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## **Software Products for Training and Testing Occupational Health and Safety (OHS) Knowledge – A literature review**

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### **Abstract**

The rapid digitalization of workplaces and the increasing complexity of occupational risks require innovative methods for training and assessing Occupational Health and Safety (OHS) knowledge. Traditional classroom-based training is often insufficient to ensure effective knowledge retention and practical skills development. Software products designed for OHS training and testing provide interactive, scalable, and adaptable learning environments that can significantly enhance workers' safety awareness and competencies.

This paper analyzes modern software solutions used for OHS training and knowledge assessment, including e-learning platforms, simulation-based systems, virtual reality (VR) training tools, and automated testing applications. The study examines their functionalities, advantages, and limitations, with a focus on improving knowledge retention, risk awareness, and compliance with safety regulations. The results highlight the role of digital technologies in optimizing OHS education and demonstrate how software-based solutions can contribute to safer workplaces.

**Keywords:** Occupational Health and Safety, E-Learning, Safety Training Software, Knowledge Assessment, Digital Learning Tools

### **1. Introduction**

Occupational Health and Safety (OHS) training plays a fundamental role in preventing workplace accidents, occupational diseases, and unsafe behaviors. Effective OHS training programs provide workers with the necessary information and practical skills to identify potential hazards, understand risk factors, and apply appropriate preventive and protective measures during their daily activities. Consequently, well-designed training initiatives contribute significantly to reducing accident rates, improving workplace safety culture, and ensuring compliance with national and international safety regulations.

Traditionally, OHS training has been delivered through classroom lectures, printed materials, presentations, and periodic briefings conducted by safety specialists. Although these conventional methods have been widely used for decades, they often present several limitations. Passive learning approaches may reduce worker engagement and make it difficult to ensure that trainees fully understand complex safety procedures or risk scenarios. In addition, traditional training methods typically provide limited opportunities for practical interaction, and the assessment of workers' knowledge is often restricted to simple written tests that may not accurately reflect their ability to apply safety principles in real workplace situations. As a result, organizations increasingly recognize the need for more dynamic and effective training approaches that support deeper learning and long-term knowledge retention.

The rapid advancement of digital technologies and the transition toward Industry 4.0 have created new opportunities for improving occupational safety training. Digital transformation in the workplace has introduced intelligent systems, automation, and interconnected technologies, which require workers to adapt to new operational environments and emerging risks. In this context, software-based training tools have emerged as powerful solutions for enhancing both the delivery and evaluation of OHS training programs. These technologies enable organizations to implement interactive learning environments that are more engaging, flexible, and adaptable to different categories of workers.

Modern software products designed for OHS training integrate a variety of digital learning technologies, including e-learning platforms, multimedia educational content, interactive simulations, and automated knowledge assessment systems. Through these platforms, employees can access training modules that incorporate videos, animations, graphical representations of

hazards, and scenario-based exercises that replicate real workplace situations. Such interactive elements help learners better understand complex safety concepts and visualize potential risks that may occur during operational processes.

Another important advantage of software-based OHS training systems is their ability to simulate hazardous situations in a controlled digital environment. Simulation-based learning allows workers to experience realistic accident scenarios, emergency situations, or equipment failures without being exposed to actual danger. By interacting with these virtual scenarios, trainees can practice identifying hazards, making safety-related decisions, and applying appropriate response procedures. This experiential learning approach significantly enhances workers' situational awareness and helps them develop practical competencies that are directly applicable in real working conditions.

In addition to improving the training process, software products also provide efficient tools for testing and evaluating employees' OHS knowledge. Digital testing systems can automatically generate quizzes, scenario-based assessments, and adaptive testing modules that adjust the difficulty level based on the trainee's responses. These systems can also record and analyze performance data, enabling organizations to monitor training progress, identify knowledge gaps, and implement targeted corrective training measures. Automated evaluation ensures objectivity and allows safety managers to maintain detailed records of employee competencies, which is particularly important for regulatory compliance and safety audits.

