Can AI enhance VR training? A systematic review of AI-VR training research.

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Introduction

This review analyzes **best practices** and **preliminary findings** in AI-VR research, revealing gaps and providing guidelines for future studies.

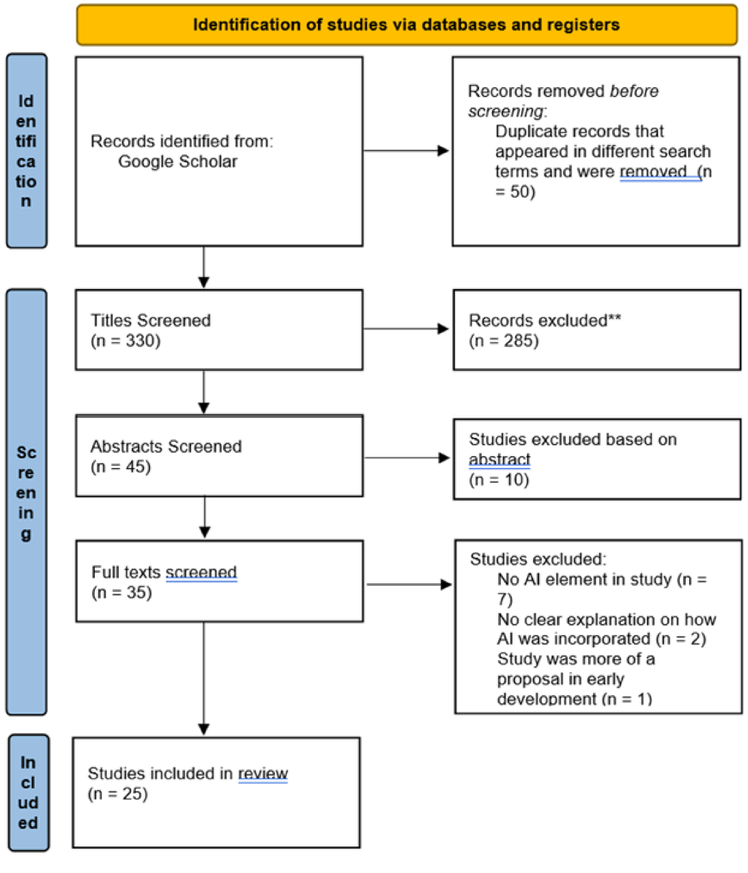
RQ 1: Are the current VR and AI training programs utilizing best practices from the science of training?

RQ 2: Are current studies on AI-enhanced VR training programs utilizing a proper control group?

RQ 3: Do current studies on AI-enhance VR training programs have a sufficient number of people to make inferences about their effectiveness?

RQ 4: What are the preliminary findings? Does adding AI to VR training result in a better experience for the trainee, greater learning, or better on-the-job performance than regular VR training?

Methods



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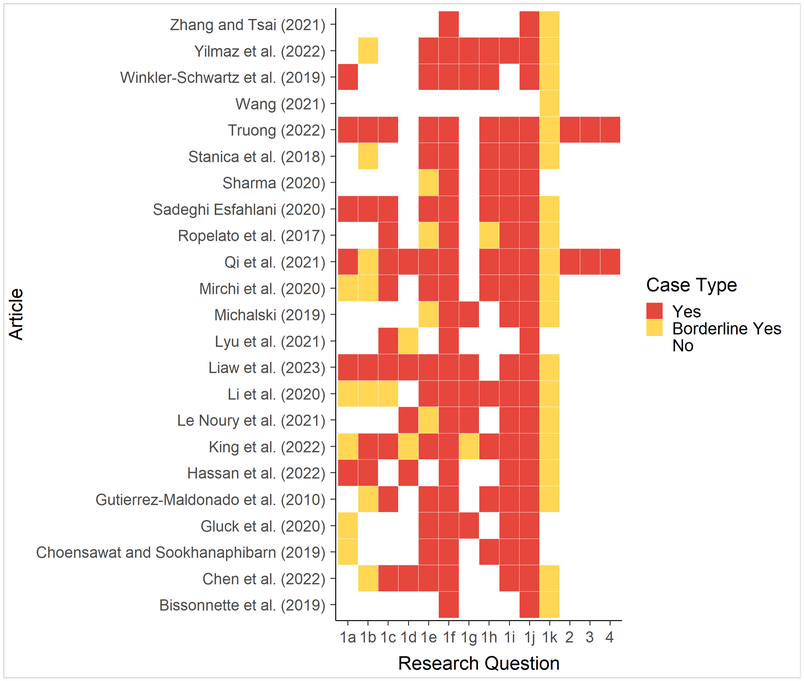
Results



