XR Kindle Redesign: Prototype 2 Evaluation Report - VR Implementation

Objective and Validation Metrics

This evaluation aimed to test **the effectiveness of VR-native interactions for book selection, environmental control, and spatial workspace customization** using Meta Quest headset with full VR implementation. The test sought to discover whether Meta Quest controller interactions provide intuitive, comfortable, and engaging methods for core reading preparation tasks.

Target Success Criteria:

- **Task 1 (Book Grab)**: >80% success rate, <45 seconds completion time
- **Task 2 (Audio Control)**: >90% discovery success, <30 seconds interaction time
- **Task 3 (Workspace Customization)**: >70% multi-object manipulation success, <60 seconds arrangement time
- **User Experience**: Naturalness rating >7/10, minimal discomfort, positive concept validation

Critical Testing Constraint: Due to technical limitations with VR locomotion implementation and testing session time constraints, only 1 participant (P1 - tutor) completed the evaluation protocol, falling significantly short of the planned 5-participant minimum.

Results

Technical Implementation Status

Component	Implementation Status	Functionality
Meta Quest Integration	✓ Successful	Headset connection, visual rendering working
Controller Tracking	✓ Successful	Hand movements and head rotation functional
VR Locomotion	✗ **FAILED**	Unable to walk/move using controllers
APK Deployment	Partial Success	Required Sidequest workaround, not direct build

Book Grab Interaction	✓ Successful	Physics-based grabbing functional
Poke Audio Control	✓ Successful	Interaction detected, audio playback working
Object Scaling	✗ Not Tested	Unable to reach workspace due to movement constraint

Participant Testing Results (P1 - Tutor)

Task 1: Environmental Assessment & Book Selection	**Task 2: Environmental Audio Control**	**Task 3: Workspace Customization**
• **Completion Time**: 15 seconds (Target: <45 seconds) **ACHIEVED** • **Success Rate**: 100% (1/1 successful) • **Naturalness Rating**: 8.5/10 (Target: >7/10) **ACHIEVED** **Think-Aloud Observations:** • *"This is very intuitive, it's just like picking up a real book"* • Participant immediately understood the interaction paradigm • Successfully grasped book on first attempt without hesitation • Commented that environment clearly communicated concept purpose	• **Completion Time**: 25 seconds (Target: <30 seconds) **ACHIEVED** • **Success Rate**: 100% (tested via Meta simulator on laptop) • **Discovery**: Located poke target without guidance **Think-Aloud Observations:** • *"I'm not sure if the audio is playing... let me move closer to hear"* • Participant located audio controller screen independently • Interaction registered successfully, audio played as intended • **Critical Feedback**: Uncertainty about interaction state - needed to confirm audio was playing by listening near laptop • Suggested adding visual/text UI indicators for interaction feedback	• **Status**: **INCOMPLETE** - Could not test due to locomotion failure • Participant unable to navigate to workspace area • Object scaling functionality not testable in Meta simulator fallback • **Validation Status**: UNVALIDATED

Post-Test Interview Summary

Q1: Book Grabbing Naturalness (1-10)
Rating: 8.5/10 - "Very natural to just pick up a book, aligns with real-world interaction"

Q2: Poke Interaction Intuitiveness
Response: Interaction was visible and functional, but better UI with text indicators would improve feedback clarity

Q3: Object Manipulation Comfort
Response: Concept of scaling and environment creation is interesting, expressed desire to experience full functionality

Q4: Spatial Understanding & Comfort
Response: No issues - participant is experienced VR user, found space comprehensible

Q5: Workspace Meaningfulness
Response: "Would like to see and use this function for how it works" - positive validation of concept

Q6: Unique VR Value
Response: "Can help have better immersive experience, even non-readers would want to try this"

Q7: Interaction Changes
Response: "These are basics that can be polished better - continue working on it"

Q8: Additional Gestures
Response: Continue developing existing interactions before adding new features

Analysis/Insights

Successfully Validated Elements

VR Book Interaction Paradigm: The physics-based book grabbing received exceptional feedback (8.5/10), validating that translating real-world book selection to VR creates intuitive, natural experiences. The 15-second completion time (67% faster than target) demonstrates strong usability.

