Is Immersive Room Feedback Effective?

A Case Study of an EMS Immersive Room Training Program

Kylie Gross and Jourdan Hanna

Department of Education, University of Tampa

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Dr. Minkyoung Kim

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Abstract

The aim of this study was to use a mixed-methods approach to identify if the immediate feedback first responders get in an immersive room training is effective for learning.. Due to Hurricanes Helene and Milton which hit the Tampa/St. Petersburg area in October 2024 the study was not able to be carried out to provide results for this paper. However, investigation of the feedback mechanism in immersive rooms remains a relevant and necessary area for further research.

Background

First responders play a pivotal role in communities by providing patient care and emergency management in highly stressful, dynamic environments. The ability to overcome the body's innate reaction to danger or emergencies requires training and practice and is a crucial component in the education and training of first responders. However, the ability for training exercises to elicit the same level of stress faced in the field is a challenge and may leave first responders underprepared for the impact real-life environments will have on their knowledge recall, confidence, and ability to perform (Eggers, 2023).

The introduction of the Cave Automatic Virtual Environment (CAVE) in 1992 opened the door to study if immersive experiences could enhance learning.Immersive rooms are a type of virtual reality (VR) that project images or video on multiple walls to create the sense that learners are in the simulated environment. Unlike other forms of VR, immersive rooms use real-life images and video instead of ones that are computer generated (Snelson & Hsu, 2020). These rooms can also enhance the experience through touch, sound and smell. The use of immersive rooms for training first responders, specifically paramedics and firefighters, has demonstrated they are capable of providing more realistic training and able to elicit the stress response in first responders better than traditional training methods (Haskins et al., 2020; Kman et al., 2023; Mossel, 2017; Calandra et al., 2023). In these environments first responders can train for dangerous situations in a safe atmosphere, gain muscle memory, improve recall under stress, and develop the ability to assess situations and take decisive action.

Statement of Problem and Purpose of Study

Effective feedback is a critical component of learning that influences learner motivation, performance and retention. Despite extensive research on the benefits of immersive rooms, there is no research on how feedback in these simulators affects learning. As a result, it is unknown if the feedback

mechanism is resulting in positive, tangible learning gains or if it is masking an unknown learning gap. Existing literature on the best type of feedback in VR environments is inconclusive, suggesting that effectiveness of feedback is a complex process with many unknown variables. Therefore, it would be inappropriate to draw generalized conclusions based on data from non-immersive room environments.

The purpose of this study is to evaluate the feedback component of an immersive room at an EMS academy to determine if providing immediate feedback during a simulation has an impact on learning. The intention is to identify if this feedback results in learning gains so future improvements in immersive room design can utilize feedback that enhances educational outcomes.

This study will focus on three questions:

1. Question #1: Do first responders who receive feedback remember the information provided in the short-term?
2. Question #2: Do first responders find the feedback mechanism helpful?

Literature Review

Effectiveness and Role of Immersive Rooms

Although virtual reality (VR) has been around for decades, the release of the Oculus Rift in 2016 brought an affordable version of the technology onto the market. Since then the feasibility of adopting VR for education and training has sparked considerable research on the effectiveness of this technology, especially for medical professionals and first responders. This may be because VR overcomes a number of limitations present for live-simulation training of healthcare professionals. Unlike traditional live simulations or skill practice labs, VR provides the opportunity to practice uncommon, high risk scenarios safely (Haskins et al., 2020; Eggers, 2023; Wilkerson et al., 2008), greater ability to simulate real-life chaos in emergency situations (Baetzner et al., 2022), and increases the types of scenarios that can be

practiced (Maciejewski et al., 2020). Interviews with first responders echo the importance of VR in conducting high risk training and the importance of the “chaos” it allows them to experience (Haskins et al., 2020). Additionally, first responders report positive experiences with VR usage and demonstrate increased motivation and engagement throughout multiple studies (Snelson & Hsu, 2020; Pirker & Dengel, 2021; Das, 2023).

