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ENHANCING OCCUPATIONAL HEALTH AND SAFETY TRAINING THROUGH VIRTUAL REALITY: EFFECTS OF INTERACTIVE LEARNING ON EMPLOYEE KNOWLEDGE ACQUISITION AND ENGAGEMENT

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Occupational health and safety (OHS) training is a fundamental component of accident prevention and sustainable organisational development. However, conventional training methods, primarily based on lectures, printed materials, and passive instruction, often fail to maintain learners' attention, promote active participation, or ensure long-term knowledge retention. Nevertheless, recent advances in immersive technologies have created new opportunities to transform workplace safety education through highly interactive and realistic learning environments. Among these technologies, virtual reality (VR) has emerged as one of the most promising tools for improving employee training effectiveness while simultaneously supporting organisational sustainability objectives.

The literature indicates that VR-based training has considerable potential to increase learner engagement, support hazard recognition, and provide realistic opportunities for practising safety-related procedures. Rather than reporting direct experimental effects, this paper synthesises theoretical and empirical evidence concerning the potential contribution of immersive technologies to occupational health and safety education. The objective is to evaluate the educational opportunities and limitations associated with immersive technologies in occupational safety training. It considers how VR may complement conventional safety education and discusses managerial implications and future research directions, including artificial intelligence, adaptive learning systems, and mixed reality technologies.

Keywords: occupational health and safety, virtual reality, immersive learning, interactive training, employee education, workplace safety, safety culture, sustainable development, digital transformation

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1. INTRODUCTION

OHS has become an integral component of sustainable organisational management, extending beyond its traditional role of ensuring legal compliance and preventing workplace accidents. Contemporary organisations increasingly recognise that employee safety is closely associated with organisational resilience, operational efficiency, social responsibility, and long-term competitiveness. Within the framework of sustainable development, protecting employees from occupational risks represents not only an ethical obligation but also a strategic investment in human capital, organisational performance, and business continuity (ILO, 2019; EU-OSHA, 2023; ISO, 2018; WHO, 2010).

Despite continuous technological progress and increasingly sophisticated safety management systems, occupational accidents and work-related illnesses remain a significant global concern. According to the International Labor Organization, millions of occupational injuries occur annually, resulting in substantial human suffering, productivity losses, and considerable economic costs for employers and society. Many of these incidents are associated with insufficient hazard recognition, inadequate safety awareness, or ineffective employee training. Consequently, improving the quality of occupational safety education has become one of the principal priorities for organisations seeking sustainable and resilient workplace environments (ILO, 2019; EU-OSHA, 2023).

Traditional OHS training has historically relied on instructor-led lectures, printed manuals, presentations, and standardised e-learning modules. Although these approaches remain widely implemented because of their relatively low cost and ease of administration, their educational effectiveness has increasingly been questioned. Passive learning environments often fail to maintain employee attention, provide limited opportunities for practical experience, and rarely simulate the complex decision-making processes encountered in real occupational settings. Furthermore, conventional training methods frequently emphasise regulatory compliance rather than the development of practical competencies required for hazard identification, risk assessment, and rapid response during emergency situations (Zerguine et al., 2023; Mayer, 2021).

Educational research consistently demonstrates that active learning strategies produce superior educational outcomes compared with passive information transfer. Interactive learning encourages participants to engage cognitively and behaviourally with educational content, resulting in greater motivation, improved knowledge retention, enhanced critical thinking, and stronger transfer of acquired competencies into practical workplace performance. Within occupational safety education, these characteristics are particularly valuable because employees must often make rapid decisions in stressful and dynamic conditions, where theoretical knowledge alone is insufficient (Kolb, 2015; Mayer, 2021).

The rapid development of digital technologies has fundamentally transformed educational practice across numerous disciplines. Technologies such as VR,

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augmented reality, mixed reality, artificial intelligence, serious games, and adaptive learning systems have created new possibilities for experiential learning that can extend established approaches such as physical simulators, scenario-based exercises, training grounds, desktop simulations, and practical demonstrations. These innovations enable employees to experience realistic simulations of hazardous situations while substantially reducing the physical risks associated with real-world training. Nevertheless, VR training also introduces specific risks, including loss of balance, collisions with physical obstacles, cybersickness, visual fatigue, and psychological stress in intensive or emotionally demanding scenarios (Radianti et al., 2020; Breque et al., 2021).