RQ 1: The best practices **most implemented** in AI-VR training studies are features that enable trainees to use the same cognitive processes they would in the transfer environment (1f; 96%), features that boost psychological fidelity (1j; 96%), and the use of valid learning/outcome taxonomies (1k; 80%).

The **least implemented** are learning objectives (1a; 24%), self-efficacy boosts (1b; 24%), increases in engagement and interest (1d; 20%), and progress monitoring (1g; 28%).

RQ 2: Most studies did not utilize a proper control group to test the incremental effects that AI brings to VR training technologies (92%).

RQ 3: Most studies did not have adequate sample sizes, and only 2 that did utilized proper control groups

RQ 4: Of the articles that do compare AI-VR to VR training programs, **AI was found to significantly enhance training outcomes**.

Qi et al. (2021) found that AI had a **moderate effect** on performance. Truong et al. (2022) demonstrated that AI **doubles the log-odds** of passing a trial, indicating improved success rates with AI integration in VR training.

Discussion

Guidelines for Future AI-VR Training Research and Adherence to Best Practices

Research Question	Guidelines for Future Research
1a. Are learning objectives created and clarified to the reader?	Create clear learning objectives by including a behavior and criterion. The condition is often implied in AI-VR training programs, but it can be helpful to include.
1b. Is the training delivered in a way that builds trainees' belief in their ability to learn and display trained skills (self-efficacy)?	Measure self-efficacy directly using a self-efficacy assessment.
1c. Does the training encourage trainees to participate in training to learn rather than to appear capable (promotes a learning orientation)?	Include effective feedback mechanisms, encourage error making, and create training aspects that focus on learning rather than performance.
1d. Does the training engage trainees and build their interest?	Measure engagement directly using an engagement assessment.
1e. Does the training utilize a valid training strategy and design? This involves providing information, giving demonstrations of good and bad behaviors, allowing opportunities to practice, and providing meaningful feedback.	AI-VR training programs should strive to incorporate all of these aspects.
1f. Does the training allow trainees to use the same cognitive processes that they will have to in the environment this learning should transfer to?	Create immersive training programs that replicate real life tasks and scenarios.
1g. Does the training keep trainees' attention by allowing trainees to monitor their progress toward goals?	AI-VR training programs can allow trainees' to monitor progress via user interface (UI) elements such as maps and progress bars. AI-VR training programs can also implement checkpoints and endpoints with visual / haptic feedback (success screens, animations, sounds, etc.)
1h. Does the training encourage trainees to make errors?	Provide instant feedback and additional opportunities for practice to encourage errors.
1i. Does the training provide sufficient structure to trainees when allowing them to make decisions about their learning experience?	Build game elements that allow trainees to select training courses or use adaptive ai to tailor the sequencing of courses to the trainee's performance. Create scenarios that allow autonomous movement and decision making. Use algorithms that select training scenarios based on participant's training decisions.
1j. Does the training simulation increase psychological fidelity (e.g. job-relevant, technology used fits the task)?	Ensure that the training programs are job-relevant, have good task-technology fit, and are immersive enough to boost user presence.
1k. Does the training use established learning / outcome taxonomies (e.g. affective, cognitive, and/or behavioral indicators)?	Always include cognitive and / or behavioral indicators. Include reaction measures beyond engagement and self-efficacy to help provide more information to readers.

Note:

This table highlights guidelines for achieving each of the training best practices suggested by Salas (2012).

Future AI-VR training research should **directly test the effects of AI** against a proper control.