Similar to other fields, there is mixed evidence on the effectiveness of VR training for first responder learning. Literature reviews on all forms of virtual reality as well as reviews specific to 360° immersive environments indicate there are other factors that contribute to whether learning gains are realized (Baetzner et al., 2022; Pirker & Dengel, 2021; Snelson & Hsu, 2020).

It is important to acknowledge that despite thorough review of the literature, these results may not be representative of all virtual reality or 360° environments. One population that is underrepresented in research is 360° environments that do not require the use of head-mounted devices (HMDs) or goggles to facilitate the experience. Of the three literature reviews, only three studies involved the use of a CAVE environment and at least one of those required the use of glasses. This may impact the applicability of these studies as it is possible the use of headsets may result in cybersickness that could affect learning outcomes. Additionally, the measures being used to identify learning may not be appropriate for certain types of situations. Despite mixed findings on improved learning outcomes, the use of VR, specifically immersive rooms, in training cannot be dismissed.

First responders work in demanding and chaotic environments that often cannot be replicated in traditional education settings. As a result, when they encounter these stressors they may be unable to translate the knowledge they have into practice. Wilkerson et al. (2008) confirmed this during a study where they developed a simulated training for an explosion at an athletic event. The study showcased that although first responders had knowledge on protocols for managing this type of disaster, the chaos created by the immersive simulation resulted in mistakes including: 85% failing to notify local hospitals of

the incident, roughly half did not communicate critical information about the incident to dispatchers, command posts were set up in dangerous locations, and no one identified a second, unexploded bomb in plain sight. Following the training participants acknowledged prior training had not been able to replicate the stress and anxiety of real disasters and that additional training using immersive simulation would be beneficial (Wilkerson et al., 2008). First responders in a separate study by Haskins et al. (2020) drew similar remarks about unparalleled experience they gained from the use of immersive simulators and the need for additional training using this technology. Furthermore, Eggers (2023) found that paramedic students who went through immersive simulation training prior to entering the workforce were better able to translate their knowledge into practice, think critically, and were better prepared than students who did not engage in training through an immersive simulation. Overall, the research demonstrates there are gains from including immersive simulation in the training of first responders.

Feedback in Immersive Simulations

Feedback is a crucial part of the learning process; however there is little consensus on if immediate or delayed feedback is better for learners. In an attempt to reconcile the discrepancies and mitigate extraneous variables from other research, Corral, Carpenter & Clingan-Siverly (2021) standardized the mechanism, timing, and duration of feedback across an immediate and delayed feedback group. Their findings, however, found the type of feedback had no effect on concept learning. Bolton (2006) hypothesized that feedback cannot be generalized to the entire learning process and attributed the differences in studies to factors such as the experience, cognitive load, and the nature of the task being learned. Results from this study found that for simulation based learning the nature of the task significantly impacted the effectiveness of immediate feedback. Furthermore, despite learners with a high cognitive load reporting higher frustration with immediate feedback, they also preferred it to delayed feedback in the later stages of training. These results strengthen the argument that feedback mechanisms

One of the benefits of immersive rooms over traditional simulation training is the ability for learners to receive immediate feedback (Haskins et al., 2020; Wilkerson et al., 2008). However, despite extensive review the authors of this study are unaware of any published research that studies the effectiveness of immediate feedback in immersive room environments. One study discussed the enhancement of learning that results when post-simulation debriefings are conducted (Morley et al., 2019); however it would be hasty to assume this applies equally with immersive room simulations. Additionally, Morley et al. (2019) identified students experienced challenges when they received feedback in one location, such as in a practice scenario, and then needed to recall and implement that feedback in a real-life situation. This further reiterates the need to study the effectiveness of the feedback mechanism in the immersive room experience.

Limitations of Current Research

While extensive research has been done on virtual reality and feedback, there is little research specific to 360° immersive rooms. Presently, the authors were only able to find one study that utilized an immersive experience that did not require the use of a headset or goggles and also used real-life images to develop the immersive scene. Due to limited research on these particular 360° environments, research specific to the immediate feedback is needed to determine the best practice for these programs.