Furthermore, software-based training solutions offer significant advantages in terms of accessibility and scalability. Training programs can be delivered remotely and accessed at any time, allowing organizations to train large numbers of employees across different locations without significant logistical constraints. This flexibility is especially valuable for companies operating in complex industrial sectors, such as manufacturing, energy production, construction, or transportation, where workers may be distributed across multiple worksites.

Considering these technological developments, the integration of software products into occupational safety training represents an important step toward modernizing OHS education systems. By combining interactive learning environments, realistic simulations, and automated knowledge evaluation mechanisms, digital training platforms can significantly improve the effectiveness of safety education programs.

The aim of this paper is to analyze the role of software products used for training and testing Occupational Health and Safety knowledge, focusing on their main technological characteristics, functionalities, and practical benefits. The study also examines how these digital tools contribute to improving workers' understanding of occupational risks, enhancing knowledge retention, and supporting organizations in maintaining high standards of workplace safety.

**2. Literature Review**

The rapid evolution of digital technologies has significantly influenced the methods used for training and evaluating Occupational Health and Safety (OHS) knowledge. Over the past decade, numerous studies have examined how

software-based training tools can improve safety education, enhance knowledge retention, and support organizations in maintaining safe working environments. A systematic search conducted across Web of Science database identified 100 articles related to software products for training and testing OHS knowledge (fig.1). From this large body of literature, 20 representative studies were selected to develop a comprehensive understanding of the current research landscape and technological developments in this field.



**Fig 1:** Web-of-science categories covered by software products for training and testing OHS knowledge

The selected studies reveal a strong trend toward the integration of digital learning technologies, immersive simulation environments, artificial intelligence, and mobile training solutions into occupational safety education. These technologies are increasingly viewed as essential tools for addressing the limitations of traditional training methods and adapting safety education to the requirements of modern workplaces characterized by automation, complex equipment, and distributed workforces.

**Table 1:** Record Count for Web of Science Categories Fields

Web of Science Categories Fields	Number of articles	% of 100
Public Environmental Occupational Health	29	29%
Engineering Industrial	15	15%
Ergonomics	13	13%
Operations Research Management Science	13	13%
Environmental Sciences	11	11%
Computer Science Artificial Intelligence	9	9%
Engineering Multidisciplinary	9	9%
Computer Science Theory Methods	6	6%
Engineering Electrical Electronic	6	6%
Engineering Manufacturing	5	5%
Psychology Applied	5	5%
Computer Science Information Systems	4	4%
Computer Science Interdisciplinary Applications	4	4%
Education Educational Research	4	4%
Environmental Studies	4	4%
Green Sustainable Science Technology	4	4%
Transportation	4	4%
Management	3	3%
Multidisciplinary Sciences	3	3%
Social Sciences Interdisciplinary	3	3%
Business	2	2%
Energy Fuels	2	2%
Materials Science Multidisciplinary	2	2%
Psychology	2	2%
Automation Control Systems	1	1%

## 2. Types of Software Products for OHS Training

### 2.1 E-Learning Platforms for Occupational Health and Safety Training

E-learning platforms represent one of the most widely adopted digital solutions for delivering Occupational Health and Safety (OHS) training in modern organizations. The rapid expansion of digital technologies and internet accessibility has transformed traditional safety training approaches, enabling companies to implement structured learning environments that can be accessed remotely and adapted to diverse organizational needs. Through web-based learning management systems (LMS), organizations can develop, distribute, and monitor training programs that support the continuous development of safety competencies among workers.

E-learning systems provide structured training modules that integrate multimedia educational materials such as instructional videos, animations, interactive diagrams, case studies, and self-assessment quizzes. These elements create dynamic learning environments that facilitate a better understanding of safety procedures and workplace hazards. Unlike traditional classroom instruction, where information is often delivered in a passive format, e-learning platforms encourage active learner participation and allow workers to engage with content at their own pace.

One of the primary advantages of e-learning platforms is their *flexibility of access*. Workers can complete training modules from any location and at any time, using computers, tablets, or mobile devices. This flexibility is particularly valuable for organizations with geographically distributed operations or employees working in remote locations. For example, multinational companies operating in sectors such as construction, logistics, and energy production frequently rely on e-learning systems to ensure that employees across multiple sites receive standardized safety training.