Recent empirical studies indicate that VR-based safety training can improve learner engagement, increase motivation, strengthen hazard recognition abilities, and enhance procedural learning across various industrial sectors. Immersive simulations can support learning by allowing learners to repeat complex procedures at their own pace while receiving immediate feedback. However, highly immersive or complex environments may increase mental workload, particularly for inexperienced users who must devote cognitive resources to operating the technology itself. Moreover, VR enables organisations to train employees in dangerous, rare, or high-risk situations that would be prohibitively expensive, technically challenging, or ethically unacceptable to reproduce in real working environments (Rokooei et al., 2023; Stefan et al., 2023; Shayesteh et al., 2023; Vigoroso et al., 2023; Makransky, Petersen, 2021).

The aim of this paper is to synthesise current theoretical and empirical evidence concerning the educational potential and limitations of immersive technologies in occupational health and safety training, with particular attention to employee engagement, knowledge acquisition, hazard recognition, and practical safety learning. The paper also integrates perspectives from occupational safety, educational technology, and sustainable organisational development and outlines practical considerations for managers, safety professionals, and policymakers seeking to modernise employee education through digital technologies.

2. CONCEPTUAL BACKGROUND AND APPROACH

2.1. Safety training in the context of sustainable development

OHS training constitutes one of the fundamental preventive measures employed by organisations to reduce workplace accidents, occupational diseases, and human error. Beyond fulfilling legislative requirements, effective safety education can contribute to organisational resilience, employee well-being, and long-term business sustainability. Contemporary approaches to sustainable management increasingly recognise employees as strategic assets whose knowledge, competencies, and safety

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awareness form one of several factors influencing organisational performance, productivity, and social responsibility alongside technology, work organisation, leadership, economic conditions, and organisational safety culture (ILO, 2019; EU-OSHA, 2023; ISO, 2018; Breque et al., 2021; WHO, 2010).

Organisations that invest in high-quality employee education may bolster accident prevention, employee competence, and safety culture. Positive safety outcomes usually result from a combination of factors, including an effective OHS management system, responsible leadership, engineering and organisational controls, and employee competence. Consequently, OHS training should not be viewed solely as a legal obligation but as one component of a broader strategic investment in human capital and prevention (EU-OSHA, 2023; ISO, 2018; WHO, 2010).

Traditional approaches to occupational safety education have primarily relied on classroom lectures, printed instructional materials, videos, standardised e-learning modules, practical demonstrations, drills, and simulators. Although these methods remain widely implemented because of their relatively low costs and ease of administration, lecture- and information-based formats generally provide fewer opportunities for the safe, repeatable rehearsal of complex or high-risk situations than immersive simulation-based methods.

2.2. Interactive learning as a foundation for effective safety education

Educational psychology consistently demonstrates that active participation enhances learning outcomes. Constructivist learning theories argue that knowledge is most effectively acquired when learners actively construct understanding through experience rather than passively receiving information. This theory similarly emphasises the importance of concrete experience, reflection, conceptualisation, and active experimentation throughout the learning process (Kolb, 2015; Bandura, 1997).

Interactive learning environments encourage learners to participate directly in educational activities through simulations, collaborative exercises, problem-solving tasks, and immediate feedback. Compared with conventional lecture-based instruction, interactive approaches may boost learner motivation and concentration, and improve problem-solving ability, hazard recognition, situational awareness, safety-related decision-making, and knowledge retention when these outcomes are explicitly supported by the training design (Kolb, 2015; Mayer, 2021).

2.3. Virtual reality as an innovative educational technology

VR has emerged as one of the most influential technologies transforming professional education across numerous disciplines. Advances in computer graphics, motion tracking, wearable devices, and immersive visualisation have enabled the creation of highly realistic virtual environments, in which users can interact naturally with digital objects and simulated workplaces (Slater, Sanchez-Vives, 2016; Radianti et al., 2020).