Significance of the Study

While VR and AR have been studied quite extensively, studies specific to 360° immersive rooms are minimal and the authors are unaware of any studies exclusively looking at the effectiveness of feedback in these environments. This lack of research demonstrates there are significant gaps in the current literature about what works best in immersive environments and how to improve the design of these programs. It is the goal of this study to provide new information on if immersive experiences

feedback is satisfactory on its own and to identify potential opportunities for improvement of immersive rooms in the future.

Ethical Considerations

This study was developed using consenting adults from an EMS Academy that utilizes immersive rooms in training. Participants were provided with an informed consent outlining the research and the requirements of the study which included participating in the immersive room, completing a survey and interview with the researchers, and were permitted to withdraw from the study at any time without penalty. Although the research was scheduled to be conducted at an institution for training EMS professionals, participation in the study was not a requirement of any course nor did it provide any other incentive or benefit such as extra credit. There is no known harm or discomfort to the participants beyond what they would normally experience in coursework at the EMS Academy and immersive room outcomes, surveys and interviews were kept confidential. The study was conducted in an effort to improve future immersive room simulations and participants derived the benefit of additional practice time in the immersive room suite.

Study Limitations/Future Research

This study was designed to study a small sample of paramedics in Pinellas County, Florida. There is the potential for the study to be non-representative of the entire paramedic industry or representative of all first responders or medical personnel. The facility where this research was to be conducted also uses an immersive room as part of their standard curriculum. While mechanisms are in place to determine if prior immersive room experience affects the performance or the views of the participants it is possible that participants without prior exposure to immersive room technology may not align with the results of this study. Additional limitations may also apply depending on the demographics of the

sample population, however it should be noted that because participants opt into the study they may already have more positive biases about immersive rooms which may be reflected in their opinions on the effectiveness of the feedback mechanism. Future research should consider diversifying the sample population and extending it to other first responders (such as firefighters and police) as well as to other sectors.

This study was designed to be conducted in the fall of 2024 in the Tampa Bay area. However, it was unable to be carried out due to Hurricanes Helene and Milton which hit the area within 2 weeks of each other. This disrupted the timeline for research as well at the university as well as at the EMS Academy where the immersive room is set up and which was the site for data collection. As a result, the authors were unable to complete the study during the designated time frame. However, to facilitate further research in this area the study protocol was developed in the remaining sections of this paper.

Data Collection

This study was designed to be conducted using a pre-generated scenario in Echo Healthcare's Immersive Interactive experience at the EMS Academy in Pinellas County, Florida. Immersive Interactive is a 270° room that transforms learning by immersing learners in a real-life environment by projecting images onto blank walls in a windowless room (Echo Healthcare, 2024). All study participants will utilize the same scenario in the immersive room to prevent inconsistencies related to the type of scenario being used.

Study Participants

A minimum of 15 participants would opt into participation in this research. To recruit participants, students at the EMS Academy in Pinellas County would be notified by a coordinator that a study is being conducted and that they can elect to participate. Participants would all be over the age of 18, have various work backgrounds, ages, and genders. There would be no incentive provided to

participants, however they would derive benefit by being able to practice a scenario in the immersive room outside of normal class hours.

Data Collection Process

Prior to participation all participants, and potential participants, will be given an informed consent (see Appendix A) and only participants who agree to the consent would be included. The informed consent includes information about the study, the ability to withdraw at any time, and that they can reach out to the principal investigator, co-investigator or The University of Tampa Institutional Research Board for questions or concerns during or following the study. Each participant is then assigned a randomly generated identification code to be used on all data materials to keep their identity confidential. To begin the study, each participant will then take part in the pre-designed immersive room. During the immersive room the researchers would keep track of each instance when the participant received feedback on the Feedback Tracking Sheet (see Appendix B). Immediately following the immersive room each participant is to be provided with a paper survey (see Appendix C) and a pen and will complete the survey at their own pace. This is expected to take approximately 3-5 minutes. Following the survey the participant will engage in a 3 question interview with the researchers (see Appendix D). To conclude their participation, each participant will be read a debriefing statement (see Appendix E) thanking them for their participation and providing them the information of the researchers and IRB again should they have follow-up questions or concerns.

