

# The Effects of Using Emotions in VIRTUAL REALITY TRAINING

By Richard Hannah

**DESPITE IMPROVEMENTS** in safety and health training for workers in the energy industry and construction trades that support the energy industry, key indicators used to gauge contractor safety have remained level since 2015. However, according to U.S. Bureau of Labor Statistics (BLS) data, severe violations in safe work practices and procedures that lead to injuries or fatalities continue to occur. The energy and construction industries continue to face significant challenges to the safety and health of their operator and contractor workforce, even though these industries' safety records are better than average among all industries tracked by BLS (2022a). Safety metrics have not improved significantly despite innovations in tooling and improvements in safe work practices and procedures in recent years. In 2020, total recordable cases for the construction industry (injuries per 100 full-time workers) reached a total recordable incident rate of 2.5 (BLS, 2022a). This rate includes much of the work done by contractors in the energy industry. Although a total recordable incident rate of 2.5 is lower than the national average among other industries, this number includes 1,034 fatalities within the energy industry, an overall increase from previous years. In 2021, 798 worker fatalities were caused by exposure to harmful substances or environments, the highest total number of U.S. worker fatalities since 2011 and an 18.8% increase from the previous year (BLS, 2022b).

Production facilities in the energy industry are challenging workplaces with many hazards that must be mitigated to ensure worker safety. Operating in and around confined spaces

is a hazardous work task on these jobsites that can lead to injuries or fatalities. According to BLS (2022c), 1,030 confined space fatalities occurred between 2011 and 2018. Exposure to harmful substances or environments, a classification for permit-required confined space work and hazards, led to more worker fatalities in 2021 than in 2020 and the highest number of fatalities in this category for the past 10 years (BLS, 2022b; Hannah, 2024a).

In the U.S., OSHA offers training and compliance standards to organizations that support the energy industry, workers who enter the energy industry, and workers already in the industry. OSHA's training standards have reduced the likelihood of severe safety incidents and decreased injury and fatality incident rates since the introduction of the process safety management standards in 1992; however, improvements in training are necessary to continue to drive incident rates down and protect workers. According to BLS, the energy industry employs more than 300,000 new employees every year, and the construction industry accounts for nearly 11 million workers in the U.S. workforce. That number is expected to rise again to prepandemic levels, around 12 million workers. If the energy industry expects to gain nearly 400,000 new jobs by 2030 in construction-related trades, an increase in total recordable incident rate would mean more full-time workers exposed to potentially fatal jobsite hazards.

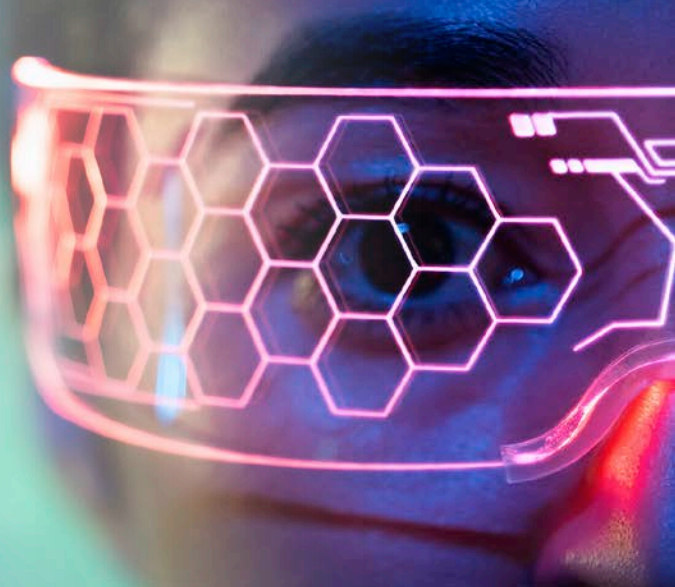
OSHA mandates that contractors who support the energy industry receive initial and annual refresher training on confined space dangers and safe work practices (OSHA, 2015). Most of this is delivered through computer-based training (CBT). CBT is easily scalable to large populations, provides consistency across a workforce, and can track and quickly report compliance. For training to be effective, however, the learner must retain information from the training and apply it in the field. This transfer of learning is the person's ability to use the skills and knowledge gained in training in a work environment, which is imperative for safe work practices and procedures. According to Haskell (2000) cited in Hannah (2024b), transfer of learning is the learner's ability to apply what has been learned in training in another similar, yet wholly different, context (Hannah, 2024b). Haskell identifies six levels of transfer of learning:

- 1) nonspecific transfer, where learning has a trivial connection to past experiences for the learner,
- 2) application transfer, where learning is applied to a specific situation,
- 3) context transfer, where learning is applied in a slightly different context from that in which it was trained,
- 4) near transfer, which is similar to context transfer but where learning is transferred to new or similar situations,
- 5) far transfer, where learning is applied to a new situation, and

## KEY TAKEAWAYS

- The purpose of this study was to investigate the effects of emotionally resonant videos on knowledge retention and the potential for transfer of learning for adult learners who take virtual reality (VR) computer-based training (CBT) courses on confined space awareness.
- The intent was to optimize VR exercises that are used to support energy industry workers who train at safety training councils. The experimental group took a CBT course augmented with VR exercises and work-relevant videos designed to arouse an emotional response. Participants in the control group took the same CBT course with VR exercises but without the videos.
- A quantitative analysis was performed on data collected from a follow-up quiz delivered 3 days after course completion. Quiz data were analyzed to determine whether there was greater knowledge retention and, therefore, increased potential for learning transfer among the experimental group than the control group.
- The results found a non-statistically significant relationship between the groups and provided insight about whether and how to use emotion as an initiative in safety campaigns and training.

# on to Optimize TRAINING



6) creative transfer, where learning is applied in new ways and where new concepts could be created.

Finding ways to make CBT more effective in inspiring application transfer, context transfer, and near transfer has the potential to improve safety metrics and keep more workers safe on energy industry jobsites, especially for employees entering and working in and around confined spaces.

When developing CBTs, various methods can be used to help inspire greater learner engagement and produce more long-lasting memories for adult learners, including job-relevant videos, interactive slides, animations, case studies, reflective practice, and virtual reality (VR) exercises. Studies have shown that providing CBTs that engage and allow the learner to practice, reflect and simulate real-world experiences in VR leads to more durable memory development (Boller et al., 2021; Kamińska et al., 2020; Knörzer et al., 2016). A study of work practices in petrochemical plants that included both VR and non-VR training showed that learners who completed training in a VR environment had more effective transfer of learning (Colombo et al., 2014; Hannah, 2024b). Other industries are seeing reduced training costs and time using VR as a training tool. Safety training using VR simulations has two main strengths. First, it can allow learners to practice high-risk procedures in a safe, simulated and realistic environment. Secondly, it can help make complex and complicated training more accessible for learners through practice and iteration.

Kolb's learning cycle is founded on the idea that adult learners alternate between action and thoughtfulness or active learning and reflection (Fenwick, 2004; Kolb, 1984; Merriam & Bierema, 2014). This cycle is described by other learning theorists such as Piaget (1977), who expresses that learning is a continuous cycle of mutual interaction between the accommodation of concepts to experience and the process of assimilating these experiences to previous world experiences. Kolb's learning cycle includes this interplay between action and reflection as it leads from concrete experience to observations and reflection, followed by the formation of abstract concepts and the learner's testing of these concepts in new situations before starting the cycle again. This study's framework provides learners an opportunity to interact with a simulated training environment and have that experience modified, allowing it to shape future experiences and give learners a chance to reflect and observe. The VR exercises in the present study were designed to let learners perform actions that were taught via the CBT course in a VR environment (Figure 1) and, when followed by an emotionally resonant video, the learner had an opportunity to reflect, analyze, construct meaning and build on concepts with which they had previous experience.

As VR technology improves and becomes more accessible, VR studies have focused on how virtual simulations can be optimized to increase training effectiveness using greater presence, immersiveness and embodiment; how VR simulations can create an opportunity for greater self-efficacy for learners; and in what ways VR courses can enhance learner motivation. Several studies investigate how to optimize VR using multisensory cueing methods such as using distinct smells or tactile feedback, and acceptance of VR as a training technology. Integrating and optimizing VR into a safety council's standard course delivery systems can improve learning transfer for the worker, knowledge retention of course and safety information, and learning outcomes for workers who visit safety councils or other learning communities that rely on CBT. Integrating VR with emotionally resonant videos into CBT courses could further optimize the effectiveness of these and similar courses, potentially improving safety standards for industrial workers in the field.