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Unlike conventional multimedia learning, VR fully immerses learners within a computer-generated environment that responds dynamically to their actions. This immersive experience increases the perception of presence – the psychological feeling of "being there" – which has been associated with greater learner engagement, improved concentration, and enhanced memory formation (Slater, Sanchez-Vives, 2016; Makransky, Petersen, 2021). Figure 1 illustrates the immersive OHS training setup used in the author's broader research activities. The configuration includes a VR headset, tracked hand controllers, a VR-capable computer, and an external projection that enables the instructor to observe the trainee's virtual view. The figure is included as an illustrative example of practical implementation and is not used as empirical evidence in the present review.



Fig. 1. Immersive interactive OHS training (own research)

Several empirical investigations have demonstrated that VR training increases learner engagement, enhances procedural knowledge, and improves hazard identification compared with conventional instructional methods. Participants frequently report higher satisfaction, greater motivation, and increased confidence after completing immersive training programmes (Rokooei et al., 2023; Vigoroso et al., 2023).

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2.4. Virtual reality and workplace safety performance

One of the principal objectives of occupational safety education is to influence employee behaviour rather than merely expand theoretical knowledge. Effective training should improve hazard perception, strengthen compliance with safety procedures, and encourage proactive risk management.

Immersive technologies appear particularly effective in achieving these objectives because they allow employees to experience the consequences of unsafe decisions within realistic yet completely safe virtual environments. Mistakes become valuable learning opportunities without resulting in injuries, equipment damage, or production interruptions. Consequently, employees can repeatedly practice complex procedures until they achieve the desired level of competence (Rokooei et al., 2023; Stefan et al., 2023).

Furthermore, immersive learning enables organisations to simulate rare but high-consequence events such as chemical leaks, explosions, equipment failures, confined-space emergencies, or large-scale evacuations. Such scenarios are difficult to organise using conventional training methods because of safety concerns, operational disruptions, and financial costs (Stefan et al., 2023; Tamascelli et al., 2023).

2.5. Review approach

This paper adopts a narrative and conceptual review approach to examine the role of VR in OHS training. The analysis draws on established learning theories and selected empirical studies addressing immersive learning, safety education, hazard recognition, engagement, and workplace sustainability. The original literature selection was narrative, sources were identified through targeted searches in Scopus and Web of Science, supplemented by backward citation checking, using combinations of terms such as "virtual reality", "immersive learning", "occupational safety", "OHS training", "safety training", "hazard recognition", "knowledge retention", and "employee engagement". Priority was given to peer-reviewed studies directly related to safety education or immersive learning and to established theoretical sources. Publications unrelated to training, purely technical VR studies without an educational component, duplicate records, and sources with insufficient information to support the relevant claim were excluded.

The purpose of the present paper is not to establish causal effects or to provide a direct statistical comparison between VR and traditional training. A previously conducted questionnaire-based investigation and the author's practical VR activities informed the broader motivation for this topic and provided the illustrative material used in figures 1 and 2 and table 1; however, these materials are not used as independent empirical evidence for the conclusions of the present review. Instead, the literature is used to identify recurring educational benefits,

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implementation challenges, and areas in which further controlled and longitudinal research is required.

Accordingly, statements concerning improved learning, engagement, hazard recognition, or knowledge retention are interpreted as potential or previously reported effects in the literature rather than as objectively measured outcomes of the present paper.

2.6. Scope and limitations

Because this article does not present a new empirical dataset, no participant sample is analysed in the present paper. Consequently, no claims are made regarding sample-level differences, statistical significance, effect sizes, behavioural change, accident reduction, or long-term knowledge retention.

The discussion is limited to conclusions supported by the cited literature. Evidence concerning the effectiveness of VR remains context-dependent, and differences in sector, training design, level of immersion, learner characteristics, and outcome measurement should be considered when interpreting published findings.

2.7. Analytical focus

Based on the theoretical background, the analysis focuses on learner engagement, understanding workplace hazards, knowledge acquisition and retention, perceived educational value, and the relationship between immersive learning and sustainable workplace safety. For clarity, these outcomes are considered within three learning domains: knowledge (acquisition and retention), skills (hazard recognition, procedural performance, situational awareness, and safety-related decision-making), and attitudes (engagement, motivation, confidence, and perceived value). These themes are discussed as areas of potential benefit and future empirical verification rather than as hypotheses tested in the present paper.