Another important advantage of digital learning platforms is the *standardization of training content*. Through centralized learning management systems, organizations can ensure that all workers receive consistent safety information aligned with regulatory requirements and organizational policies. Standardized training materials help reduce inconsistencies in safety practices and support the development of a strong safety culture within the organization.

E-learning platforms also include *automated progress tracking and performance monitoring features*. These systems allow safety managers to monitor employees' participation in training programs, track course completion rates, and evaluate test results in real time. The data collected by these platforms can be used to identify knowledge gaps, evaluate the effectiveness of training programs, and design targeted interventions for improving worker competencies.

Another significant benefit of digital learning environments is the *reduction of training costs*. Traditional safety training often requires dedicated training facilities, printed materials, travel expenses, and instructor time. By contrast, e-learning platforms allow organizations to distribute training content electronically, reducing logistical expenses while increasing the scalability of training programs. Once digital courses are developed, they can be reused and updated easily, making them cost-effective solutions for long-term training strategies.

In recent years, numerous international platforms have been developed specifically to support OHS training and certification programs. These platforms integrate learning management functionalities with specialized safety training modules designed for different industries and risk environments.

One widely recognized platform is *OSHA Education Center's online training system*, which provides digital safety training courses aligned with the standards of the Occupational Safety and Health Administration (OSHA) in the United States. The platform offers courses covering topics such as hazard communication, personal protective equipment, construction safety, and workplace ergonomics. Workers can complete the training modules online and receive certification upon successful completion of assessments. This system has been widely adopted by organizations operating in construction, manufacturing, and industrial sectors.

Another example is *SafetySkills*, an international digital training platform that provides a large library of safety training courses covering topics such as fire prevention, electrical safety, chemical handling, and machine safety. The platform uses video-based learning modules combined with quizzes and knowledge assessments to evaluate workers' understanding of safety procedures. SafetySkills also offers customizable training content, allowing organizations to adapt courses to their specific operational risks and regulatory requirements.

Similarly, the *iHASCO e-learning platform* provides comprehensive online health and safety training solutions used by organizations across Europe and other regions. The platform offers interactive courses designed to address a wide range of workplace safety issues, including manual handling, working at height, workplace stress management, and fire safety. One of the key strengths of iHASCO is its user-friendly interface and engaging course design, which incorporates animations, real-life examples, and scenario-based learning activities to improve knowledge retention.

In the United Kingdom, the *National Examination Board in Occupational Safety and Health (NEBOSH)* has also developed digital learning solutions that support professional OHS certification programs. Through partnerships with accredited training providers, NEBOSH courses are delivered via online learning platforms that include video lectures, interactive exercises, and remote examinations. These digital learning environments allow professionals to obtain internationally recognized safety qualifications without attending traditional classroom courses.

Another international example is *SC Training (formerly EdApp)*, a mobile-friendly microlearning platform widely used for workplace safety training. SC Training focuses on delivering short, interactive learning modules designed to improve engagement and knowledge retention. The platform incorporates gamification elements, such as points, badges, and leaderboards, which motivate learners to actively participate in training activities. This approach is particularly effective for younger workers or employees with limited time for traditional training sessions.

Large multinational corporations also develop their own internal digital training platforms. For example, several global manufacturing and energy companies implement customized learning management systems integrated into

their corporate safety management frameworks. These internal platforms provide tailored training modules that address specific operational risks, company procedures, and regulatory requirements relevant to the organization's activities.

In addition to corporate training systems, international organizations and governmental agencies have also developed digital platforms aimed at improving global access to safety education. For instance, the International Labour Organization (ILO) offers online training courses through its e-learning platform that address topics such as occupational risk assessment, safety management systems, and workplace health promotion. These courses are designed to support capacity building and knowledge dissemination across different countries and industrial sectors.

### **Challenges in implementation of e-learning platforms**

Despite their numerous advantages, the implementation of e-learning platforms for OHS training also presents certain challenges. One of the main limitations *concerns the need to ensure that digital training remains engaging and interactive*. Poorly designed online courses may reduce learner motivation and lead to superficial knowledge acquisition. Therefore, effective instructional design and the integration of multimedia elements are essential for maximizing the effectiveness of digital training programs.