Although numerous studies show the effectiveness of VR training, few studies apply emotion to VR through storytelling techniques and measure the potential for learning transfer to occur. Additionally, very few studies focus on how VR training with emotionally resonant videos can be applied within the community of contract industrial field workers who support the energy industry. Research shows that emotion can be leveraged in training to enhance the encoding and durability of memories of learning objectives (Brown, 2014). Many studies show that emotional arousal for adult learners, regardless of the learning delivery or environment, can lead to greater memory durability. Some of these studies also demonstrate a link between memory

## FIGURE 1 VR ENVIRONMENT

Sample screen from the VR exercise, performing safety attendant duties.



encoding and durability with emotion type. Holland and Kensinger (2010) explain that adult learners are more likely to recall memories filled with emotions and that relevant and personal experiences are more likely to be remembered. According to Oatley and Johnson-Laird (2014), emotions can enhance empathy and reasoning in adult learners and help consolidate memory. Many researchers have found that memories associated with highly emotional moments are often easier to recall, even with long gaps between memory development and the recall event (Holland & Kensinger, 2010).

Emotion also stimulates learning and the development of more durable memories. Dirkx (2001) states that when confronted with powerful emotions, the learner utilizes mental images to construct meaning. In their study of emotions' impact on memory, Tyng et al. (2017) explain that stimulating learner emotions can increase the chance for more emotional information to be encoded in the long term. Brosch et al. (2013) found that emotion impacts the learner's degree of attention and perception during learning and creates an emotionally resonant moment, leading to more focused memory development. Neurobiological systems and systemic functions at the heart of emotional memory development, such as the hippocampus and amygdala, can also aid learners in recall. Kuriyama et al. (2010) found that while the hippocampus is integral in encoding event memory, the amygdala is critical for emotional memory construction. Researchers find that the amygdala's role in memory development is greater than previously thought because of the system's relationship with emotion. Studies show that emotional memories are better retained by learners than neutral ones, and this is at least in part because of the amygdala's work encoding emotional stimuli.

## Materials & Methods

The research question guiding this investigation was whether learner recall differs between participants who completed traditional CBTs augmented with VR exercises and those who completed the same training enhanced with emotionally resonant videos. The videos, which were shown immediately after the VR exercise and played within the VR headset, depicted interviews with friends and family members of a worker who was killed in a confined space jobsite similar to what the learner experienced in the VR exercise. Transfer of learning was measured by recall quizzes provided 3 days after course completion.

The present study followed an experimental research design using quantitative data analysis with an independent variable. This design included three essential aspects of experimental research: random assignment, the opportunity to include a control group, and the opportunity to manipulate an independent variable. The sample for this study included energy industry contractors who worked in the Gulf Coast region of the southern U.S. and visited a safety council to take a confined

**TABLE 1**  
**FOLLOW-UP RECALL QUIZ**

Question text	Correct answer
What are the potential hazards of a spark or fire occurring in a tank? a) engulfment due to sloping sides b) electrostatic discharge leading to electrocution c) explosion of latent flammable gases d) accumulation of hazardous gases such as H <sub>2</sub> S	c) explosion of latent flammable gases
What should an attendant or hole watch immediately do when fire is present in a confined space? a) allow confined space entrants to decide b) use a Class C extinguisher on the fire c) call for help or fire response via phone d) order evacuation of all entrants	d) order evacuation of all entrants
Which of the following is a permit-required confined space? a) storage tanks, vaults and excavations deeper than 4 ft b) motor control cabinets or crawl spaces c) semitrailers or hoppers d) scaffold platforms or roof access areas taller than 6 ft	a) storage tanks, vaults and excavations deeper than 4 ft
Which of the following is an example of entry into a confined space? a) testing the atmosphere using a meter wand b) applying barricade tape on the outside of a hopper c) climbing down to grab a tool that fell into a 4-ft-deep ditch d) all of the above	c) climbing down to grab a tool that fell into a 4-ft-deep ditch
Whose primary responsibility is ensuring the safety of entrants of confined spaces? a) the attendant or hole watch b) the entry supervisor c) the entrant d) rescue services	a) the attendant or hole watch

space awareness course (Hannah, 2024b). Learners in the control group took the course with VR exercises, while learners assigned to the experimental group took the CBT with VR exercises and emotionally resonant videos. The material in both courses was identical apart from the emotionally resonant video for the experimental group.