Spatial Audio Integration: Successfully implemented using Meta SDK Unity Event Wrappers and Pointable components (see Appendix A for technical implementation). The poke interaction registered correctly, proving the technical architecture is sound.

Concept Validation: Despite technical constraints, the participant clearly understood the reading environment customization concept and expressed genuine interest in experiencing the full implementation.

Critical Failures Requiring Immediate Resolution

VR Locomotion System: The complete failure of controller-based movement fundamentally undermined the testing protocol. This prevented validation of spatial navigation, workspace discovery, and multi-location interactions - core elements of the immersive reading experience.

Deployment Pipeline: Inability to directly build and run APK files forced reliance on Sidequest workaround, introducing unnecessary complexity and potential version control issues.

Interaction Feedback Systems: The audio control interaction lacked clear state indication, causing user uncertainty about whether the system responded to input.

Methodological Limitations Impact

Single Participant Data: With only 1 tester, no patterns or trends can be identified. Individual preferences and experience level (advanced VR user) may not represent target user base. Statistical significance is impossible with n=1.

Simulator Fallback Compromise: Testing Task 2 via Meta simulator on laptop fundamentally changed the interaction modality from immersive VR to desktop observation, invalidating direct comparison to intended VR experience.

Incomplete Feature Testing: Task 3 remains completely unvalidated - the workspace customization concept that differentiates this project from basic VR reading apps was untestable.

Evaluation of Aims

PARTIALLY VALIDATED - The evaluation achieved mixed results across objectives:

Achieved Targets	Critical Failures	Uncertain Elements
• Book grab interaction: ✓ Intuitive (8.5/10), Fast (15s), Successful (100%) • Audio control: ✓ Discoverable, Functional (25s completion) • Concept interest: ✓ Strong positive validation from experienced evaluator	• VR locomotion: ✗ Complete system failure prevented core spatial navigation testing • Participant recruitment: ✗ Achieved 20% of minimum target (1/5 participants) • Workspace customization: ✗ Completely untested due to movement constraint	• Multi-object manipulation usability • Spatial arrangement coherence in 3D workspace • User comfort during extended VR sessions • Effectiveness for non-experienced VR users

	• Scaling interaction: ✗ Unvalidated in VR environment	

Concept Iteration

Critical Priority Fixes (Must Complete Before Next Testing)

1. VR Locomotion Implementation

- **Issue**: Controller movement non-functional despite head/hand tracking working
- **Solution**: Implement continuous movement using Meta XR All-in-One SDK locomotion components
- **Validation**: Test movement in multiple build environments before participant testing
- **Timeline**: Complete and verify 48 hours before next testing session

2. APK Build Pipeline Optimization

- **Issue**: Direct build fails, requires Sidequest workaround
- **Solution**: Troubleshoot Unity build settings, verify Meta Quest developer mode configuration, ensure proper SDK integration
- **Validation**: Successfully deploy test build directly from Unity to headset
- **Timeline**: Resolve before implementing locomotion fixes

3. Interaction Feedback Enhancement

- **Issue**: Audio control lacks visual confirmation of interaction state
- **Solution**: Add UI text panel showing "Audio Playing" / "Audio Stopped" states, implement visual glow/color change on poke target activation
- **Implementation**: Create Canvas UI element near audio controller, connect state changes to Pointable Unity Event Wrapper events

Enhanced Features (Post-Locomotion Fix)

4. Workspace Navigation Guidance

- **Addition**: Visual waypoint or highlighted path directing users from library to workspace
- **Rationale**: Ensures users discover workspace area for Task 3 testing

5. Object Manipulation Tutorial

- **Addition**: Brief in-VR instructional overlay explaining grab/scale gestures before Task 3
- **Rationale**: Reduces learning curve for complex multi-gesture interactions

6. Performance Optimization

- **Analysis**: Monitor framerate during testing to ensure consistent VR comfort
- **Target**: Maintain 72fps minimum on Meta Quest 2/3

Reflection on Concept/Design/Methodologies/Future Testing

Technical Implementation Lessons

Locomotion as Foundation: This evaluation starkly demonstrated that spatial navigation is not an optional feature for spatially-distributed VR experiences - it is fundamental infrastructure. Testing any multi-location interaction pattern without functional movement is futile. Future prototypes must validate core VR systems (locomotion, hand tracking, controller input) through isolated technical tests before integrating into full experiences.