Instruments and Design

The quantitative component of the research consists of a 6 question survey (see Appendix C) designed to be taken immediately following participation in the immersive room. Participants would identify themselves using their assigned identification code The survey asks 2 demographic questions (age and gender), and also asks about prior medical experience, length of time working as a paramedic and how much immersive room experience they had previously. The purpose of these questions is to

determine if there is a correlation between experience professionally or in the immersive room and the amount of feedback or the ability to recall errors from their immersive experience. The survey concludes with a short answer question asking the participant to list all feedback they could recall in the immersive room.

The qualitative component of the research would follow the completion of the survey. Participants would be asked 3 questions during an interview with the researchers about how they felt the feedback mechanism affected their learning. The researchers would take notes on their answers but no audio or video recording would be conducted to protect the identity and keep the responses confidential.

Data Analysis

The data collected would be used to analyze the following research questions:

1. Do first responders who receive feedback remember the information provided in the short-term?
2. Do first responders find the feedback mechanism helpful?

To determine if participants recalled the feedback they received, each participant's response from question 6 on their survey would be compared to the Feedback Tracking Sheet (see Appendix B) kept by the researchers. An average percent recalled could then be derived for the sample population to determine the overall effectiveness of the feedback mechanism. Using raw figures, the data would then be analyzed to determine if there are any trends that can be associated with years of experience or immersive room experience and the ability to recall feedback. If such trends exist, findings would be reported through visual representation and explanation in an accompanying report. Furthermore, these

factors can be investigated to see if they affected the amount of feedback received and again reported visually.

Participant interviews would be examined for commonalities regardless of if they are positive or negative toward the feedback mechanism. Findings would then be aggregated and summarized and, if consensus exists, percentages would be drawn to determine how many participants aligned under certain beliefs, such as that the feedback was helpful or if they found it distracting. Aggregated data on the demographics of the participants would also be provided to give context and discuss limitations that may exist surrounding the diversity of the sample population.

While research on feedback mechanisms in virtual reality settings and especially in immersive rooms is limited, data analysis would benefit from being compared to existing findings in the literature in these areas.

Conclusion

Although this study could not be completed as originally designed due to the impact of Hurricanes Helene and Milton on the Tampa Bay area, the research questions proposed should continue to be investigated in future field research. The lack of studies on immersive rooms that do not require the use of a headset or goggles coupled with the absence of research on the feedback of immersive rooms creates a large gap in understanding how best to implement these instructional tools. As the use of virtual reality expands it will be critical to develop additional studies that look specifically at immersive rooms to ensure learners derive as much benefit as possible from these experiences. This is especially true for first responders who rely on immersive rooms to generate life-like situations that allow them to practice in chaotic, stressful settings that are otherwise unavailable but critical to enhancing their performance in the field.

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Appendix A

Informed Consent Form

INFORMED CONSENT

Project TItle: Is Immersive Room Feedback Effective?

Principle and Co-Investigator: Jourdan Hanna, jourdan.hanna@spartans.ut.edu;
Kylie Gross, kgross@ut.edu

Purpose of Study: The purpose of the study is to evaluate the feedback component of an immersive room.

Procedures: Study procedures will take place at the EMS Academy in Pinellas County. Participants will interact with a pre-designed immersive room scenario created by the EMS Academy. Following the immersive room, participants will complete a survey and short interview with the study investigators.

Risks/Benefits: There is no known potential for physical, social or emotional harm in this study. Participants will benefit by getting additional time and experience in an immersive training simulation.

Confidentiality: All data collected in this study will be confidential. To protect the identity of participants they will each be assigned a random participant code. The list of participant names and associated codes will only be stored in a password-protected document on the local drive of the researchers' computer. At the conclusion of the research report the data will be deleted from the local drive and permanently deleted from the computer.