As contracting organizations registered learners for confined space training, the safety council learning management system randomly assigned them to one of the two groups. Both groups included information that would allow the participant to be trained to the OSHA compliance standard. The study was conducted over 3 months to ensure that the minimum number of participants needed for a between-subjects study to maintain adequate power (approximately 30 participants per group) was met. A follow-up recall quiz sent via short message service (SMS; text message) to participants' smartphones 3 days after course completion acted as the posttest measurement instrument to determine recall and measure the potential for transfer of learning among the groups. The 3-day delay was in line with other studies measuring VR knowledge retention (Bréchet et al., 2019; Kamińska et al., 2020; Karpicke & Roediger, 2008).

Confidentiality was maintained for all research participants, and data was not linked to the participant's name or other identifying information. Participant names were not shared with their organizations, and contractor organization names were not shared with the safety council. Data collection began after the study was approved by the safety council's executive leadership team and the Kansas State University Institutional Review Board. Study participants were given informed consent

to participate in the study prior to beginning the course. The researcher and the safety council ensured that there were no financial or other interests in collecting participants' data or in the analysis and write-up of the results. Study participants, regardless of condition, completed the courses at the safety council contractor training facility using one of the standard computer terminals used by that council for course delivery. The course was proctored by safety council members at all times. All assets for this study were developed by the safety council learning development team and delivered with the safety council customer service and proctoring teams.

The CBT sections of the course were developed using Articulate Storyline course development software. This e-learning authoring tool enables instructional designers to develop customized training content that is engaging and accessible across multiple devices and delivery modes. Tools in the software include drag-and-drop interactions, quizzes, simulations, and branching scenarios, which enhance learner engagement and retention. The software also supports SCORM, xAPI, and AICC standards, ensuring seamless integration with learning management systems. The digital assets and adult learning techniques used for the CBT course included multiple narrators for audio narration, an unscored pretest, animations, explanation videos, interactive scenarios, 26 unscored in-course knowledge check questions with remediation for incorrect answers, and a 25-question course final exam.

Participants completed four distinct VR exercises, including an introductory exercise designed to help orient the participant to the equipment and the simulation, and three 5-minute exercises developed to help reinforce confined space knowledge and general practices or procedures. The VR exercises were designed by the safety council's instructional designers with the intent to support the CBT course. Participants completed four distinct exercises and took the VR exercises at the same workstation as the CBT course without having to change positions. The VR exercises were developed using the Visual Studio, Unity and Blender software and applications, and were vetted by industry subject matter experts. The VR exercises included audio narration, four timed exercises that supported the information provided in the CBT, and a virtual space designed to simulate a jobsite that a contractor supporting the energy industry might encounter (Hannah, 2024b). Seated modality, as opposed to room-scale, was used to best fit established safety council procedures.

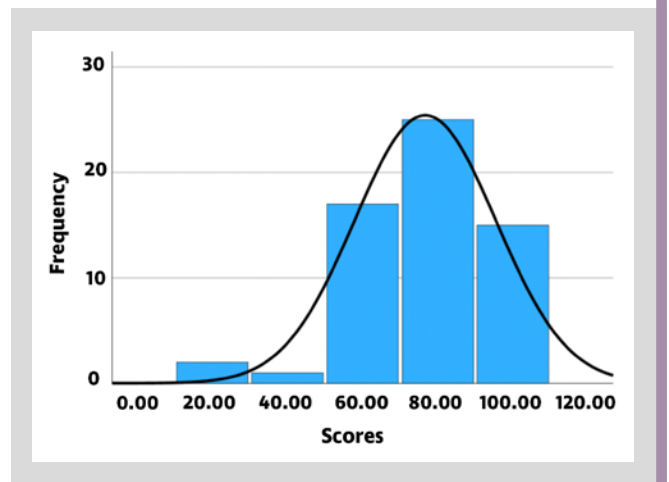
The VR exercises were designed to last 3 to 5 minutes each and were developed to help reinforce confined space knowledge and general practices or procedures. These exercises included an introduction that helped participants understand how to use the VR equipment and interact with the virtual world, an exercise that asked learners to identify different types of confined spaces, an exercise in which learners selected appropriate PPE and safety equipment to use for specific confined space types, and an exercise that placed the participant in the role of a hole watch or safety attendant.