2.8. AI tools

Artificial intelligence (AI) tools were used to support selected stages of the preparation of this manuscript. Midjourney was employed for the creation of illustrative figures and graphical concepts. ChatGPT and Microsoft Copilot were used to assist in retrieving synthetic information and organising background knowledge. ChatGPT was also used to support the literature analysis, the interpretation of statistical methods, and language refinement of the manuscript. All outputs generated with AI assistance were critically reviewed, verified, and edited by the author, who assumes full responsibility for the accuracy, originality, and scientific integrity of the final manuscript.

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3. SYNTHESIS OF THE LITERATURE

3.1. General evidence on immersive safety training

The reviewed literature generally presents VR as a promising complement to conventional OHS instruction, particularly where realistic practice would otherwise be dangerous, costly, or operationally difficult (Rokooei et al., 2023; Stefan et al., 2023; Scorgie et al., 2024; Stefan et al., 2024; Evangelista et al., 2025; Bernabei et al., 2024).

Published applications span different occupational contexts, but their methods, participant groups, technologies, and outcome measures vary considerably. This heterogeneity limits direct comparison and makes broad claims about effectiveness inappropriate.

Nevertheless, the literature suggests growing interest in immersive technologies as part of the wider digital transformation of workplace education (Radianti et al., 2020; Breque et al., 2021).

Recent evidence supports this cautious interpretation. A 2024 systematic review and meta-analysis reported positive effects of VR safety training on knowledge acquisition and retention, while recent studies in electrical safety and confined-space training also found promising learning and performance outcomes; at the same time, the findings remain dependent on training context, design, and the outcome measures used (Scorgie et al., 2024; Stefan et al., 2024; Evangelista et al., 2025).

3.2. Learning outcomes: knowledge, skills, and attitudes

A recurring theme in the literature is the capacity of immersive environments to increase perceived presence and active involvement in learning activities (Slater, Sanchez-Vives, 2016; Radianti et al., 2020; Makransky, Petersen, 2021).

Within this review, learning outcomes are therefore distinguished as knowledge outcomes (acquisition and retention), skill outcomes (hazard recognition, procedural performance, situational awareness, and decision-making), and attitudinal outcomes (engagement, motivation, satisfaction, and confidence). This distinction is important because positive learner reactions should not automatically be interpreted as evidence of objective competence or long-term behavioural change.

Studies of VR-supported training frequently report positive learner responses, including engagement, motivation, and satisfaction (Rokooei et al., 2023; Vigoroso et al., 2023). These outcomes are relevant to OHS education because interactive scenarios can place learners in situations requiring active observation and decision-making rather than passive reception of information.

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VR also enables learners to interact with simulated equipment and hazardous situations without exposure to the corresponding physical risks. Such environments may support hazard-recognition and procedural-learning activities, although the magnitude and durability of these effects depend on training design and require further empirical verification (Rokooei et al., 2023; Stefan et al., 2023; Shayesteh et al., 2023).

Positive perceptions of VR should not be interpreted automatically as evidence of improved objective knowledge, behaviour, accident rates, or long-term retention.

3.3. Interpretation of potential learning benefits

Theoretical models of experiential and multimedia learning provide plausible explanations for why immersive environments may support engagement and learning (Kolb, 2015; Mayer, 2021; Makransky, Petersen, 2021). Experiential learning suggests that VR can support learning when trainees move through concrete experience, action, feedback, reflection, and repeated practice. The Cognitive Affective Model of Immersive Learning further indicates that presence and interactivity may foster attention and motivation, while multimedia learning theory highlights the need to manage limited cognitive resources. Consequently, immersive features may support learning when they are aligned with the training objective, but they may also increase extraneous cognitive load when interface operation, visual complexity, or novelty competes for the learner's attention. Thus, the educational mechanism lies not in immersion alone, but in the combination of meaningful interaction, feedback, repetition, and appropriate cognitive demands (Kolb, 2015; Mayer, 2021; Makransky, Petersen, 2021). Presence, engagement, and confidence should therefore remain conceptually distinct from objectively demonstrated competence.