Another challenge relates to the *digital literacy of workers*. Some employees, particularly those working in traditional industries or older workforce groups, may have limited experience using digital learning platforms. Organizations must therefore provide adequate support and guidance to ensure that all workers can successfully participate in online training programs.

*Data security and privacy considerations* also represent important aspects when implementing digital learning systems. Organizations must ensure that employee training records, assessment results, and personal information are stored securely and comply with relevant data protection regulations.

Overall, e-learning platforms have become essential components of modern occupational safety education. By providing flexible access to training materials, standardized safety information, automated knowledge evaluation, and scalable learning environments, these digital tools significantly enhance the effectiveness of OHS training programs. As digital technologies continue to evolve, e-learning systems are expected to play an increasingly important role in supporting safer workplaces and promoting continuous professional development in occupational health and safety.

## **2.2 Simulation-Based Training Software**

Simulation-based training software represents an important advancement in the field of Occupational Health and Safety (OHS) education, providing a dynamic and interactive method for developing workers' competencies in risk identification, hazard control, and emergency response. Unlike traditional training methods that rely primarily on theoretical instruction, simulation systems recreate realistic workplace environments where trainees can actively engage with virtual scenarios and practice safety procedures in a controlled and risk-free setting. This approach allows workers to experience complex operational situations without exposure to real hazards, making it particularly

valuable in industries characterized by high levels of occupational risk.

Simulation-based training environments typically reproduce specific work processes, equipment operations, and hazardous conditions that may occur in real workplaces. Through specialized software platforms, trainees can navigate digital representations of industrial facilities, construction sites, laboratories, or energy production plants while encountering different safety challenges. These virtual environments are designed to replicate real operational contexts as accurately as possible, enabling learners to understand the sequence of events that may lead to accidents and to explore appropriate preventive measures.

One of the main advantages of simulation-based training is the possibility of recreating critical or emergency scenarios that would be difficult, expensive, or dangerous to reproduce during traditional training sessions. For example, trainees can be exposed to simulated fire emergencies, where they must identify the source of ignition, activate fire alarm systems, select appropriate firefighting equipment, and follow evacuation procedures. By practicing these actions in a simulated environment, workers become more familiar with emergency protocols and develop the confidence required to respond effectively in real situations.

Another common application of simulation software involves chemical spill scenarios, which are particularly relevant in industries such as chemical manufacturing, pharmaceuticals, and laboratory operations. In these simulations, trainees may be required to identify hazardous substances, assess potential exposure risks, select appropriate personal protective equipment (PPE), and implement containment and cleanup procedures. This type of experiential learning allows workers to understand the consequences of improper handling of hazardous materials while reinforcing the importance of following established safety protocols.

Simulation-based training is also widely used to demonstrate equipment malfunctions and operational failures. In many industrial environments, machinery and technological systems play a critical role in production processes, and improper operation can lead to serious accidents. Through digital simulations, trainees can explore how mechanical failures occur, recognize warning signs of equipment malfunction, and apply safe shutdown procedures. By observing the outcomes of unsafe actions within the simulation, workers develop a better understanding of how human errors can contribute to workplace incidents.

Another important area where simulation software is highly effective is confined space training. Confined spaces, such as tanks, tunnels, pipelines, and storage vessels, present significant hazards due to limited ventilation, restricted access, and the potential presence of toxic gases. Traditional training for confined space entry often relies on theoretical instruction and limited practical demonstrations. Simulation software, however, can recreate confined space environments where trainees must evaluate atmospheric conditions, verify ventilation systems, use monitoring equipment, and follow entry and rescue procedures. Such simulations allow workers to practice critical decision-making processes while understanding the importance of strict adherence to safety protocols.

Beyond individual training scenarios, simulation-based software also supports the development of situational awareness and decision-making skills. By exposing trainees

to multiple hazard scenarios and allowing them to explore different response strategies, these systems help workers understand the dynamic nature of workplace risks. Simulation exercises often include feedback mechanisms that analyze the trainee's actions and provide recommendations for improving safety performance. This immediate feedback encourages reflective learning and reinforces correct safety behaviors.