Developed by the safety council instructional designers, the emotionally resonant videos included a 4-minute overview of an incident that occurred in an industrial setting, publicly available news video clips of the deceased worker's friends and family member reactions to the incident, and a trainer discussion of the importance of the training. The video footage was deliberately selected to inspire a sense of empathy from the learner by including publicly available video testimonials about

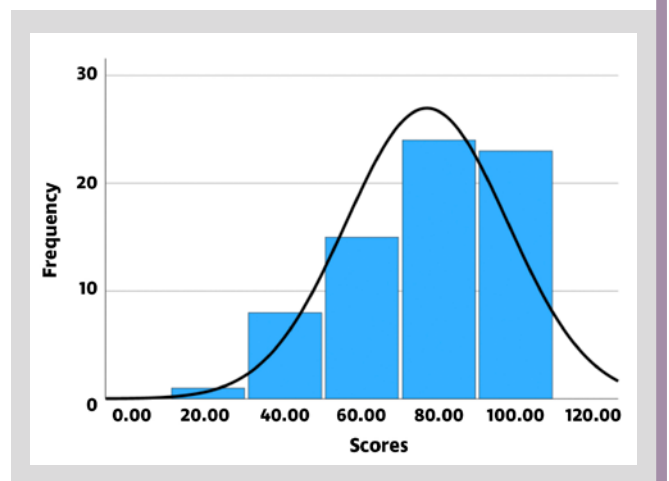
the victim from friends, relatives, and officials involved in the incident or who knew the deceased worker.

A disclaimer notice with contact information for a national post-traumatic stress disorder outreach and consulting service through the Substance Abuse and Mental Health Services Administration was provided at the end of the course with the emotionally resonant video for study participants to use if the video triggered trauma for them. Since releasing the emotionally resonant video to the safety council VR learners in 2022, there have been no reports of any concerns regarding learners being triggered by the videos. The absence of any complaints or obvious emotional distress has led the researchers to believe that the videos, which purposefully avoided any graphic visuals of the incident, met the intended goal of evoking sympathy or empathy among the participants without triggering a negative response. The emotionally resonant videos were carefully crafted to focus on the human elements of the events and emphasize the personal and relational aspects of the narratives with the aim of encouraging viewers to internalize the content more meaningfully.

**FIGURE 2**  
**SCORE DISTRIBUTION: VR-ONLY**



**FIGURE 3**  
**SCORE DISTRIBUTION: VR & VIDEOS**



Regardless of group, all participants were sent a follow-up recall quiz 3 days after the course completion. The quiz consisted of five questions designed to judge the study participant's knowledge retention of the learning objectives. The questions were multiple choice with only one correct answer and three incorrect answers per question. This quiz was delivered via text message. A reminder text was sent to the learner's smartphone the day after course completion to establish contact with learners and encourage them to complete the follow-up recall quiz. Another reminder was sent to nonresponsive learners after the initial 3 days and again 10 days after course completion. All results from the quiz were analyzed regardless of how many days the participant took to answer the questions. There was no capability to determine whether a participant completed the quiz 3 days or weeks after the course, which means that this study analyzed recall with a minimum of 3 days recall gap between course completion and recall measurement, but the maximum time was limited by the study's end date.

Study participants who failed courses or had an opportunity to take the course, the course exam, or the follow-up recall quiz more than once were removed from the data before analysis to ensure that those who had multiple opportunities to learn the material did not affect the internal validity of the study from the learning or practice effects. Once data was collected from the study participants, various measures were used to address and provide insight to answer the research questions based on principles of analysis provided by Bridgmon and Martin (2013), Keppel (1991), and Williams et al. (2022). Data from the variable collection form and quiz scores were imported into SPSS software to analyze and address the research questions.

## Results

During the study period, the safety council had 42,372 visitors for training across all sites and online. Of those, 501 were registered for and assigned to one of the study's groups. Of these 501 potential participants, 397 (79%) completed the course, consented to participate in the study and received a follow-up recall quiz delivered to their phones 3 days following the completion of their course. Of the 397 participants who received recall

quizzes, 131 (33%) completed the follow-up recall quiz such that: 60 (46% of respondents) were randomly assigned to the VR-only group, and 71 (54%) were randomly assigned to the VR with emotionally resonant video group. Because 131 participants completed the follow-up recall quiz, more than 30 per group, the threshold for an appropriate sample size was met by this study. Table 1 (p. 24) shows descriptive statistics for each group of the follow-up recall quiz participants' scores.