Simulator Limitations: While Meta simulator provides rapid iteration for some interactions, it cannot substitute for actual VR testing of spatial experiences. The simulator's inability to test scaling and the qualitative difference in experiencing audio control highlight that simulator validation must always be followed by headset verification.

Build Pipeline as Testing Blocker: The APK deployment issue consumed valuable testing time and introduced uncertainty about build consistency. Establishing a reliable, repeatable deployment process is as critical as feature implementation - technical debt in deployment infrastructure directly undermines evaluation effectiveness.

Methodological Failures and Recovery Strategies

Participant Recruitment Crisis: Achieving only 20% of the minimum participant target represents a fundamental evaluation failure. The primary contributing factors were:

1. **Technical Issues Deterrence**: Locomotion failure became visible to waiting participants, likely discouraging participation
2. **Time Management**: Setup and troubleshooting consumed time allocated for multiple testers
3. **Insufficient Backup Planning**: No contingency for technical failures beyond "backup headset"

Future Participant Recruitment Strategy:

- **Pre-Session Technical Verification**: Run complete test protocol solo 1 hour before testing window, document any failures

- **Explicit Scheduling**: Pre-schedule 5 specific participants via direct communication rather than relying on opportunistic recruitment
- **Rolling Start Times**: Schedule participants at 7-minute intervals to accommodate 5-minute test + setup buffer
- **Transparent Communication**: Inform scheduled participants of technical constraints upfront so they understand any limitations

Evaluation Design Improvements

Modular Testing Approach: Future testing plans should structure tasks as independent modules that can be evaluated even if other systems fail. For example, book grabbing could be tested in isolation even when locomotion fails, but workspace customization could not. Designing fallback testing protocols for partial system functionality would have salvaged more data.

Quantitative Baseline Establishment: While the 15s and 25s completion times provide data points, without multiple participants, we cannot establish distribution, variance, or confidence intervals. Future testing must prioritize achieving minimum participant counts over feature comprehensiveness.

Mixed-Methods Validation: The think-aloud protocol proved valuable for capturing qualitative insights even from a single participant. Future testing should maintain this approach while adding structured quantitative instruments (SUS scale, NASA-TLX for workload) that provide comparable data even from small samples.

Design Philosophy Validated

Real-World Fidelity vs VR Capabilities: The successful book grabbing interaction (8.5/10 rating) validates that real-world interaction metaphors translate well to VR. However, P1's suggestion to "not limit ourselves" and "polish the basics" suggests a tension between familiar interactions and exploiting VR's unique affordances. The next iteration should explore hybrid approaches - maintain intuitive real-world grabbing while adding VR-specific enhancements like gesture-based library browsing or floating UI panels.

Interaction Feedback Criticality: The audio control uncertainty ("not sure if audio is playing") reveals that VR's immersive nature paradoxically creates feedback ambiguity. In desktop apps, visual confirmation is sufficient; in VR, users need multi-modal feedback (visual + audio + haptic) to confidently understand system state. This principle must extend to all interactions.

Next Testing Session Requirements

Technical Validation Checklist (Complete 48 hours before testing):	**Participant Recruitment Plan**:	**Expanded Testing Protocol**:	**Data Collection Enhancement**
• VR locomotion functional in headset (continuous movement + snap turning) • Direct APK build and deployment successful • All 3 tasks completable solo without technical intervention • Backup headset tested with identical build • Scene optimized for consistent framerate (>72fps)	• 5 participants scheduled with confirmed time slots • Reminder messages sent 24 hours before testing • Testing environment prepared with sanitization supplies, recording equipment, observation forms	• Add VR experience pre-screening (novice vs experienced users) • Include SUS usability scale for quantitative comparison • Test complete feature set including workspace customization and object scaling • Document locomotion comfort specifically (potential motion sickness trigger)	: • Video recording of headset view + participant hands for gesture analysis • Standardized observation form capturing interaction attempts, errors, recovery strategies • Post-test comparative ranking of all three interaction types

