Faculty Research in Partnership with RIDIL

White Paper on Virtual Reality Implementation in Organizational Learning

This white paper provides a summary of the work from:

Yang, M., Miller, C., Crompton, H., Pan, Z., & Glaser, N. (2024). The Implementation of Virtual Reality in Organizational Learning: Attitudes, challenges, side effects, and affordances. *TechTrends, 68*(1), 111-135. https://doi.org/10.1007/s11528-023-00917-y

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Overview

As the workforce becomes increasingly diverse and geographically dispersed, it has been challenging to engage trainees for successful training transfer using traditional training strategies. Among the digital technologies adopted by organizations, VR has been gaining popularity. Despite the potential that VR brings to revolutionize organizational learning, it is important to consider the challenges or potential side effects to maximize the benefits of VR while minimizing the potential drawbacks.

Purpose of the Research

In this study, the authors took a systems-thinking approach to mainly investigate the challenges and side effects of integrating VR into organizational training and report the contexts VR has been applied to, people's attitudes toward VR applications, and the affordances VR provides. The research questions are:

1. What are the challenges of integrating VR in training?
2. What are the side effects of integrating VR in training?
3. How has VR been implemented?
4. What are the affordances reported in these studies?

Method

A systematic review methodology was employed to answer the research questions following the PRISMA protocols. A five-part Boolean search resulted in 50 articles. A grounded coding methodology was used to analyze the selected articles.

Findings and Discussion

The growing attention on VR is focused on healthcare and medical contexts and most of the medical studies were in various countries. Training programs aimed at the following competencies: Medical knowledge and surgical skills; Safety knowledge and skills; Motor or operation skills; Cognitive skills; Sensory skills; Attitude and motivation; Social and communication skills; Behavioral responses and management; and Military tasks. The findings related to the research questions are summarized below.

Challenges in implementing VR

Multiple challenges were reported. Table 1 shows the axial codes and a summary of the findings for each category.

Table 1. *Challenges of VR*

Axial codes	**Description**
Accessibility issues	Age limitation and accessibility to devices or software created some barriers for some group of people
Lack of scaffolding	There was a lack of help system for inexperienced users. Customization was not achieved for different levels of learners.
Operational challenges	There were some control or movement issues reported, making operations challenging.
Unrealistic design	It is hard to capture the complexity of real world in the virtual environment. Contextualize the learning scenario is also challenging.
Technology limitations	Technology infrastructure is not strong enough to run VR systems
Divergent conception with vendors	Different ideas with vendors.
Evaluation and research	Lack of quantifiable metrics to evaluate effectiveness and hard to measure behavioral outcomes.

Affordances of VR

The selected studies reported a variety of affordances that VR could bring to training, which were summarized in Table 2.

Table 2. *Affordances of VR*.

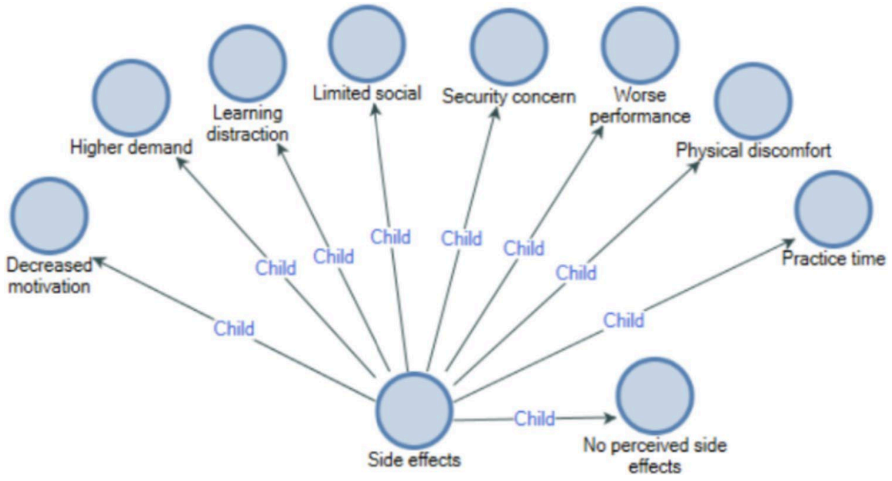
Axial codes	**Description**
Attitude & motivation	The use of VR had positive impacts on learners' attitudes at all three dimensions (i.e., affective, cognitive, and behavioral). It also fosters learners' motivation to learn.
Cognitive load	Decreased mental demand was reported. When redundancy strategy is used, extraneous cognitive load is decreased.
Engagement	Learners showed significant higher engagement levels in the VR groups.
Immersion & presence	Strong senses of immersion in realistic environments were reported by participants, enabled by the multisensory stimulation. The sense of (social) presence was one of the most frequently reported affordances.

