

Appendix One: Complete Codebook

Layer 1: Foundational Principles

The five foundational principles represent core design considerations that developers prioritize across all VR onboarding contexts:

Table 1: Layer 1: Foundational Principles for VR Onboarding

Principle	Definition	Agreement
Technical Constraints	Hardware specifications, software compatibility, processing power, and technical limitations determine what onboarding designs are possible	15/15
Progressive Disclosure	Introducing actions and information step-by-step, starting with basic interactions and gradually adding more complex controls	14/15
Progressive Intervention	Providing context-sensitive assistance triggered when users show difficulty, rather than frontloading instructions	13/15
Adaptive Onboarding	Dynamically adjusting the onboarding process to match each user's pace, skill level, and VR familiarity	13/15
In-Application Integration	Embedding onboarding seamlessly within the application experience to preserve immersion and enable embodied learning	13/15

Layer 2: VR-Specific Challenges

The six VR-specific challenges represent obstacles developers consistently encounter when designing onboarding:

Layer 3: Design Strategies

Layer 3 comprises seven primary design strategies that emerged from developer interviews, with five additional implementation variations that developers employ to operationalize these core approaches across different VR contexts:

Layer 4: Evaluation Metrics

The four evaluation metrics represent complementary measurement approaches developers employ to assess onboarding effectiveness:

Note. Agreement values indicate the number of developers (out of 15 total) who mentioned or emphasized each theme during interviews. Higher agreement suggests stronger consensus among experienced VR practitioners.

Table 2: Layer 2: VR-Specific Challenges Developers Encounter

Challenge	Definition	Agreement
User Confusion	Uncertainty about how to interact within VR environments, caused by unfamiliar controls or inconsistent interface behaviors	12/15
Controller Complexity	Challenges learning to operate VR input devices with 6DoF tracking and varying button layouts across headsets	12/15
Motion Sickness	Physical symptoms from sensory conflict between what the eyes see and what the inner ear expects during motion	12/15
Lack of Clear Instruction and Affordance Recognition	Users do not understand what actions are possible because interactive elements are not clearly indicated	11/15
Seamless vs. Separated Onboarding Dilemma	Challenge of deciding whether tutorials should be embedded in the main experience or provided in a separate space	10/15
Discomfort and Fear of Open Spaces	Psychological unease when users cannot see the physical world and feel uncertain about their surroundings	9/15

Table 3: Layer 3: Design Strategies for VR Onboarding

Strategy	Definition	Agreement
Multimodal Guidance	Using multiple sensory channels (visual, auditory, haptic) to communicate instructions during VR onboarding	12/15
Instruction Clarity in Absence of Familiar Reference Points	Providing precise operational guidance in environments where users cannot rely on familiar interface conventions	10/15
Borrowing Familiar Patterns	Using known interaction conventions from other platforms or real-life behaviors to make VR onboarding more intuitive	11/15
Interactive Trial and Error with Safe Failure	Designing onboarding so users learn by experimenting in low-stakes environments where mistakes have no negative consequences	10/15
Targeting the Lowest Experience Level	Designing onboarding accessible to complete beginners by introducing actions and information in small, manageable steps	12/15
Narrative Integration and Motivation	Embedding onboarding directly into the main flow or story so users learn skills while pursuing meaningful in-world goals	9/15
Iterative Refinement Strategy	Continuously gathering user responses and performance data to refine onboarding over time through systematic feedback collection	11/15

Table 4: Layer 4: Evaluation Metrics for Onboarding Success

Metric	Definition	Agreement
Behavioral Observation	Watching how users behave to identify confusion, hesitation, and unexpected patterns that quantitative metrics may not reveal	12/15
Time-on-Task and Error Patterns	Measuring how long users spend performing onboarding tasks and how their mistakes change over repeated attempts	11/15
Completion Rates and Task Achievement	Whether users can progress through onboarding and independently perform key actions, indicating effective knowledge transfer	10/15
User Satisfaction and Confidence	Self-reported measures of how users feel after completing onboarding, indicating comfort and understanding	10/15