Based on the histograms of the quiz scores shown in Figures 2 and 3 (p. 25), there was an approximately normal distribution of quiz scores across all three groups. This distribution of results and the descriptive statistics shown in Table 2 indicate that the results are likely to be generalizable across a larger population. This means that the study's findings can confidently and reliably be extended to a broader population or other similar situations (Bridgmon & Martin, 2012; Williams et al., 2022).

To check that the results can be analyzed appropriately and with the confidence needed to rely on the results, a statistical test known as Levene's test was performed on the data. Levene's test checks whether different groups have similar amounts of variation in their data. This helps to understand whether the groups compared in the study are similarly consistent, which is important for the reliability of the results. When applying Levene's test to this study's data, the results show that the variances of the groups' means across the different groups are statistically equal, meaning that there are similar levels of consistency or dispersion of the data. In practical terms, passing Levene's test allows researchers the opportunity to proceed with analyses such as analysis of variance (ANOVA) or *t*-tests, with more confidence that the data is meaningfully correct.

The next step in the analysis is to determine how much impact the VR with video treatment had on the follow-up quiz scores. This is done through either a *t*-test when comparing two independent groups or through ANOVA. This analysis revealed that the effect was very small, almost negligible. In other words, the VR with video treatment did not seem to make much difference in how well participants performed on the quiz 3 days after course completion. For these tests, a *p*-value result that is less than a target value generally indicates that there is statistical significance between the groups. In most cases, the target for a *p*-value is .05. For this study, the *p*-value results were not < .05. The ANOVA shown in Table 3, found that there was no statistical significance in knowledge retention for participants who completed confined space courses with VR and emotionally resonant videos. In simpler terms, this result suggests that any difference can be just as easily attributed to chance variation rather than the application of the emotionally resonant video.

**TABLE 2**  
**DESCRIPTIVE STATISTICS**

Group	<i>n</i>	Mode	Median	Mean	Range	Min/Max	IQR
CBT with VR	60	80 (25)	80	76.67	80	20/100	60 to 90
CBT with VR and video	71	80 (24)	80	76.90	80	20/100	60 to 100

Note. The maximum score is 100. IQR = interquartile range.

**TABLE 3**  
**ANALYSIS OF VARIANCE RESULTS**

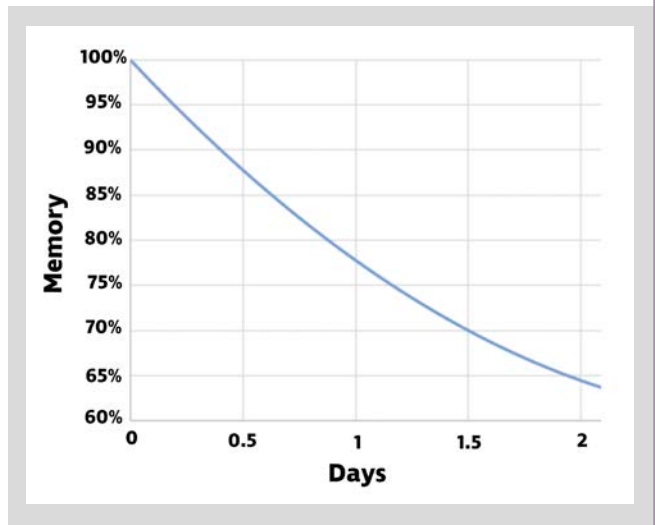
Source	DF	SS	MS	F stat	<i>p</i> value
Between groups	1	1.7913	1.7913	0.0045	.9469
Within groups	129	51,851.5782	401.9502		
<b>Total</b>	<b>130</b>	<b>51,853.3695</b>			

Note. DF = degrees of freedom; SS = sum of squares; MS = mean square; F stat = Fisher statistic, or the ratio of the mean square between; *p* value = probability value.

## Discussion

The implications of this research can aid safety professionals and instructional designers within the community of learners that the safety council supports. A primary contention of this study was that VR with emotional elements such as empathy-inspiring videos could help learners develop more memory cues through cognitive

**FIGURE 4**  
**EBBINGHAUS FORGETTING CURVE**



learning theories, constructivist learning theories, emotion and immersiveness. These learning techniques should have encouraged greater retention and, therefore, a greater likelihood of learning transfer for the learners. The emotionally resonant video delivered to the experimental group should have inspired more memory cues through emotion and narrative storytelling. However, this study found that the application of emotionally resonant videos did not significantly increase the chance for learning transfer when combined with VR exercises.

