12th International Conference of the Immersive Learning Research Network
iLEAD Proceedings iLRN2026
DOI: https://doi.org/10.56198/enfxx504

Making Practice Repeatable: Building and Piloting a VR Active-Shooter Scenario for Police Training

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Abstract. Live exercises for Immediate Action Rapid Deployment (IARD) can be resource-intensive and difficult to replicate. This study explores how a customized virtual reality (VR) solution can provide stressful, realistic, and repeatable practices for learners who may need to respond to active shooter IARD incidents. To increase realism and embodied engagement, the design of the VR scenario incorporates locomotion mechanics, spatialized audio, mechanics such as aiming, shooting, and reloading, as well as speech-recognition interaction with non-player characters. This VR experience also includes practice tutorial and a post-scenario dashboard that summarizes key performance metrics such as reaction-time to support instructor-led debrief and learner reflection. Drawing on usability testing and pilot feedback from instructors and learners, we present design factors and insights that might inspire future development of high-stakes VR training.

Keywords: Virtual Reality, Active Shooting, Immediate Action Rapid Deployment, Scenario-Based Training.

1 Introduction

Immediate Action Rapid Deployment (IARD) is known as swift and immediate deployment of law enforcement resources to an on-going, life-threatening situation and active shooter event is a real-life threat that requires IARD [1]. IARD demands critical incident capabilities from police officers who must communicate, make decisions, and act under time pressure during ambiguous, unpredictable, and life-threatening events [2].

Scenario-based training (SBT) is often considered an effective approach and widely used in critical incident training because it creates relatively safe environments for learners to practice response options while under simulated stress [3]. However, delivering consistent, high-fidelity scenario-based training can be challenging for multiple reasons. First, SBT for IARD such as active shooter response is complex and often not available for repeated practices. Secondly, IARD scenarios can be costly as they usually require secure spaces, facilities, props and equipment such as training pistols and ammunition, as well as personnel such as role players, instructors, and observers. Lastly, a common issue with live-action scenarios lies in their level of consistency. Effective SBT requires well-coordinated role players, instructors, and observers. When the consistency of SBT varies, the effectiveness of the training may be compromised [3]. These gaps make it challenging to provide frequent, consistent practice and document accurate readiness improvements.

Hence, Virtual reality (VR) experiences that allow police officers to interact with three-dimensional visual and auditory cues in an IARD event can be a complement to live exercises because it can increase consistency and repetition [4]. Evidence is emerging that VR scenarios can elicit stress responses comparable to those experienced in live scenario-based training: an important condition when the goal is to improve decision-making skills and performance under pressure [3, 5].

Early pilot implementations, however, also highlight the need to align immersive simulations with evolving operational practices and training environments. Recent research further emphasizes the importance of explicitly mapping scenario goals to observable skills and measurable outcomes [6]. This includes incorporating key performance metrics, such as reaction time, to support effective debriefing, coaching, and ongoing skill improvement [7].

2 The Active Shooter Scenario

In early January 2022, the project team at the Centre for Teaching, Learning, and Innovation initiated the development of the virtual reality active shooter scenario in collaboration with the Police Academy at JIBC and a graduate student team at the Centre for Digital Media. The work began as an exploration of virtual reality applications for IARD training, with an intention to create an immersive, repeatable experience that strengthens situational awareness and supports instructor-led debrief.

Through the project, a VR scenario simulating an active-shooter emergency in an office environment was developed to engage learners' situational awareness, decision-making, and stress-management skills. The VR experience aimed to provide an end-to-end learner experience, from onboarding tutorials, through the immersive active shooter experience, to debrief and reflection (see Fig.1). The development process focused on key features that support high fidelity learning environment and embodied engagement: a detailed 3D office environment, short- and long-distance locomotion, immersive spatialized audio, and mechanics such as aiming, shooting, and reloading (see Fig.2). The simulation also incorporated limited speech recognition so learners could interact more naturally with non-player characters (NPC), reinforcing communication behaviors within the scenario rather than relying solely on menu-driven prompts. For example, learners could shout out "get out from here" or "find somewhere safe" as if they were talking to civilians in real life.

Fig. 1. Users selecting the practice session before entering the active shooting scenario.

Fig. 2. Users interacting with NPCs through speech recognition in VR.

To make the experience actionable for instruction and debrief, the prototype included a summary dashboard that displays key performance indicators, such as engagement time with suspects, searching time, ammunition-use efficiency, and reaction time — the interval between when the shooter fires to when the recruit returns fire (see Fig.3). Although the metrics are not designed for formal evaluation or grading, they provide useful data points for debrief and learner reflection.

Fig. 3. Dashboard that presents key performance metrics.