Learning Outcomes

This evaluation, despite its technical failures and limited participant pool, provided critical insights that strengthen the project's foundation:

1. **Validated Core Interaction**: Book grabbing is intuitive and fast, proving the concept's basic viability
2. **Identified Infrastructure Gap**: Locomotion is non-negotiable for spatial VR experiences
3. **Revealed Feedback Needs**: VR interactions require richer state communication than desktop interfaces
4. **Highlighted Recruitment Criticality**: Technical polish directly impacts participant willingness to engage
5. **Demonstrated Concept Interest**: Even with constraints, the reading customization concept resonated positively

The path forward is clear: resolve locomotion and deployment issues, recruit participants proactively, and maintain the validated interaction quality while expanding to untested

features. The next iteration must deliver the complete, polished VR experience that this evaluation could only partially demonstrate.

Appendix: Testing Data and Technical Implementation

Appendix A: Technical Implementation - XR Poke and Spatial Audio

Implementation Overview

The audio control system was implemented following Meta SDK Unity Event Wrapper methodology, integrating spatial audio with poke interaction through the following technical architecture:

Components Used:

- **Meta Spatial Audio Building Block**: Provides 3D positional audio rendering
- **Poke Interaction Building Block**: Creates finger-touch responsive surface
- **Pointable Unity Event Wrapper**: Bridges Meta SDK interactions to Unity events
- **Custom AudioPlayer Script**: Manages audio playback state

Implementation Steps:

1. Added Spatial Audio building block from Meta Tools → Building Blocks → Audio category
2. Configured Audio Source component with audio clip, disabled Play On Awake and Loop
3. Added Poke Interaction building block, positioned for comfortable reach distance
4. Attached Pointable Unity Event Wrapper to "[BuildingBlock] ISDK_PokeInteraction" child object
5. Connected Pointable reference to Poke Interactable component
6. Created AudioPlayer.cs script with PlayAudio() and StopAudio() methods
7. Connected When Selected() event to AudioPlayer.PlayAudio() function

AudioPlayer Script Structure:

```
using UnityEngine;

public class AudioPlayer : MonoBehaviour
{
   public AudioSource audioSource;

   public void PlayAudio()
   {
      audioSource.Play();
```

```
    }

    public void StopAudio()
    {
        audioSource.Stop();
    }
}
```

This architecture enables scalable event-driven audio control where any interactable type (poke, grab, ray) can trigger audio responses through Unity's event system without custom interaction code.

Appendix B: Participant 1 (P1 - Tutor) Testing Session Data

Testing Plan

XR Kindle Redesign: Prototype 2 Testing Plan - VR Implementation

Project Pitch
This project is Amazon Kindle but using XR for creating fully immersive, customizable reading environments where users leverage Meta Quest hand tracking and controller interactions to navigate 3D library spaces, manipulate environmental elements through spatial gestures, and construct personalized reading workspaces that adapt to their preferences in real-time.

Testing Objective
From my above concept, I have identified the effectiveness of VR-native interactions for book selection, environmental control, and spatial workspace customization that needs testing. This test aims to discover whether Meta Quest controller and hand tracking interactions provide intuitive, comfortable, and engaging methods for users to perform core reading preparation tasks, and how successfully users can leverage VR's spatial affordances to create personalized reading environments.

Testing Methodologies

This testing plan will use controlled task-based usability testing with think-aloud protocol and post interview, and quantitative performance metrics 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 provide comprehensive VR interactions that test the core assumptions of immersive reading environment creation through three distinct interaction paradigms. It features a fully navigable VR library with physics-based book grabbing using controller interactions, poke-interactable audio controls for environmental ambiance, and a workspace area with grabbable, scalable objects (picnic rug, modular tree components, basket) that users can spatially arrange to construct their ideal reading environment using natural VR gestures.

Data Collection Method

During the testing process, I will be recording screen capture of VR headset view, logging task completion times using stopwatch, documenting interaction errors and recovery attempts, capturing think-aloud verbal feedback through audio recording, and conducting structured post-test interviews with standardized questions to document comprehensive quantitative and qualitative results.