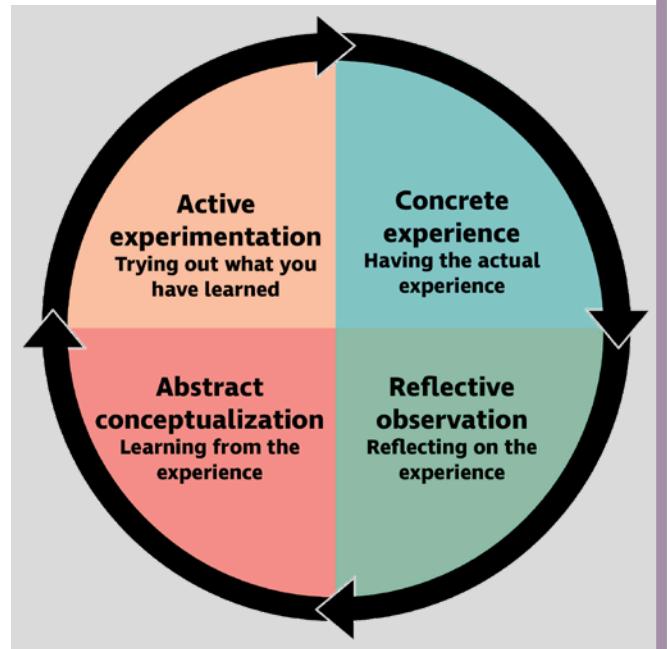
While the emotionally resonant video was designed to help learners develop a network of memory cues by immersing them in a narrative story, feeling empathy for other workers in a similar situation to that which they have experienced, and using more memory development systems such as the amygdala and hippocampus, the results do not show that learners who saw the emotionally resonant video remembered more for longer. This emotional resonance was created by showing a video of an incident and by providing that video in an immersive VR environment. Immersiveness is the quality or state of being deeply engaged or involved in the virtual simulation. Immersive experiences typically involve a high level of interactivity, sensory stimulation, and emotional involvement, creating a sense of presence leading to greater engagement. In this case, these learning tools and techniques did not have a significant result for memory durability for the participants.

### Forgetting Curve

Failing to find statistical significance in this study is not in line with results from previous studies. The safety council's previous studies included a minimum 5-day gap between course completion and follow-up recall quiz delivery (HASC, 2020). These previous studies yielded statistically significant results over 5 days, whereas this study, which had only a 3-day gap, did not. This difference could have allowed for a greater degree of forgetting to occur, which was not provided for in this study.

Forgetting is a natural occurrence in training. The Ebbinghaus Forgetting Curve posits that information is lost by the learner as time elapses after the training event (Custers, 2010). Simply put, the more time that elapses, the more information is lost, as shown in Figure 4. Knowing this, training

**FIGURE 5**  
**KOLB'S LEARNING CYCLE**



professionals should design their courses with intention, reinforcement exercises, and with the understanding that information will be lost over time. This study shows that even when tools and techniques are provided with the intention of improving retention, the practical application of the interventions still cannot overcome the effects of forgetting. Training professionals may want to focus on other tools such as spaced practice opportunities, reinforcement training courses, microlearning reflective practice or other techniques that help overcome forgetting (Kerfoot et al., 2010).

### Kolb's Learning Cycle

Based on these results, it only makes sense for instructional designers in the energy industry who use VR or emotional resonance to influence safety and learning to know the limits of these tools and techniques to influence memory and transfer of learning. Many studies verify the efficacy of active learning through simulations, VR simulations and reflective practice (McHaney et al., 2018; Schott & Marshall, 2018; Zapalska et al., 2012). Kolb's learning cycle (Figure 5) illustrates learning taking place through active experimentation, experience, reflection, and abstract conceptualization or reasoning. Well-designed VR simulations follow this learning format.

Based on the present study's findings, VR instructional designers may want to allow learners to retry the VR simulation after they have viewed emotionally resonant videos, which would allow learners to inhabit the "reflective observation and abstract conceptualization" phases of Kolb's learning cycle longer or more fully. Providing learners a second opportunity to practice or test what they have learned in the video and working through the simulation again might help them fully reflect and test what they have learned and work through the learning cycle more completely.