Figure 2 illustrates a fire-extinguisher training scenario used in the author's VR activities. In this type of scenario, the trainee can practise the sequence of actions required to respond to a fire and repeat the procedure after feedback. The figure demonstrates the procedural and interactive character of the training environment. This learning experience could be very close to the real on-site fire-fighting training but with much less resources needed and limitless possibility to repeat this process to many users as possible.

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Fig. 2. Using the fire extinguisher in VR (own research)

The available literature supports cautious interpretation: VR can provide valuable learning opportunities, but its effectiveness should be established using clearly defined outcome measures and appropriate comparison groups.

3.4. Summary of the literature synthesis

Overall, the reviewed evidence supports VR as a potentially valuable component of OHS education, especially for experiential practice and simulation of hazardous situations (Rokooei et al., 2023; Stefan et al., 2023; Vigoroso et al., 2023).

Positive user perceptions should not be assumed to translate into lasting knowledge, safer behaviour, fewer accidents, or improved organisational performance. These outcomes require dedicated empirical evaluation.

4. DISCUSSION

4.1. Implications

The present paper examines the educational potential of VR in OHS training and its possible contribution to employee learning, workplace safety, and sustainable organisational development. The reviewed literature suggests that immersive environments can offer engaging and practical learning experiences, while evidence of superiority over conventional training depends on the specific design, outcomes measured, and comparison conditions. In accordance with the analytical framework,

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the principal learning implications are discussed below in terms of knowledge, skills, and attitudes.

Knowledge. Knowledge acquisition and retention represent another important area of interest. Immersive practice may support memory and procedural learning (Mayer, 2021; Radianti et al., 2020; Makransky, Petersen, 2021; Scorgie et al., 2024; Stefan et al., 2024), although evidence of long-term retention still requires further longitudinal measurement.

Skills. The literature suggests that immersive learning may support employees' understanding of workplace hazards and the practice of safety-related skills. Unlike traditional lecture-based instruction, VR can enable participants to experience realistic work environments, identify risks, and observe the consequences of decisions (Rokooei et al., 2023; Stefan et al., 2023).

Attitudes. One of the most consistently reported advantages of VR in the reviewed literature is its potential to support learner engagement, attention, motivation, and active participation (Rokooei et al., 2023; Vigoroso et al., 2023). These observations correspond with educational theories emphasising active interaction with learning content (Kolb, 2015; Mayer, 2021; Makransky, Petersen, 2021). Previous studies also suggest that immersive technologies may strengthen learners' confidence in applying acquired knowledge, although confidence should not be treated as equivalent to objectively measured performance.

From the perspective of organisational management, the implementation of VR-based safety training may generate benefits extending beyond individual educational outcomes. Organisations that adopt immersive learning technologies may strengthen their overall safety culture by encouraging active employee participation, continuous learning, and proactive hazard recognition. A strong safety culture has repeatedly been associated with lower accident rates, reduced absenteeism, improved productivity, and greater organisational resilience. Consequently, investments in innovative educational technologies should be considered strategic investments in organisational sustainability rather than merely technological upgrades (EU-OSHA, 2023; Bayramova et al., 2023; Gray et al., 2023; ISO, 2018).

Table 1 provides an illustrative comparison for selecting VR training scenarios. The level of suitability was assigned qualitatively using four criteria: the severity of potential consequences, the probability and practical availability of the event for live training, the feasibility and safety of reproducing the situation in real conditions, and the educational value of repeatable interaction and decision-making in VR. The classifications are therefore expert-informed screening categories intended to support scenario selection rather than validated quantitative risk scores.

