Virtual reality in radiology education: a narrative review of applications and future directions

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BACKGROUND

- Radiology education has historically relied on didactic teaching and two-dimensional (2D) images and videos.
- Virtual reality (VR) has the potential to enhance learning and engagement via 3D simulations and immersive classrooms.
- VR: computer-generated, 3D environment that users are immersed in and can interact with
- Augmented Reality (AR): overlay of VR onto the real world, augmenting the real world
- Mixed Reality (MR): real-time interactions between real and virtual environments



Figure 1: An immersive learning suite using mixed reality

METHODS

- Narrative review using PubMed and Google Scholar, focusing on studies from the past decade.
- Search terms included “radiology education” and “virtual reality”.
- Studies evaluating VR in diagnostic and interventional radiology and anatomy education were analyzed, focusing on outcomes such as performance, satisfaction, and engagement.

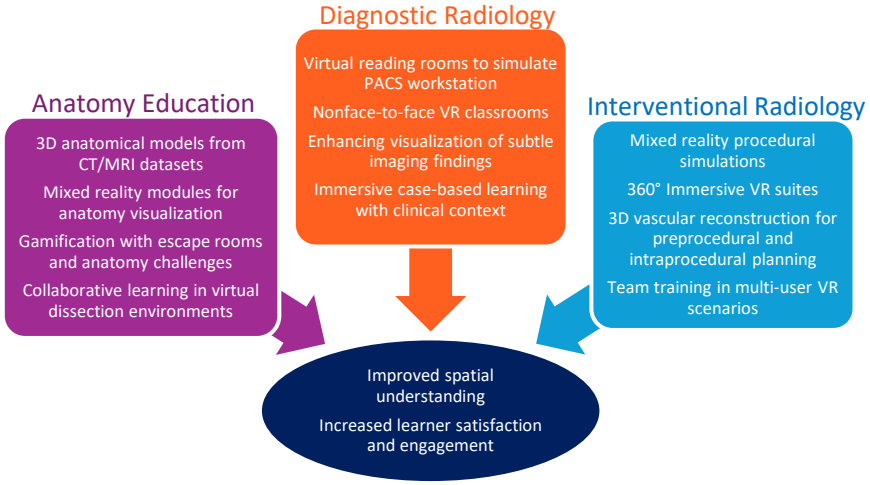


Figure 2: Integration of VR into Radiology Education

Results

- VR-based surgery planning = improved diagnostic accuracy (8.43 vs. 6.86, p<0.001) and reduced answer time compared to 2D methods (6.24 vs. 9.13 min, p<0.001).
- VR modules reconstructed from CT/MRI datasets improved spatial understanding (p<0.01) and motivation (p<0.01)
- In nonface-to-face learning, VR teaching achieved comparable outcomes to traditional in-person instruction (p=0.596), though trainee engagement and satisfaction were increased (4.00 vs. 2.60, p<0.001).
- In interventional radiology, VR-based training environments provide realistic and controlled settings for practicing catheter navigation and other procedures.

CONCLUSIONS

- VR has proven to be effective in radiology training as a way to visualize anatomy, increase learner engagement, and offer realistic practice environments.
- Across disciplines, VR consistently increased learning satisfaction, engagement, and enjoyableness, even when learning outcomes were comparable to traditional methods.
- Its broader adoption in medical and resident education has the potential to enhance trainee education and overall engagement.

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