Testing Setup

- Meta Quest 2/3 headset fully charged and calibrated
- Unity prototype built and deployed to headset
- Screen recording software configured for headset mirroring
- Stopwatch/timer for task duration measurement
- Audio recording device for think-aloud and interview capture
- Observer notebook for behavioral annotations
- Post-test interview question sheet prepared
- Backup headset available in case of technical issues

Testing Process (Schedule/Time: 5 minutes per participant)
Pre-Test Setup (30 seconds)

Headset fitting and safety briefing - Ensure comfortable fit, explain VR safety, get verbal consent

Task Execution Phase (3 minutes)

Task 1: Environmental Assessment & Book Selection (60 seconds)

Instructions: "Take in your surroundings and describe what you see. Then use the controllers to go to a bookshelf and grab a book you want to read."

Success Criteria: User successfully navigates VR space, identifies library elements, and completes book grab interaction

Metrics: Time to complete grab, number of grab attempts, spatial orientation success

Think Aloud:

Observations & Quotes

User's thought process:

Notable quotes:

Struggles/Confusion points:

Task 2: Environmental Audio Control (45 seconds)

Instructions: "Look for the poke-interactable element that controls audio. Interact with it to test environmental sound control."

Success Criteria: User locates poke target, successfully triggers interaction, audio feedback responds appropriately

Metrics: Discovery time, interaction accuracy, user satisfaction with feedback

Think Aloud:

Observations & Quotes

User's thought process:

Notable quotes:

Struggles/Confusion points:

Task 3: Workspace Customization (75 seconds)

Instructions: "Navigate to the green workspace area. Grab the items on tables (rug, tree parts, basket), scale them as desired, and arrange them to create your ideal reading environment."

Success Criteria: User grabs minimum 2 objects, demonstrates scaling interaction, places objects in workspace area

Metrics: Object manipulation success rate, scaling interaction completion, spatial arrangement coherence

Think Aloud:

Observations & Quotes

User's thought process:

Notable quotes:

Struggles/Confusion points:

Post-Test Interview (90 seconds)

Post-Test Interview Questions

Interaction Effectiveness

Q1- Rate the naturalness of the book grabbing interaction from 1-10. What felt most/least natural about it?

Q2- How intuitive was the poke interaction for audio control? Did the visual feedback match your expectations?

Q3- Which object manipulation (grab/scale/place) felt most comfortable? Which was most challenging?

Spatial Understanding & Comfort

Q4- How comfortable did you feel navigating the VR space? Any disorientation or motion sickness?

Q5- Did the workspace customization feel meaningful? Could you envision reading in the environment you created?

Comparative Assessment

Q6- Compared to traditional reading apps, what unique value does this VR experience offer?

Q7- What would you change about these interactions to make them more intuitive?

Future Feature Validation

Q8- If you could add one gesture or interaction to enhance this reading preparation experience, what would it be?

Success Metrics & Evaluation Criteria

Quantitative Benchmarks

Task 1: >80% success rate, <45 seconds average completion
Task 2: >90% discovery success, <30 seconds interaction completion
Task 3: >70% multi-object manipulation success, <60 seconds for basic arrangement

Qualitative Indicators

Comfort: <2 reports of significant discomfort or motion sickness
Engagement: Positive verbal feedback during think-aloud
Intuitiveness: <3 attempts needed for core interactions
Spatial Coherence: Users can articulate their workspace design choices

Risk Mitigation & Additional Considerations

Technical Contingencies

Headset malfunction: Backup device ready for immediate swap
Tracking issues: Pre-calibrated guardian boundaries, adequate lighting
Performance drops: Prototype optimized for consistent framerate

Participant Comfort

Motion sickness: Immediate stop protocol if participant reports discomfort

Enhanced Data Collection (if time permits)

Error categorization: Distinguish between user error vs. system limitation
Preference ranking: Have participants rank interaction types by preference

Session Metadata

- **Date**: [Testing Date]
- **Duration**: Approximately 8 minutes (extended due to technical troubleshooting)
- **Testing Environment**: VR Headset (Tasks 1, partial) + Meta Simulator (Task 2)
- **Participant Experience Level**: Experienced VR user, familiar with Meta Quest systems

Participant Notes

Task 1: Environmental Assessment & Book Selection

Task Instructions Given: "Take in your surroundings and describe what you see. Then use the controllers to go to a bookshelf and grab a book you want to read."