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Table 1. Comparative analysis for selecting a suitable VR training scenario

Hazard	Typical Causes	Severity of Consequences	Probability of Occurrence	Typical Consequences	Suitability for VR Scenarios	Training Benefit
Explosion	Gas leakage, spark, welding, technological failure	**Very high**	**Low**	Fatal injuries, destruction of equipment, secondary fire	**Highly suitable**	Understanding the chain of causes, decision-making under pressure, fire prevention
Toxic Gas Exposure	Leaks, work in confined spaces, ventilation failure	**Very high**	**Low**	Suffocation, permanent consequences, death	**Highly suitable**	Awareness of invisible hazards, importance of prevention and personal gas detectors
Fire	Hot materials, ignition of vapors, welding, improper storage of materials	**High**	**Medium**	Burns, smoke inhalation, material damage	**Suitable**	Practicing evacuation, selecting appropriate PPE, orientation in a smoke-filled environment
Falls from Height	Missing or improperly selected PPE, work on roofs, scaffolding	**Very high**	**Low**	Fatal or severe injuries	**Extremely suitable**	Powerful experience of the consequences of incorrect decisions and changes in behavior
Trips and Slips	Untidy workplace, obstacles on walkways, stairs, wet or slippery surfaces	**Medium**	**High**	Fractures, bruises	**Unsuitable**	More suitable for demonstrating a "wow" effect; consequences are not as severe
Entrapment / Crushing	Work near moving machinery, safety guard violations, moving mechanisms	**Very high**	**Low**	Fatal injuries, devastating trauma	**Suitable**	Strengthening respect for rules and preventing routine behavior

Source: own research.

The relationship between immersive learning and sustainable development deserves particular attention. Sustainable organisations seek to balance economic performance, employee well-being, and responsible resource management. VR-based education contributes to these objectives in several ways. First, realistic simulations

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reduce the need for repeated practical exercises involving expensive equipment, consumable materials, or production interruptions. Second, hazardous scenarios can be practised safely without exposing employees to physical risks or generating environmental impacts associated with conventional field exercises. Third, standardised digital training ensures consistent educational quality across multiple organisational locations while facilitating scalable workforce development.

The reviewed literature includes investigations reporting positive educational outcomes associated with immersive technologies (Rokooei et al., 2023; Vigoroso et al., 2023). This paper places these findings within the broader framework of sustainable organisational development while treating effects on organisational resilience and long-term safety performance as areas requiring further empirical investigation.

Despite these positive findings, several challenges associated with the implementation of VR should be acknowledged. Initial investments in hardware, software development, and employee training may represent significant barriers, particularly for small and medium-sized enterprises. Organisations must also ensure that virtual scenarios accurately reflect real working conditions and remain consistent with current legislation, technological developments, and operational procedures. Furthermore, successful implementation requires instructors who possess both technical competencies and pedagogical skills necessary to facilitate immersive learning effectively. Recent implementation guidance similarly emphasises the importance of systematic design, development, integration, and validation of VR-based OHS training (Bernabei et al., 2024).

Several limitations should be considered when interpreting the literature synthesised in this paper. Existing studies differ in sample composition, occupational context, VR technology, training scenarios, comparison conditions, and outcome measures. Positive perceptions, engagement, or confidence should not be interpreted as direct evidence of improved safety behaviour, reduced accident rates, or long-term knowledge retention. Controlled comparative and longitudinal studies are therefore required.

Future research should therefore adopt longitudinal designs that monitor employees over extended periods following completion of VR training. Such studies would enable direct assessment of knowledge retention, behavioural transfer, accident reduction, and organisational safety performance. Future investigations should also compare different levels of immersion, evaluate mixed reality and augmented reality applications, and examine how artificial intelligence can personalise educational content according to individual learner performance. Adaptive learning algorithms capable of automatically adjusting scenario complexity, providing personalised feedback, and identifying individual competency gaps represent a particularly promising direction for the next generation of occupational safety education (Breque et al., 2021).

In conclusion, the literature reviewed in this paper indicates that virtual reality has potential beyond its role as an innovative visualisation technology. Properly implemented immersive environments can provide opportunities for active participation, hazard-recognition practice, and procedural learning.

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4.2. Conclusion

The rapid digital transformation of contemporary workplaces has expanded the range of tools available for employee education and OHS management. While conventional methods remain important, immersive technologies can provide additional value when training requires safe and repeatable practice of dynamic, rare, or high-risk situations.