Interaction	Collaboration and interaction for geographically distributed users could be enabled. Additionally, the hierarchical structure dissolved, making it easier to interact and exchange knowledge.
Knowledge & skills	Better or improved knowledge acquisition and retention for different types of knowledge and skills including declarative/conceptual/ procedural/spatial knowledge, conversational skills, social cognition skills, mindfulness, motor skills, and technical skills.
Performance	Users showed improved or better performance after VR training
Transfer	Users were able to generalize learning to performance context, or were positive about their transfer, especially in more complex scenarios.
Potentials	VR training could be flexible in meeting new training needs and scenarios. There are different purposes it could be applied for such as virtual courses, meetings, or presentations.

Side effects of VR applications

Not a lot of studies directly studied the side effects of using VR for training. A few side effects were reported as shown in Figure 1 (Yang, et al., 2024). Under the parent code (i.e., side effects), there were 9 child codes/categories. Some design feature might decrease learners' motivation (e.g., quick travel function limits inexperienced users' exploration). Some wearable devices might cause higher physical demand. There might be multiple learning distractions by the design of technology limitations. Most VR applications had restricted "single player" mode, resulting in limited human interaction in the simulation. The most frequently reported side effects were physical discomfort caused by the devices or simulation such as simulator sickness. Participants in the VR group had fewer practice quantity due to a combination of reasons such as technology setup, physical discomfort and possibly practice fatigue. Lower learning outcomes or transfer of training was found for certain groups of users such as those with CP conditions. Some users reported concerns about security on confidential business insights.

Figure 1. *Sides effects of VR applications (Yang et al., 2024).*



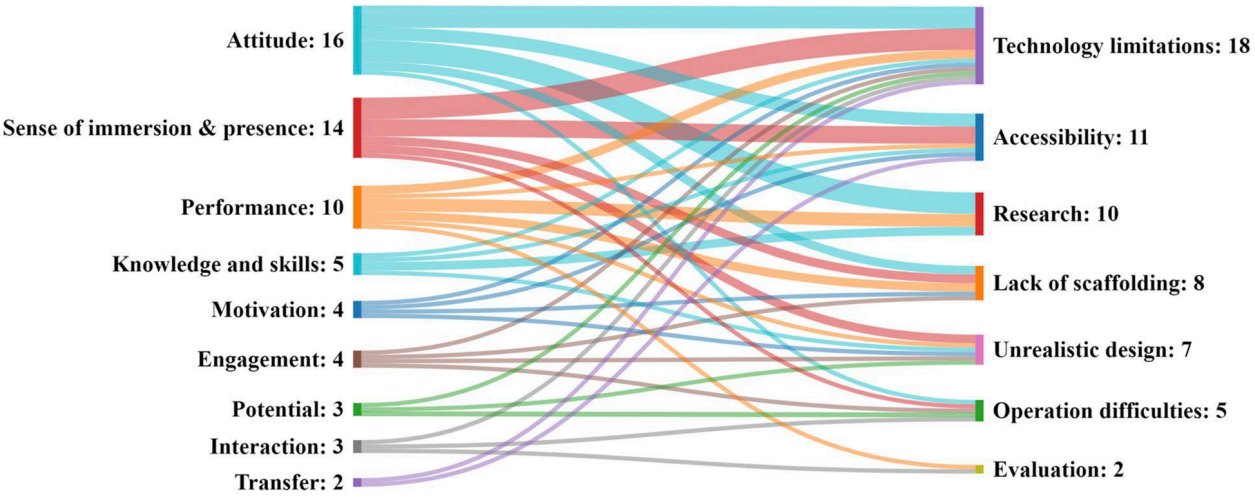
Associations among challenges, side effects, and affordances

Sankey graphs were generated to illustrate the relationships among the reported challenges, side effects, and affordances. In each graph, the labels on both the left and right columns indicate all the codes under the respective categories of challenge, side effects, or affordance. The number indicates the frequency of the corresponding codes reported in all the articles. The edges connecting different codes indicate their co-

occurrence, with thicker edges representing higher co-occurrence frequencies. Below are the Sankey graphs as seen in Figure 2, 3, and 4 (Yang et al., 2024).

Figure 2 shows the association between the reported affordances and challenges. In this figure, for example, attitude was the most frequently reported affordance of VR, followed by sense of immersion & presence. The main co-occurred challenges with these two affordances are technology limitations and accessibility.

Figure 2. *The association between affordances and challenges (Yang et al., 2024)*.



In figure 3, the Sankey graph illustrates the association between the affordances and side effects. Attitude co-occurred almost with every side effect except for practice time. Almost every affordance co-occurred with physical discomfort except for interaction and potential. For all types of affordances that co-occur with challenges, the edge connected to Physical discomfort is always the thickest.

Figure 3. *The association between affordances and side effects (Yang et al., 2024)*..