3 User Testing, Piloting, and Lessons Learned

During the development process, two structured usability tests were planned and designed to identify the gaps between a working prototype and a tool that instructors and learners could potentially use: 1) The first test separated participation between recruits and instructors, so pain points from teaching and participant management perspectives could be surfaced, in addition to learner experience issue; 2) The second test brought instructors and recruits back together to validate the stability of the build, observe vestibular responses after locomotion changes, and gather feedback on how to guide a recruit through the simulation and the post-simulation exercise.

Toward the end of 2022, the active shooter IARD VR training was piloted using Meta Quest 2 as if it were embedded in the first section of the curriculum. The experience was piloted with 16 learners following completion of an in-person IARD role-play. The pilot used a single-station setup in the campus gym, with one instructor and two facilitators supporting equipment setup and observation. A designated play area marked by a mat was used to promote safe movement. Although each session was initially planned to last up to 20 minutes per recruit, actual completion times were shorter, averaging 13.5 minutes in the morning and 11.25 minutes in the afternoon. Based on these observations, it is recommended to plan 15 minutes per learner and ensure an open area for safe movement. Importantly, observations and feedback from the pilot testing directly shaped iteration priorities and design and facilitation decisions, with key ideas summarized in the table below:

Table 1. TKey observations and feedback from learners and instructors.

Area	Observations & Feedback	Design & Facilitation Responses
Onboarding and controls	Learners needed support adjusting the headset	Instructors and facilitators need to demonstrate and support headset adjustment
Onboarding and controls	Some learners initially struggled with controls, including missing the movement button or having difficulty maneuvering	Instructors and facilitators need to provide a brief onboarding instructions on controls and movements without over-explaining the scenario
Speech-enabled interaction	Speech-enabled interaction for evacuation remained responsive even with ambient noise	Speech-enabled interaction is a valuable and viable feature; retain speech-based interaction as a core feature of the simulation
Speech-enabled interaction	Some learners expected natural conversation throughout, and used phrases and languages outside the NPC's vocabulary	Expand the range of accepted voice commands and increase NPC response options in future builds
Threat Engagement	Learners engaged with threats during the scenarios	Preserve threat engagement and improve the realism of 3D characters
Locomotion	Controller-based locomotion may cause motion sickness	Continue refining movement systems to support both comfort and immersion
Locomotion	Controller-based locomotion and teleportation were helpful when physical space was limited	Include controller-based movement as an option
Firearm Realism	VR hand controllers did not align well with real-world firearm handling, especially for trained police officers	Recognize controller-based weapon interaction may create a risk of negative learning transfer

Specifically, priorities for iteration focused on balancing VR comfort, including motion sickness considerations, with embodied interaction and realistic scenario flow. For example, mobility features were explored to better accommodate real-world constraints. User testing showed that controller-based movements were useful when physical play space was limited or when headset boundary constraints disrupted the learning flow (see Fig. 4).

However, a persistent challenge was the mismatch between VR hand controllers and real-world firearm handling. For trained police officers, using controllers to aim and fire can conflict with established muscle memory, raising concerns about negative learning transfer [8]. At the same time, while marksmanship was not the primary instructional goal of this simulation, basic aiming, shooting, reloading remained necessary in an active-shooter scenario. This concern was echoed during the pilot in the context of assessment: Grading or evaluating physical movement in VR using the same criteria as live training was not appropriate, because movement and interaction patterns in a headset differ from those in real-world scenarios.

Fig. 4. Participants using controller-based movements in a limited physical space.

4 Design Factors for Scenario-Based Learning in VR

Designing scenario-based training in VR requires more than recreating a space in the virtual environment. In high-stakes contexts such as IARD, design choices should carefully consider: 1) The learning objectives and goals: What skill, knowledge, and ability the scenario is meant to develop; 2) The type of fidelity required: What level of realism matters for the particular scenario; and 3) The realities of implementation: How the virtual learning experience will be facilitated, supported, and sustained. The following design factors highlight considerations that may support future VR-based scenario training.

4.1 Structure Reflection and Dialogue to Surface Learners' Mental Models

Learners enter simulations with existing mental models, partial stories about how situations work and what actions matter [9]. Simulations become more instructionally powerful when they make these models visible through prediction, explanation, and debrief. Our pilot reinforced the importance of building time and structure for debrief. Reflection prompts, peer dialogue, and facilitator questioning help learners articulate why they acted as they did, compare alternatives, and revise assumptions. This is particularly important in adult learning contexts where prior experience can both help and mislead. Surfacing participants' mental models by design transforms VR experiences from activity into actionable learning [8].

4.2 Deliberately Manage Emotion and Stress

Emotion is not merely noise; it can be integral to professional performance, especially in conflict-laden or high-stakes IARD settings. Yet stress and emotion can hinder learning when unmanaged or when learners lack the supports to re-regulate and reflect [10]. The pilot highlighted practical ways to support regulation and readiness, such as allowing recruits more time to acclimate in the practice session and onboarding participants without over-explaining the scenario. In immersive scenarios, especially VR, developers and designers must make explicit design decisions about what kind of stress, how much, for whom, and at what stage of training. This includes pre-brief expectations, opt-out pathways, trauma-informed facilitation, pacing, and debrief structures that prioritize psychological safety alongside performance feedback.

