think you need some past experience or some guidance to figure that out.

Interviewer: So the text helped with that?

Participant 5: Text helped me do that, and since the platform is a bit raised, so I thought maybe I can stand up. I mean, usually, I thought that probably I need to place something on it.

Interviewer: Okay, okay. That's what I thought.

Interviewer: So, compared to realistic book grabbing from a shelf, did this VR-only approach make it more engaging or different, and why?

Participant 5: It is different because I have this cute mini library in front of me and I can grab the books and I can scale them up and down. But, yeah, the experience is different. But if I have to go to a real library, I just have to scroll through all the books. So if I can have a filtering option as well, because if I have many books in my library, then too many shelves and too many books might make me feel cluttered.

Interviewer: What you got is... Thank you for this testing.

Participant 5: You're welcome.

Google Form Results:

Timestamp	Finding and grabbing mini books	Scaling books to readable size	Locating PortalCore and PortalDock	Using the portal system to teleport	Rate the intuitiveness of the interaction (1 least 1) Mini Library concept	Rate the intuitiveness of the interaction (1 lea 2) Book scaling gesture	Rate the intuitiveness of the interaction (1 lea 3) Portal teleportation system
23/10/2025 10:37:27	Easy	Very Easy	Easy	Neutral	5	5	3
23/10/2025 11:09:06	Very Easy	Easy	Very Easy	Neutral	4	4	4
23/10/2025 11:35:24	Very Easy	Very Easy	Easy	Easy	5	5	4
23/10/2025 11:54:08	Easy	Easy	Very Easy	Easy	4	4	4
23/10/2025 12:24:28	Easy	Neutral	Neutral	Neutral	4	4	3

Which interaction style do you prefer for VR r	What made the VR-native interactions (mini li	Were the text labels (Mini Library, PortalDock,	What would you change to improve these inte	If you could add one feature to this VR readin
Both have value for different contexts	The customisabilty of the world makes the possib	Somewhat helpful	Make the cube dock and books more linked	Opening books to interact with it.
Realistic approach (grabbing full-size books from	It resemblance the actual library in the real world	Very helpful	The teleportation needs more instructions	Change the portal feature into a walk in instead of
Both have value for different contexts	Valuable because I can make it my personal librar	Very helpful		Show how an open book looks like maybe
Realistic approach (grabbing full-size books from	Teleporting to different area was fun	Very helpful	Raycaster to grab item instead of only grab from	Music perhaps
VR-native approach (miniature portable library wit	Benefits : I was able to see my entire library infron	Very helpful	I would probably make teleportation platform mo	Flipping pages of the book

Link:

https://docs.google.com/spreadsheets/d/1jgBYd1cjj-mwCltYcnQLQ7z4SpcmHSN-0wl-7zNTaxk/edit?usp=sharing