Complete List of Inclusive Virtual Reality Learning Guidelines (Last updated: 23/06/2025)

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Core UDL[1]-Based Guidelines (IGVRL)[2]

1. Provide Options for Recruiting Interest

- Advocate for active exploration and problem-solving in VR, aligning with constructivist learning methods
- Incorporate interactive elements, enabling learners to engage with the virtual environment
- Embrace task-based learning within VR, allowing learner agency
- Provide opportunities for choices and decisions, endorsing learner autonomy
- Boost presence by connecting VR to meaningful real-world or engaging narratives
- Prioritize authenticity through realistic graphics and immersive technology

2. Provide Options for Perception

- Provide diverse content modalities, encompassing various media forms, 3D visualizations, 360° visuals, 3D models, and audio narratives. Aim for seamless integration of 360° content with 3D models
- Enhance spatial awareness with interactive environments emphasizing exploration and physical navigation, including VR-integrated UI elements
- Utilize external projection methods, allowing the larger group to view VR experiences
- Introduce customization options addressing audio-visual and spatial components
- Ensure the inclusion of closed captions for auditory content

3. Provide Options for Physical Action

- Utilize diverse interaction modalities, including speech, gaze controls, haptic feedback, and controller inputs, facilitating a multi-sensory environment

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[1] CAST. 2024."Universal Design for Learning Guidelines Version 2.2." https://udlguidelines.cast.org/.
[2] Wehrmann, Frank, and Raphael Zender. 2024. "Inclusive Virtual Reality Learning: Review and 'Best-Fit' Framework for Universal Learning." *The Electronic Journal of E-Learning* 22(3):74–89. doi:10.34190/ejel.21.6.3265.

- Introduce alternative navigation options, like teleportation, to counteract motion sickness
- Design VR environments that render experiences accessible to students with disabilities, such as virtual excursions to non-accessible sites
- Integrate or enable compatibility with assistive technologies to ensure broad accessibility within the VR learning platform

4. Provide Options for Effort and Persistence

- Emphasize goals through authentic narratives in learning experiences
- Encourage flexible and proactive task exploration, allowing learners to dictate their learning path
- Offer configuration tools for educators to customize learning application content, ensuring they are user-friendly
- Design cooperative tasks for both VR and non-VR participants
- Develop networked VR learning applications supporting multi-user cooperation
- Integrate automated feedback systems for real-time learner insights

5. Provide Options for Language and Symbols

- Offer optional linguistic aids for both text and spoken words within applications
- Employ varied media to cater to diverse learner receptivity and provide alternative means for language reception
- Ensure application availability in multiple languages
- Develop avatars capable of emoting and using body language and gestures

6. Provide Options for Expression and Communication

- For networked VR applications, incorporate network voice communication
- Enable avatars with expressive faces to enhance communication and consider incorporating nonverbal communication methods
- Allow students to create or import content into learning applications where appropriate

7. Provide Options for Self Regulation

- Assign clear roles or goals to guide learners, especially in multi-user VRLAs
- Explore automatic assessment methods to provide learners with insights into their performance

8. Provide Options for Comprehension

- Develop authentic virtual environments for a comprehensive understanding of the subject
- Integrate pre- and post-simulation activities within the application's design
- Embed context that relates to learners' prior experiences, allowing modifications by teachers or aligning with standard curricula
- Offer guidance, feedback, prompts, and scaffolding to aid exploration within virtual environments
- Incorporate metacognitive elements like badges, markers, arrows, and highlighting
- Clearly define the simulation's goal for students at its outset

9. Provide Options for Executive Functions

Note*: Limited findings were available for this category in the original research*

Extended Nonverbal Communication Guidelines [3]

Avatar Design and Representation

- Provide options for avatar design, ranging from abstract to photoreal, and enable a diverse range of facial features, outfit options and non-gender specific options to enable users to represent a wide range of cultural and gender identities
- Allow abstract avatars and floating torsos as well as full-body avatars
- Recognize that different users have different avatar preferences and needs

Spatial Social Design

- Design for social fidelity within the spatial dimension in Multi-User Virtual Environments (MUVEs)
- Account for shared virtual spaces by incorporating spatial and workplace awareness as well as co-presence into application design

Nonverbal Communication Tracking

- Implement options for tracking NVC features such as hands, feet, facial expression, gaze and lip syncing as appropriate for the task
- Implement inverse kinematics to generate a full range of body movements from limited data points
- Provide options for users to enable and disable the tracking options that suit their preferences for privacy and comfort
- Mind the heterogeneous needs of users: some prefer a fuller range of expression, some experience discomfort with full tracking

Enhanced Communication Options

- Provide options for augmented, enhanced and abstract NVC
- Allow users to choose if they want their peers' NVC to be displayed authentically or exaggeratedly

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[3] Wehrmann, Frank, and Raphael Zender. 2025. “Systematic Review of Nonverbal Communication in Virtual Reality Environments: Potentials for Inclusive Education”. Submitted for publication at eLeed.

- Give users the ability to set preferences for perspective changes and transformations of avatars
- Provide interaction mechanisms beyond mirroring of body language
- Include the option to use emojis, to simulate facial expressions and to play animations of standard gestures instead of having the user do them
- Provide options for diverse kinds of communication to allow users to develop individual communication strategies that suit their needs and preferences

Visualization and Communication Tools

- Provide options for visualization tools beyond body language tracking
- Provide users with laser pointers, pens, other tools or the ability to shift perspectives
- Enable manipulation of the actual position of objects and body parts to enhance communication abilities

Design Insights for Multi-User VR Learning

Note: *Draws on conclusions from a systematic review[4]. Explicit guidelines were not formulated as part of a publication yet. They are to be treated as preliminary formulations, subject to change.*

Cooperative Design Principles

- Use role differentiation to ensure meaningful participation for all learners rather than viewing differences as barriers.
- Design tasks where each participant's unique contribution becomes essential to group success, making cooperation necessary rather than optional.
- Assign different tools, information, or perspectives to participants within VR environments to create authentic task interdependence.
- Create differentiated roles that leverage participants' varied capabilities rather than requiring identical skills from everyone.

Implementation Strategies

- Support meaningful participation across VR headsets, desktop interfaces, and non-digital materials to address accessibility barriers and resource limitations.
- Build in structured mechanisms for communication and coordination that participants need for cooperative success.
- Create applications where users have genuinely different capabilities, tools, or information access.
- Structure activities so they cannot be completed without contributions from multiple, differently-equipped participants.

[4] Wehrmann, Frank, and Raphael Zender. 2025. “A Systematic Review of Cooperation in Multi-user Virtual Reality Learning Environments”. Submitted for publication at JCAL.