4.3 Iterate Through Learner Needs Assessment and Usability Testing

Designers are not representative users, and assumptions about learner behavior can be distorted by the false-consensus effect [11]. Immersive training scenarios benefit from recurring cycles of learner needs assessment and usability testing across stakeholder groups: learners, instructors, program leads, and support staff. Ensuring a smooth and engaging user experience is crucial, as friction not only consumes mental effort but also weakens the instructional goals [12]. For example, learners sometimes missed locomotion controls or struggled with maneuvering early on, suggesting that even small usability friction can shape the learning experience.

4.4 Build for Accessibility with Technology Supports

Access costs are not only financial. They include device requirements, bandwidth, digital literacy, physical capability, and usability accommodations. Without deliberate attention, technology can unintentionally amplify marginalization. Accessibility in immersive simulation includes alternative modes where feasible, onboarding supports, captions and transcripts for audio, clear user interface affordances, comfort and motion considerations, and policies that ensure learners can participate fully. In short, accessibility is not a compliance add-on, it is foundational to adoption. In our pilot, physical space and boundary supports were also part of accessibility and safety: a designated space helped learners access the immersive experience and manage movement.

4.5 Plan for Sustainable Adoption Within Training Environments

Technology adoptions are more successful when they fit the broader learning environment, including curriculum sequencing, instructor capacity, scheduling, assessment methods, technical support, and ongoing maintenance [13]. The design and development team needs to plan not just for the initial development, but for the entire lifecycle: piloting, instructor training, documentation, updates, and evaluation. Achieving this requires a team with diverse expertise. Bringing together instructional design skills and operational knowledge ensures that educational goals, technical feasibility, and practical implementation remain coordinated. Our pilot provided some initial implementation parameters. It is recommended to run the VR scenario with one instructor and two facilitators and roughly 15 mins per learner, after learners received a basic IARD training.

Following the pilot, the Police Academy explored the possibility of integrating the VR scenario more fully into the IARD training program. However, implementation beyond the pilot phase proved challenging. Effective use of the simulation required instructors with specialized expertise who could observe recruits during the scenario and conduct structured debriefs afterward. This observation and debrief component was considered essential to realizing the instructional value of the VR experience, but staffing and scheduling such sessions within the existing training program proved difficult. These implementation challenges delayed further deployment while the academy considered how best to integrate the technology. During this period, developments in equipment and operational practices among police services in British Columbia also evolved. As a result, elements of the prototype simulation no longer aligned with the equipment and procedures used in current training, which ultimately limited further piloting of the system in its existing form.

5 Discussion and Conclusion

This study demonstrated how VR can supplement IARD training by making high-fidelity practice more consistent and repeatable, while still supporting key experiential elements such as moving through space, attending to sensory cues, and responding to interactive task demands. At the same time, the pilot revealed limitations and tradeoffs that are common in high-stakes VR training but difficult to fully resolve. For example, wireless VR headsets such as Meta Quest 2 can limit visual and behavioral fidelity. Locomotion design required ongoing negotiation between realism and comfort, as reducing motion sickness while maintaining embodied engagement demanded iterative testing and user-centred refinement. Limited NPC vocabulary constrained natural communication, pointing to the potential value of future AI-supported interaction. Additionally, controller-based aiming and firing remained a challenge because these actions differ from real-world firearm handling and may conflict with established muscle memory, raising concerns about learning transfer. Despite these limitations, the VR experience was designed to provide an immersive, repeatable experience that supports situational awareness and instructor-led debriefing. In this context, it may be more appropriate for instructors to focus on decision-making, communication, and scenario engagement rather than judging movement or physical mechanics in VR in the same way as in live training.

Future development could examine learner performance and the potential effects of negative learning transfer through quantitative methods. It should also continue to prioritize instructor usability such as onboarding, participant management, and support for facilitation, as well as learner experience such as locomotion options, firearm mechanics, and NPC responsiveness through speech recognition. The work described here represents an exploratory prototype developed in collaboration with the Police Academy and piloted in 2022. Although broader implementation did not proceed, largely due to integration challenges and evolving equipment and operational practices within police services in British Columbia, the pilot provided valuable insights into the design and facilitation requirements of immersive training environments. These insights remain relevant for future VR-based scenario training, particularly in domains where procedures and equipment evolve rapidly. Moving forward, a key direction will be strengthening the linkage between immersive scenario design, learning outcomes, and curriculum integration so that VR experience functions as a purposeful component in the broader IARD training plan rather than a standalone activity [4].

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