In relation to the stated aim, this paper examined the potential role and limitations of VR-based OHS training in employee engagement, knowledge acquisition, hazard recognition, and practical safety learning. The literature suggests that immersive environments can provide engaging, realistic, and practically relevant learning experiences. However, the present review does not establish that VR is universally superior to conventional instruction, and evidence concerning long-term retention, transfer to workplace behaviour, and accident reduction remains limited.

A key implication of the reviewed literature is that engagement, active participation, and practical experience may support learning when they are aligned with clearly defined educational objectives and appropriate cognitive demands. VR should therefore be considered a complementary training method whose value depends on scenario design, learner characteristics, implementation quality, and evaluation of measurable learning outcomes.

Overall, the reviewed literature suggests that virtual reality is a promising educational technology for OHS training, particularly where realistic practice would otherwise be hazardous, costly, or operationally difficult. Its value should be assessed alongside cost, usability, accessibility, cognitive workload, and evidence of measurable learning and safety outcomes. Further comparative and longitudinal research is needed before broader causal claims concerning accident reduction, behavioural change, or long-term organisational sustainability can be established (Scorgie et al., 2024; Stefan et al., 2024; Evangelista et al., 2025; Bernabei et al., 2024).

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POPRAWA JAKOŚCI SZKOLEŃ Z ZAKRESU BEZPIECZEŃSTWA I HIGIENY PRACY DZIĘKI WYKORZYSTANIU WIRTUALNEJ RZECZYWISTOŚCI: WPŁYW INTERAKTYWNEGO UCZENIA SIĘ NA PRZYSWAJANIE WIEDZY I ZAANGAŻOWANIE PRACOWNIKÓW

Streszczenie

Szkolenia z zakresu bezpieczeństwa i higieny pracy (BHP) stanowią podstawowy element zapobiegania wypadkom oraz zrównoważonego rozwoju organizacji. Jednak tradycyjne metody szkoleniowe, oparte głównie na wykładach, materiałach drukowanych i pasywnym przekazie wiedzy, często nie pozwalają utrzymać uwagi uczestników, zachęcić ich do aktywnego udziału i zapewnić długotrwałego zapamiętania wiedzy. Najnowsze osiągnięcia w dziedzinie technologii immersyjnych stworzyły nowe możliwości przekształcenia edukacji w zakresie bezpieczeństwa w miejscu pracy poprzez wysoce interaktywne i realistyczne środowiska edukacyjne. Wśród tych technologii rzeczywistość wirtualna (VR) stała się jednym z najbardziej obiecujących narzędzi służących poprawie skuteczności szkoleń pracowników, a jednocześnie wspierających cele organizacji w zakresie zrównoważonego rozwoju.

Wyniki badań wskazują, że szkolenia oparte na VR znacząco zwiększają zaangażowanie pracowników, ułatwiają głębsze zrozumienie zagrożeń występujących w miejscu pracy oraz poprawiają zdolność rozpoznawania sytuacji niebezpiecznych i odpowiedniego reagowania na nie. Uczestnicy zgłaszali większą motywację, wyższy poziom satysfakcji oraz większą pewność siebie w stosowaniu zdobytej wiedzy w rzeczywistych warunkach pracy w porównaniu z tradycyjnymi metodami szkoleniowymi. Wyniki sugerują również, że szkolenia immersyjne przyczyniają się do lepszego utrwalenia wiedzy i wspierają rozwój praktycznych umiejętności podejmowania decyzji.

Badanie to przyczynia się do transformacji cyfrowej, dostarczając empirycznych dowodów na korzyści edukacyjne płynące z technologii immersyjnych. Z praktycznego

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punktu widzenia wyniki pokazują, że włączenie VR do edukacji w zakresie bezpieczeństwa w miejscu pracy może zwiększyć skuteczność szkoleń, ograniczyć błędy ludzkie oraz wzmocnić kulturę bezpieczeństwa w organizacji.

Słowa kluczowe: bezpieczeństwo i higiena pracy, zrównoważony rozwój, rzeczywistość wirtualna, kultura bezpieczeństwa, bezpieczeństwo w miejscu pracy, transformacja cyfrowa, nauka immersyjna, szkolenia interaktywne, kształcenie pracowników

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