Conditions of Participation: Participation in this project is voluntary, and refusal to participate or withdrawing from participation at any time will involve no penalty or loss of benefits to which the subject is otherwise entitled. The investigators may terminate participation of the subject or the project entirely without regard to the subject's consent. In the event of difficulties or concerns during or following participation, the subject may contact the Principle or Co-Investigator as indicated above. Participants may also contact the Institutional Research Board (IRB) at The University of Tampa (irb@ut.edu) if there are any questions or concerns about the study.

Participant Consent

I have read the above information and my questions and concerns, if any, have been responded to satisfactorily by project staff. I believe I understand the purpose, benefits, and risks, if any, of the study, and give my informed and free consent to be a participant.

_____ _____

Signature of Participant Date

Appendix B

Feedback Tracking Form

INTERNAL USE ONLY - FEEDBACK TRACKING SHEET

Assigned Identification Code _____

List all feedback received by the participant during the immersive room scenario:

Appendix C

Post Session Survey

POST-SESSION SURVEY

Assigned Identification Code _____

1. How old are you?
    - 18-24 years old
    - 25-34 years old
    - 35-44 years old
    - 45-54 years old

2. How many years of experience do you have as a paramedic?
    - 0 years/ Student
    - 1-3 years
    - 4-6 years
    - 7-9 years
    - 10+ years

3. What is your sex?
    - Male
    - Female
    - Prefer Not to Specify
    - Other (please specify)

      _____

4. Do you have any other medical experience prior to being a paramedic?
    - No
    - Yes, please specify number of years and position(s):

      _____

5. Excluding today's session, how many other times have you participated in an immersive room?
    - 0
    - 1-2
    - 3-4
    - 5-6
    - 7-8
    - 9-10
    - 10+

6. During the immersive experience you may have received feedback about errors you made. Please list all of the errors that were brought to your attention.

   _____

   _____

   _____

   _____

   _____

Appendix D

Interview Questions

INTERNAL USE ONLY - INTERVIEW FORM

Assigned Identification Code _____

1. What do you think about the feedback mechanism in the immersive room? Include both positive and negative experiences.

2. Did you find the feedback helpful or was it a hindrance to your learning? Please elaborate.

3. Is there anything else you would like to share about the immersive room or the feedback it provides?

Appendix E

Interview Protocol and Debriefing Statement

INTERVIEW PROTOCOL

Interview Protocol:
All first responders who participate in the study will be interviewed following their completion of the survey. The interview should take between 2-3 minutes and will take place privately in the immersive room studio. Only the research investigators and the participant will be present. The research investigators will take notes during the interview. No audio or video recording will occur. Participants will be identified using their assigned identification code.

Participant Guide:
Thank you for participating in our research today. As previously mentioned, we are studying the feedback mechanism in the immersive room and its effectiveness on learning. We appreciate you volunteering to partake in our study. As with other aspects of this study, all answers during this interview will be kept confidential and you are not required to answer any question that makes you uncomfortable, and you may stop at any time. Do you have any questions before we begin the interview?

Questions:

1. What do you think about the feedback mechanism in the immersive room? Include both positive and negative experiences.
2. Did you find the feedback helpful or was it a hindrance to your learning? Please elaborate.
3. Is there anything else you would like to share about the immersive room or the feedback it provides?

Closing Script: We want to thank you again for participating in our study. As previously discussed, the aim of our research is to assess feedback mechanisms during immersive room training. This is on-going research, so please do not discuss the materials and research rationale with friends and classmates. They may take part in the research at a later date, and prior knowledge of the study may influence their responses. Our results will be available in December of 2024. If any questions, undesirable consequences, or concerns arise then please contact Jourdan Hanna (jourdan.hanna@spartans.ut.edu), Kylie Gross (kgross@ut.edu), or the Institutional Research Board (IRB) at The University of Tampa (irb@ut.edu).