Pre-Task Setup Note: Due to locomotion failure, researcher manually repositioned player near bookshelf in Unity before participant donned headset.

Think-Aloud Protocol Observations

Initial Environmental Assessment (0:00-0:05)

- P1: "Okay, I can see I'm in a library space... there are bookshelves in front of me"
- P1: "The environment is pretty clear, I understand what I'm supposed to do here"
- *Observed behavior*: Head turning to scan environment, natural orientation movements

Book Selection Process (0:05-0:15)

- P1: "Let me try grabbing this book... oh, that worked immediately"
- P1: "This is very intuitive, it's just like picking up a real book"
- P1: "The physics feel natural, it responds the way I'd expect"
- *Observed behavior*: Extended hand toward shelf, successful grip on first attempt, lifted book smoothly
- *Researcher note*: No hesitation or multiple attempts, immediate success

Post-Grab Reflection (0:15-0:20)

- P1: "Yeah, this aligns really well with real-world interaction"
- P1: "I can clearly see what this concept is about - creating a reading space in VR"

Notable Quotes:

- *"Very intuitive, it's just like picking up a real book"*
- *"Aligns really well with real-world interaction"*
- *"I understand what this concept is about"*

Struggles/Confusion Points:

- None observed for book grabbing interaction itself
- Movement constraint noted but not task-blocking due to manual repositioning

Task Completion:

- ✓ Success
- Time: 15 seconds
- Attempts: 1 (successful on first try)
-

Task 2: Environmental Audio Control

Task Instructions Given: "Look for the poke-interactable element that controls audio. Interact with it to test environmental sound control."

Testing Environment Note: Task conducted via Meta simulator on laptop due to locomotion constraint preventing navigation to audio control location in VR headset.

Think-Aloud Protocol Observations

Discovery Phase (0:00-0:10)

- P1: "Alright, I'm looking around for the audio controller..."
- P1: "I can see there's a screen or panel here"
- *Observed behavior*: Using mouse to look around simulator view, scanning environment
- *Researcher note*: Located audio control element without guidance

Interaction Attempt (0:10-0:20)

- P1: "I'm going to try touching this... poking at the screen"
- P1: "Okay, I touched it... but I'm not sure if the audio is playing"
- P1: "Let me move closer to the laptop to hear"
- *Observed behavior*: Performed poke gesture, looked uncertain about system response, leaned toward laptop speakers

Audio Confirmation (0:20-0:25)

- P1: "Oh yes, I can hear it now, the audio is playing"
- P1: "That's nice, it worked. The interaction registered"
- P1: "It would be helpful to have some visual feedback though"

Post-Interaction Reflection (0:25-0:30)

- P1: "The poke interaction itself is fine and visible"

- P1: "But I needed confirmation - maybe text saying 'Audio Playing' or a visual indicator"
- P1: "In VR without being able to hear the laptop, I wouldn't have been sure it worked"

Notable Quotes:

- *"I'm not sure if the audio is playing... let me move closer to hear"*
- *"The interaction is visible, but better UI with text to indicate would be good"*
- *"In VR I wouldn't have been sure it worked"*

Struggles/Confusion Points:

- **Interaction state uncertainty**: Unclear whether poke triggered audio playback
- **Feedback gap**: No visual confirmation of system response
- **Simulator limitation**: Audio volume low, required proximity to laptop

Task Completion:

- ✓ Success (with confirmation uncertainty)
- Time: 25 seconds
- Attempts: 1 successful poke, additional confirmation action (listening)

Task 3: Workspace Customization

Task Instructions Given: "Navigate to the green workspace area. Grab the items on tables (rug, tree parts, basket), scale them as desired, and arrange them to create your ideal reading environment."

Task Status: INCOMPLETE - Unable to test due to VR locomotion failure and Meta simulator scaling limitations

Attempted Approach:

- Researcher attempted to manually reposition player to workspace area
- Time constraints and simulator limitations prevented full testing
- P1 expressed interest in concept: *"The concept of scaling and making an environment is interesting, and I would love to work through it"*

Appendix C: Post-Test Interview Transcript

Interview Duration: Approximately 4 minutes
Format: Semi-structured, following prepared question protocol

Researcher: On a scale of 1 to 10, how would you rate the naturalness of the book grabbing interaction?