Appendix Two: Participant Demographics and Professional Background

Table 5: Participant Demographics and Professional Background (Anonymized)

ID	Domain	Role(s)	Years	VR Platform Type(s)	Status
P1	Education	Designer, Prog.	5	Standalone	Academic
P2	Entertainment	Narrative Des.	4	Desktop, Standalone	Commercial
P3	Education	Designer, Prog.	6	Standalone	Academic
P4	Training	UX/UI Designer	7	Desktop, Standalone	Both
P5	Entertainment	Game Designer	9	Desktop, Standalone	Both
P6	Education	Prog., Artist	5	Standalone	Academic
P7	Training	Manager, Des.	8	Standalone	Both
P8	Cultural	Designer, Prog.	3	Standalone	Academic
P9	Entertainment	Lead Designer	10	Desktop, Console, Standalone	Both
P10	Education	Researcher, Dev.	6	Standalone	Academic
P11	Training	UX Designer	7	Desktop, Standalone	Both
P12	Entertainment	Game Developer	8	Desktop, Standalone	Both
P13	Cultural	Multimedia Dev.	4	Standalone	Academic
P14	Edu./Enterprise	Systems Dev.	7	Standalone	Both
P15	Entertainment	Senior Designer	12	Desktop, Standalone	Both

= VR development experience; Range = 3-12 years (Mean = 7, Total = 105 years combined). Domains: Education (learning apps), Entertainment (games), Training (corporate), Cultural (museums/heritage). Abbreviations: Prog. = Programmer, Des. = Designer, Dev. = Developer. VR Platform Types: Standalone = Meta Quest/Pico headsets (no PC required), Desktop VR = PC-based systems (SteamVR, Oculus Rift), Console VR = console-connected systems. Status: Academic = non-commercial, Both = commercial/mixed release.

Appendix Four: Domain-Specific Strategy Prioritization

Table 6: Domain-Specific Strategy Prioritization

Strategy	Educational	Entertainment	Training	Cultural
Progressive Mechanical Introduction	Essential	Moderate	Essential	High
Multimodal Affordance Communication	Essential	Moderate	High	High
Borrowing Familiar Patterns	Supportive	Essential	Moderate	Moderate
Interactive Trial and Error	Encouraged	Encouraged	Conditional	Encouraged
Targeting Lowest Experience Level	Essential	Essential	Essential	Essential
Narrative Integration	High	Essential	Low	Supportive
Clear Instruction for Unfamiliar Actions	Essential	Moderate	Essential	High
Simplified Interaction Patterns	Essential	Essential	Essential	Essential
Natural Movement Mechanics	Supportive	Moderate	High	High
Spatially-Anchored Instruction	High	Moderate	High	High
Environmental Affordance Design	High	Moderate	Moderate	High
Iterative Refinement	Essential	Essential	Essential	Essential

Appendix Five: Interview Questions

Interactive Onboarding Questionnaire

Your Name

November 24, 2025

Participant Information

Name (Or Anonymous):

Date:

1. Demographics and Professional Background

Primary Development Focus

Which best describes your current focus? (Select one)

- VR NonVR Both Other If “Other,” specify:

Years of Professional Game Development Experience

How many years of professional experience do you have in game development (VR or non-VR)?

•

Years of VR Development Experience

How many years of experience do you have specifically in VR development?

•

Role(s) in Game/VR Development (Check all that apply)

- Game Designer
- Programmer / Software Engineer
- UX Designer

3D Artist

Sound Designer

Producer / Project Manager

Other (please specify):

Platforms Developed For (Check all that apply)

PC (non-VR) PC VR (SteamVR, Oculus PC) Standalone VR (Meta Quest, Pico)

Console (non-VR)

Console VR (PSVR)

Mobile (non-VR)

Mobile VR (Google Cardboard)

Other:

2. Experience in Game / VR Onboarding

Commercially Released Projects

Have you worked on a commercially released game or VR application?