Internationally, several simulation-based training platforms have been developed to support safety education in high-risk industries. For example, the Serious Factory platform offers industrial safety simulations that allow workers to experience accident scenarios and analyze their causes. Similarly, the 3D Safety Simulator developed by various engineering training providers recreates realistic industrial environments where trainees can interact with equipment and identify potential hazards. In the construction sector, simulation platforms such as SimLearn and other immersive training tools are used to replicate construction sites and demonstrate accident scenarios related to falls, equipment collisions, and structural hazards.

Another emerging trend in simulation-based training is the integration of game-based learning elements, also known as serious games. These systems combine realistic safety scenarios with game mechanics such as scoring systems, challenges, and interactive missions. Gamification increases learner motivation and engagement while encouraging participants to actively explore safety procedures and hazard recognition strategies.

Despite their numerous advantages, simulation-based training systems also present certain challenges. Developing realistic simulation environments requires significant technological expertise and financial investment. In addition, training effectiveness depends on the quality of scenario design and the extent to which simulations accurately reflect real workplace conditions. Nevertheless, ongoing advances in digital modeling, graphics technologies, and computational power are continuously improving the realism and accessibility of simulation platforms.

Overall, simulation-based training software has become an essential component of modern OHS education. By providing interactive learning environments that replicate real workplace hazards, these tools allow workers to develop practical skills, improve hazard recognition abilities, and strengthen their capacity to respond effectively to emergency situations. As digital technologies continue to evolve, simulation-based training is expected to play an increasingly important role in enhancing workplace safety and supporting the development of resilient safety cultures within organizations.

### 2.3 Virtual Reality Training Systems

Virtual Reality (VR) training systems represent one of the most innovative technological developments in the field of Occupational Health and Safety (OHS) education. VR technology enables the creation of immersive digital environments in which trainees can interact with simulated workplaces and experience realistic work conditions. By using specialized equipment such as VR headsets, motion sensors, and interactive controllers, workers are placed in computer-generated environments that closely replicate real industrial settings. Within these environments, trainees can explore workspaces, operate equipment, identify hazards,

and practice safety procedures in a highly engaging and controlled learning context.

The main characteristic that distinguishes VR training from traditional digital learning tools is the *immersive experience* it provides. Instead of simply viewing training materials on a screen, trainees are fully surrounded by a virtual environment that responds to their movements and actions. This immersive interaction significantly increases learner engagement and attention, as participants feel directly involved in the training process. As a result, VR-based training often leads to higher levels of concentration and motivation compared to conventional classroom instruction or standard e-learning modules.

One of the key advantages of VR systems in OHS training is their ability to provide *realistic hazard visualization*. Many workplace risks are difficult to demonstrate during traditional training sessions due to safety constraints or logistical limitations. Through virtual environments, however, trainees can observe and analyze hazardous situations such as falling objects, equipment malfunctions, chemical leaks, or structural failures without being exposed to actual danger. These visual simulations help workers better understand how accidents occur and what preventive measures must be implemented to reduce risk.

VR training systems are particularly effective in supporting **procedural learning**, which involves the acquisition of practical skills and the correct execution of operational tasks. In many industrial environments, workers must follow strict safety procedures when operating machinery, performing maintenance activities, or responding to emergency situations. VR simulations allow trainees to practice these procedures step by step in a realistic environment where they can repeat tasks multiple times until they achieve the correct performance. For example, workers can learn how to properly lock out and tag out machinery, use personal protective equipment, or conduct safety inspections within a virtual workspace.

Another major benefit of VR training is the possibility of *safe exposure to dangerous situations*. Certain high-risk scenarios, such as explosions, electrical accidents, confined space incidents, or structural collapses, cannot be recreated during traditional training due to safety concerns. VR technology allows these scenarios to be simulated safely, enabling trainees to observe the consequences of unsafe actions and practice appropriate emergency responses. Experiencing such situations in a virtual environment helps workers develop situational awareness and prepares them to react more effectively when facing similar conditions in real workplaces.