### Using Emotion for Safety

The community of learners supported by the safety council has initiatives that use programs similar to the emotionally resonant videos used in the present study. Organizations have been known to use emotional appeal through emotionally engaging material such as video testimonials from friends or



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The energy industry leads the way in developing systems and tools to continually improve the safety environment for its workers; VR simulations have a part to play in that, and optimizing VR for these workers will help to continue the improvements.

family members, cards, badges, and fliers to drive safety.

Another challenge in emotional manipulation that this study confronted—but which may still pose difficulties for other programs that use emotion for learning and safety—is the triggering of emotion in participants without negative effects. This study provided resources to enable learners who might be triggered by emotion to access psychological help or counseling. Using emotion without considering worker mental health can undermine the intent of the program and put the worker at greater risk instead of minimizing risks as intended.

Among the 501 potential study participants and the 131 participants who consented to be part of the study and completed the follow-up recall quiz, proctors who monitored the participants did not report any undue emotional stress or complaints. This could mean that the emotionally resonant videos did not have a sufficiently emotional resonance to inspire greater retention. There are varying degrees of success revolving around emotional arousal to augment and influence positive learning outcomes (Holland & Kensinger, 2010; Pekrun, 2006). Several studies show that negative emotions inspire greater retention of learning events (Kalpouzou et al., 2012; Rowe & Fitness, 2018). Also, many studies show the value of positive emotions for learning, particularly in multimedia learning environments (Anderson & Shimamura, 2005; Heidig et al., 2015; Özgür & Altun, 2021). It is clear from these articles and studies, as well as the results of the present study, that the emotional manipulation of learners to inspire greater learning retention can have mixed results.

The results of the present study show that using these emotionally resonant videos did not significantly impact learning. This suggests that using techniques like these may have some limited potential benefits but relying on them significantly or

without other supporting programs and initiatives may not be worthwhile. When safety representatives design campaigns that rely on personal or emotionally impactful messages, they may want to reinforce these tools with other more formal and proven concepts and techniques to ensure that the message is appropriately heard and fosters the change they hope to achieve.

### Case Study to Improve Performance

The energy industry is experiencing a loss of industrial and institutional knowledge through the retirement of both the baby boomer generation and Generation X (Mitchell, 2023). A common organizational focus is identifying ways to encourage and develop newer workers with the institutional knowledge being lost by retiring workers. Case studies and incident analyses can help learners fill this gap. Case studies have the potential to promote greater long-term memory for learners and provide them with greater insight into situations (Yadav et al., 2007).

Although this study used aspects of case study analysis, the focus of the videos was on emotion rather than on the analysis behind the incident that it covered. Studies have proven the effectiveness of case study analysis for aiding learners in developing long-term memories, increased critical thinking skills and improved performance (Bonney, 2015; Herreid, 2011). The results of the present study suggest that trainers who hope to fill the gap brought on by losing experienced workers through case study may not want to focus on the emotional impact of events. In fact, evidence shows that emotion may overwhelm newer learners' working memory load and may increase cognitive load (Sweller et al., 1998).

### Conclusion

This study adds to the body of literature regarding potential learning outcomes using VR as a teaching and delivery tool for this learning community and similar ones. The opportunity to optimize VR and integrate it into traditional CBTs for effective learning transfer requires further study to determine how it can be made more effective. Like any other e-learning experience, VR depends on the proficiency of the instructional designers, development team, curriculum designer, and delivery methods. The results show that the trends in safety training toward personalizing safety and using an emotional appeal may not be worthwhile as an individual initiative or when used in tandem with other training tools and techniques.

VR has already demonstrated its potential to enhance various aspects of education, such as increasing engagement and retention, safely exposing learners to hazards and dangerous situations in simulations, and providing greater visualization of complex and complicated procedures and processes. The learning community that uses safety councils and works to support the energy industry has not been thoroughly studied as to how different learning capabilities and delivery systems can provide more effective training and create a better opportunity for the learning transfer to occur. The energy industry leads the way in developing systems and tools to continually improve the safety environment for its workers; VR simulations have a part to play in that, and optimizing VR for these workers will help to continue the improvements. **PSJ**

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