- VR NonVR Both No

If Yes, briefly describe your role and the nature of the project(s):

Onboarding/Tutorial Experience

Have you ever designed or significantly contributed to the design of an onboarding/tutorial system?

- VR NonVR Both No

If Yes, what were the core principles or approaches you considered important?

3. Onboarding Elements and Approaches

Rate your agreement with the following statements from 1 (Strongly Disagree) to 5 (Strongly Agree).

Importance of Onboarding

“A well-structured onboarding is critical for long-term user engagement in a game or VR application.”

Select

Adaptive Onboarding

“Onboarding systems should adapt based on the user’s level of expertise (e.g., beginner vs. advanced).”

Select

Use of Multiple Tutorial Formats

“Combining various tutorial methods (video demos, tooltips/UI prompts, interactive guidance) enhances onboarding effectiveness.”

Select

Seamless vs. Separate Onboarding

“Onboarding should be integrated into the main gameplay flow rather than presented as a separate, standalone module.”

Select

Progressive Disclosure

“Gradually introducing new features (progressive disclosure) prevents overwhelming users and improves retention.”

Select

Open-Ended Follow-Up (Optional)

Which statement do you feel most strongly about and why?

4. Challenges and Barriers in (VR) Onboarding

Rate how frequently you encounter these challenges: 1 (Never) to 5 (Very Often).

User Confusion About Controls

Select

Motion Sickness or Discomfort (VR)

Select

Lack of Clear Instructions

Select

Overwhelming Users With Too Much Information

Select

Technical Limitations (e.g., hardware constraints)

Select

Open-Ended (Optional)

If you rated any challenge above a “4” or “5,” what strategies have you used to address it?

5. Educational VR: Additional Considerations

If you do NOT develop educational or training-based VR, you can skip or answer from a theoretical standpoint.

Designing for Learning Outcomes

“When designing onboarding for an **educational** VR experience, aligning tutorial steps with specific learning objectives is crucial.”

Select

Different Learning types

“Onboarding in educational VR should accommodate different learning types (visual, auditory...).”

Select

Measuring Educational Effectiveness

Which methods do you (or would you) use to measure if learners have *actually* achieved the intended outcomes? (Check all that apply)

Pre- and post-assessment quizzes/tests

In-VR performance metrics

User feedback / self-reported confidence

Observations by instructors/teachers

Other:

Integrating Onboarding with Educational Content

“Onboarding in educational VR should seamlessly blend tutorial content with learning mod-

ules.”

Select

Open-Ended

For developers with educational VR experience: Can you share an example where the on-boarding process **directly impacted** learning retention or student engagement?

6. Evaluating Onboarding Success

Key Metrics / KPIs

Which metrics do you use (or consider using) to measure **onboarding success**? (Check all that apply)

- Completion rates
- Time spent in tutorial vs. main content
- Error rates (stuck/help requests)
- Motion sickness / drop-off rates (VR)
- User satisfaction surveys
- Retention metrics (returning users)
- Learning assessments (educational VR)
- Other:

Iterative Improvement

“We systematically track user feedback and analytics to refine the onboarding experience over time.”

Select

Data-Driven Insights

Can you provide an example where **quantitative** (analytics, A/B testing) or **qualitative**

(interviews, focus groups) data led to a significant improvement in onboarding design?

7. Best Practices and Case Studies

Influential Examples

Is there a particular game or VR application (yours or otherwise) that you consider a gold standard for onboarding? What stands out about it?

Cross-Industry Adoption

“Best practices from non-VR platforms (e.g., mobile or console games) can be adapted to VR onboarding effectively.”

Select

Educational/Enterprise Context

“Onboarding for educational or enterprise VR applications requires unique considerations beyond entertainment-focused VR.”

Select

If you agree, please describe one example of a specific requirement (e.g., explicit learning objectives, instructor oversight):

8. Final Thoughts

Advice for Newcomers

If you could give **one piece of advice** to a developer who is just starting to implement an onboarding system for VR or non-VR games, what would it be?

Follow-Up Permission

Are you open to a brief follow-up interview or email exchange if we need further clarification?

- Yes No