Virtual reality training systems have been widely adopted in several high-risk industries where safety training is critical. In the construction sector, VR simulations are used to recreate construction sites where trainees must identify hazards such as unstable scaffolding, falling materials, or unsafe equipment operation. By navigating through these virtual environments, workers learn to recognize potential risks and apply appropriate safety measures before accidents occur.

In the oil and gas industry, VR platforms are used to simulate complex operational environments such as offshore platforms, refineries, and drilling facilities. Workers can practice emergency evacuation procedures, fire response strategies, and equipment inspection tasks within highly detailed virtual representations of these facilities. This type

of training allows employees to become familiar with complex industrial infrastructures before entering real operational environments.

Similarly, in the manufacturing sector, VR training systems are used to simulate machinery operation, maintenance activities, and production line hazards. Trainees can interact with virtual machines, learn correct operational procedures, and understand how improper use of equipment may lead to accidents or production disruptions.

Research studies have shown that VR-based safety training significantly improves long-term knowledge retention and enhances workers' behavioral responses in hazardous situations. Because trainees actively interact with the learning environment and experience simulated consequences of their actions, the learning process becomes more memorable and impactful. Immersive training experiences also encourage experiential learning, where workers learn through practice and direct involvement rather than passive observation.

Despite its advantages, the implementation of VR training systems also presents several challenges. The initial cost of VR hardware, software development, and specialized training content can be relatively high, which may limit adoption in smaller organizations. Additionally, the development of realistic virtual environments requires collaboration between safety experts, software developers, and instructional designers to ensure that training scenarios accurately reflect real workplace conditions.

Nevertheless, as VR technology continues to evolve and become more accessible, its application in occupational safety training is expected to expand significantly. Advances in graphics processing, motion tracking, and immersive interface design are continuously improving the realism and usability of VR training systems. Consequently, virtual reality is increasingly recognized as a powerful educational tool that can enhance the effectiveness of OHS training programs and contribute to the prevention of workplace accidents in complex industrial environments.

### 3. Methodology for Evaluating OHS Training Software

The increasing diversity of software solutions used for Occupational Health and Safety (OHS) training requires systematic methods for evaluating their effectiveness and suitability for different organizational contexts. As digital training technologies continue to evolve, organizations must carefully assess the performance and applicability of various software tools before integrating them into their safety management systems. A structured evaluation methodology allows safety professionals, training managers, and researchers to compare different platforms and identify the solutions that best support knowledge acquisition, worker engagement, and regulatory compliance.

Evaluating OHS training software involves analyzing several key criteria that reflect both the technological capabilities of the platform and its educational effectiveness. These criteria include *usability*, *interactivity*, *content adaptability*, *assessment accuracy*, and *learning effectiveness*. Together, these indicators provide a comprehensive framework for comparing different digital training systems and determining their potential contribution to workplace safety.

One of the most important evaluation criteria is *usability*, which refers to the ease with which workers can interact with the software platform. A training system with a

complex interface or difficult navigation may discourage users from fully engaging with the learning materials. Effective OHS training platforms should therefore provide intuitive interfaces, clear instructions, and simple navigation structures that allow workers to access training modules without requiring advanced technical skills. Usability is particularly important in industries where workers may have varying levels of digital literacy. Systems that are accessible through multiple devices, including computers, tablets, and mobile phones, further enhance usability by allowing workers to participate in training activities regardless of their location.

Another critical evaluation factor is *interactivity*, which reflects the degree to which users actively engage with the training content. Interactive learning environments have been shown to improve knowledge retention and increase learner motivation compared to passive instructional methods. Software products that incorporate interactive features such as simulations, scenario-based exercises, quizzes, and gamification elements encourage users to participate actively in the learning process. For example, simulation-based platforms allow trainees to explore hazardous scenarios and make safety-related decisions, while gamified training modules reward users with points or achievements for completing tasks and answering questions correctly. These features transform safety training from a purely theoretical activity into a more engaging and practical learning experience.