P1: 8.5 out of 10. It's exactly what you'd do in real life - reach out, grab the book, it comes with you. Physics felt right, no lag. Maybe add haptic feedback when you make contact.

Researcher: How intuitive was the poke interaction for audio control?

P1: The poke itself was intuitive - I could see it, poked it, it registered. But I wasn't sure if anything happened. I had to lean closer to the laptop to hear if audio was playing. Need visual indicator like "Audio On" or a color change.

Researcher: Which object manipulation felt most comfortable?

P1: Only tested the book grab, that felt comfortable. Didn't get to test scaling or workspace placement because of movement issue. The concept of building your reading environment is interesting though. I'd love to work through those interactions.

Researcher: How comfortable did you feel navigating the VR space?

P1: No issues with comfort or motion sickness. Head and hand tracking worked perfectly. The locomotion not working was a technical problem, but the space itself was comfortable.

Researcher: Could you envision reading in the environment you created?

P1: Couldn't test workspace customization, but from what I could see - yes, I'd like to see that function work. Building your own reading space is appealing.

Researcher: What unique value does this VR experience offer compared to traditional reading apps?

P1: The immersive aspect. Traditional apps are flat screens - you're still in your regular environment with distractions. This creates a dedicated space you're inside of. Even as a non-reader, I'd be interested to try this. It transforms reading.

Researcher: What would you change about these interactions?

P1: Add clear indicators for interaction states. Show me audio is on or off. Beyond that, these basics work well. Focus on polishing what's here - get locomotion working, make interactions smooth. Don't need more features right now, just make what you have solid.

Researcher: If you could add one gesture or interaction, what would it be?

P1: Complete the ones you've planned first - scaling and workspace building. Then think about additions like gesture-based library navigation or pinch-to-zoom. First priority is getting the foundation working completely.

Researcher: You asked about the audio implementation - what interested you?

P1: I was curious how you connected poke to audio playback. That's a common VR pattern. The Event Wrapper approach is smart - you can reuse that pattern for different interactions without custom code each time.

Researcher: Thank you for testing despite the technical constraints.

P1: No problem. The concept has real potential. Fix locomotion, get workspace working, test with more people. This could be compelling once fully functional.

Appendix D: Quantitative Data Summary

Task Performance Metrics

Task	Target Time	Actual Time	Success Rate	Attempts to Success
Task 1: Book Selection	<45 seconds	15 seconds	100% (1/1)	1
Task 2: Audio Control	<30 seconds	25 seconds	100% (1/1)	1
Task 3: Workspace Customization	<60 seconds	N/A	0% (0/1)	N/A

User Experience Ratings

Metric	Target	Actual	Status
Book Grab Naturalness	>7/10	8.5/10	Exceeded
Comfort/Motion Sickness	<2 reports	0 reports	Achieved
Overall Concept Interest	Positive validation	Strong positive	Achieved

Technical Issues Log

Issue	Severity	Impact	Resolution Status
VR Locomotion Failure	Critical	Blocked Task 3, limited Task 2	Requires immediate fix
APK Deployment Process	High	Extended setup time	Workaround functional, needs optimization
Audio Feedback Clarity	Medium	User uncertainty	Design iteration required
Participant Recruitment	Critical	Only 1/5 minimum achieved	Process improvement needed

Appendix E: Technical Environment Specifications

Hardware:

- Meta Quest 2/3 (exact model tested: [specify if known])
- Development PC specifications: [if relevant]

Software:

- Unity Version: 2022.3 LTS
- Build Target: Android (Meta Quest)
- Deployment Method: Sidequest (APK manual installation)

Scene Components:

- Camera Rig: Meta XR standard configuration
- Interaction Rig: Hand tracking + controller support
- Spatial Audio: Meta Spatial Audio building block
- Poke Interactable: Meta SDK poke interaction building block
- Custom Scripts: AudioPlayer.cs, [other scripts if applicable]