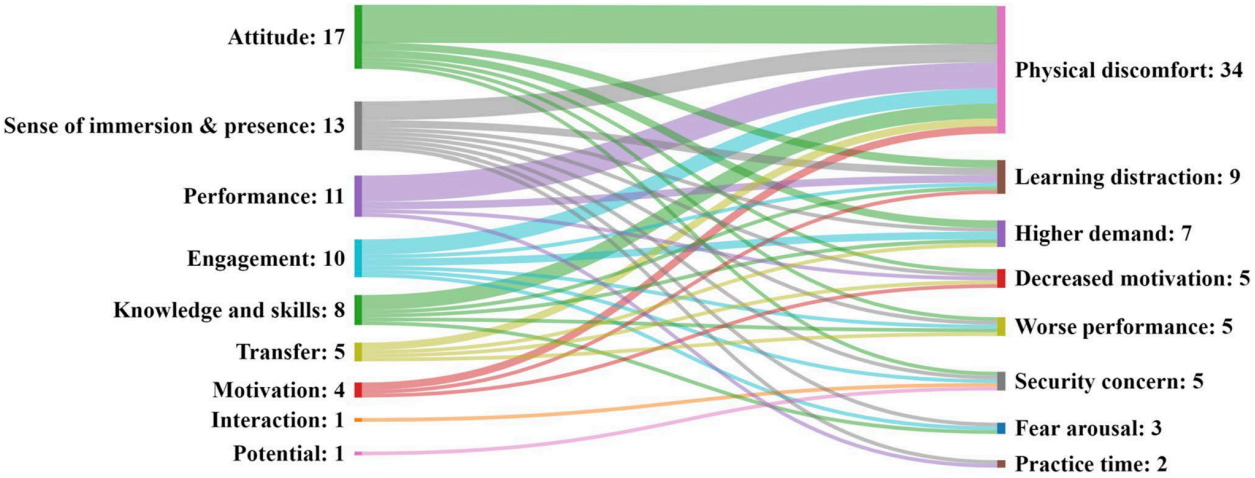
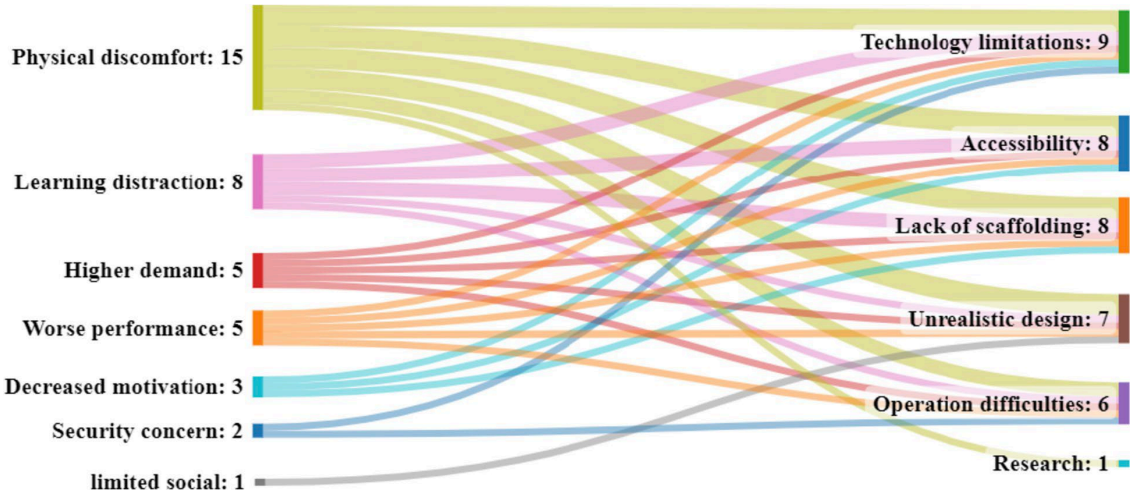


Figure 4 shows the association between side effects and challenges. In this Sankey graph, physical discomfort was the most frequently reported side effect and it co-occurred with every challenge. The edges between physical discomfort with challenges were the thickest. Learning distraction co-occurred with every challenge except for research. The first four side effects (physical discomfort, learning distraction, higher

demand, and worse performance) were more commonly found among the research studies that revealed challenges compared to the last three side effects in this graph.

Figure 4. *The association between side effects and challenges (Yang et al., 2024).*



Conclusions

In this article the authors systematically reviewed extant research that used primary data or reported the design of VR interventions, to investigate the challenges, side effects, attitudes, and affordances of integrating VR into organizational settings, offering valuable considerations for organizations looking to leverage VR technology for training purposes. To maximize the benefits of VR while mitigating the challenges and side effects, organizations should adopt a systems-thinking approach in implementing VR applications. This approach involves considering the interconnected parts and the whole system to optimize efficiency and effectiveness.

References

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