The *adaptability of training content* is another important criterion in evaluating OHS training software. Different industries face unique occupational risks and regulatory requirements, which means that training programs must often be customized to address specific operational contexts. Software platforms that allow administrators to modify training modules, update safety procedures, and integrate organization-specific case studies provide greater flexibility and long-term value. Adaptable systems enable companies to incorporate internal safety policies, industry regulations, and lessons learned from previous incidents into their training materials. This flexibility ensures that the training content remains relevant and aligned with the organization's evolving safety strategies.

In addition to training delivery, OHS software must also provide reliable mechanisms for evaluating workers' knowledge. *Assessment accuracy* refers to the ability of the software to measure trainees' understanding of safety concepts through structured testing tools. Effective systems typically include automated test generators, scenario-based assessments, and performance analytics that track learner progress. Accurate evaluation mechanisms are essential for verifying that employees have acquired the necessary competencies to perform their tasks safely. Furthermore, the use of automated scoring systems ensures objectivity and consistency in the evaluation process while reducing administrative workload for safety managers.

The final evaluation criterion concerns *learning effectiveness*, which refers to the extent to which the training platform improves knowledge retention, hazard recognition, and safe behavior among workers. Measuring learning effectiveness may involve analyzing test scores, observing improvements in workers' performance during practical tasks, or monitoring safety indicators such as incident rates and near-miss reports. Platforms that integrate immersive technologies, simulations, or adaptive learning mechanisms

often demonstrate higher effectiveness because they provide experiential learning opportunities that reinforce theoretical knowledge.

To illustrate how these evaluation criteria can be applied, a comparative analysis can be conducted across different categories of OHS training software, such as *e-learning platforms, simulation-based training systems, virtual reality (VR) training environments, and knowledge testing software*. Each type of platform offers distinct advantages and limitations depending on the specific training objectives and industrial context.

E-learning platforms generally score highly in terms of *usability and scalability*. Their web-based structure allows workers to access training materials easily from various locations, making them suitable for organizations with large or geographically distributed workforces. However, their level of interactivity may vary depending on the design of the training modules. Basic e-learning courses may rely heavily on text and video presentations, while more advanced systems incorporate interactive quizzes and multimedia elements.

Simulation-based training software typically offers a higher level of *interactivity and experiential learning* compared to standard e-learning platforms. These systems recreate workplace scenarios and allow trainees to practice safety procedures in virtual environments. Simulation tools are particularly valuable for developing decision-making skills

and hazard recognition capabilities. However, the development and implementation of simulation environments may require greater technical resources and financial investment.

Virtual reality training systems represent one of the most advanced forms of digital safety training. VR platforms provide highly immersive learning environments where trainees can interact with realistic simulations of industrial workplaces. In comparative evaluations, VR systems often achieve the highest scores in terms of *interactivity and learning effectiveness*, as the immersive experience enhances engagement and memory retention. Nevertheless, VR training also involves higher equipment costs and may require specialized technical support for implementation.

Knowledge testing software, on the other hand, focuses primarily on the *evaluation component* of training programs. These systems excel in terms of assessment accuracy and performance monitoring. By generating structured tests, analyzing results, and storing training records, testing platforms help organizations verify compliance with safety regulations and maintain documentation for certification purposes. However, testing software alone cannot replace comprehensive training systems, as it focuses mainly on evaluating knowledge rather than delivering interactive learning experiences. A simplified comparative perspective is summarized in table 2.

**Table 2:** Comparison between software types

Software Type	Usability	Interactivity	Adaptability	Assessment Accuracy	Learning Effectiveness
E-learning platforms	High	Medium	High	Medium-High	Medium
Simulation software	Medium	High	Medium	Medium	High
Virtual Reality training	Medium	Very High	Medium	Medium	Very High
Knowledge testing systems	High	Low-Medium	High	Very High	Medium

This comparative framework highlights that no single type of software can fully address all aspects of OHS training. Instead, the most effective approach often involves integrating multiple digital tools into a comprehensive safety training ecosystem. For example, organizations may combine e-learning modules for theoretical instruction, simulation or VR platforms for practical training, and automated testing systems for competency evaluation.

In conclusion, the evaluation of OHS training software requires a multidimensional approach that considers both technological and pedagogical factors. By applying structured evaluation criteria and conducting comparative analyses, organizations can select the digital training solutions that best align with their operational risks, workforce characteristics, and safety objectives. As digital learning technologies continue to advance, the integration of complementary training tools will play an increasingly important role in improving the effectiveness of occupational safety education and supporting the development of safer workplaces.

**4. Discussion**

The integration of software products into Occupational Health and Safety (OHS) training programs has become an increasingly important strategy for improving workplace safety education in modern industrial environments. As organizations adopt digital technologies and move toward more complex and automated production systems, traditional training approaches are often insufficient to

ensure that workers acquire the necessary competencies to recognize and manage occupational risks effectively. Software-based training tools offer innovative solutions that support more efficient, flexible, and interactive safety education processes.

One of the most significant advantages of implementing digital training platforms in OHS education is their *scalability*. Organizations operating in multiple locations or employing large numbers of workers often face logistical challenges when delivering traditional face-to-face training programs. Software platforms, particularly e-learning systems, allow companies to distribute standardized training materials to a large audience simultaneously. Workers can access the training modules from different geographical locations without the need for centralized training facilities. This capability is especially valuable for multinational companies, construction projects with temporary worksites, or industries where employees frequently change locations. Another major benefit of digital training systems is their *flexibility and accessibility*. Software-based training platforms allow employees to complete safety courses at their own pace and according to their work schedules. Unlike traditional classroom sessions that require fixed training periods, online systems enable workers to revisit learning materials whenever necessary, reinforcing their understanding of safety procedures and hazard control strategies. This flexibility contributes to improved knowledge retention and supports continuous professional development in occupational safety.

Digital training systems also provide *enhanced monitoring and evaluation capabilities*. Learning management systems and testing platforms can record detailed information about worker participation, training completion rates, and assessment results. Safety managers can analyze these data to identify gaps in employee knowledge and evaluate the effectiveness of training programs. Real-time monitoring of training progress allows organizations to ensure compliance with safety regulations and certification requirements. In many industries, maintaining accurate documentation of employee safety training is essential for regulatory inspections and internal audits.

In addition to improving administrative efficiency, software-based training tools significantly enhance *learner engagement*. Traditional safety training often relies on lectures or printed materials that may not capture the attention of workers. Digital platforms, on the other hand, incorporate multimedia content such as videos, animations, interactive quizzes, and scenario-based exercises. These elements create more engaging learning environments and encourage active participation in the training process. Technologies such as simulation software and virtual reality systems further increase engagement by allowing workers to experience realistic hazard scenarios and practice safety procedures in immersive digital environments.

Despite these advantages, several challenges remain associated with the implementation of software-based OHS training systems. One of the most frequently cited barriers is the *high cost of implementation*, particularly for advanced technologies such as virtual reality simulations or customized training platforms. Developing high-quality digital training content requires collaboration between safety experts, software developers, and instructional designers, which may involve significant financial investment. Smaller organizations or companies operating with limited resources may find it difficult to adopt these technologies without external support or funding.

Another important challenge relates to *technological barriers and infrastructure limitations*. Effective implementation of digital training platforms requires reliable internet connectivity, adequate computer hardware, and technical support. In some industrial sectors, particularly those operating in remote areas or developing regions, access to digital infrastructure may be limited. In such cases, organizations must carefully evaluate whether their technological capabilities can support the implementation of software-based training systems.

The *digital literacy of workers* also represents a significant factor influencing the success of digital safety training programs. Some employees, especially those in traditional industries or older workforce groups, may have limited experience using digital learning platforms. Without adequate guidance and support, these workers may encounter difficulties navigating online training modules or completing digital assessments. Therefore, organizations implementing software-based training should also provide introductory guidance and technical assistance to ensure that all employees can participate effectively.

Another important consideration is that *digital training should complement rather than replace practical workplace instruction*. While software platforms are highly effective for delivering theoretical knowledge and simulating hazardous scenarios, they cannot fully replicate the complexity of real working environments. Hands-on

training, workplace demonstrations, and direct supervision remain essential components of comprehensive safety education. The most effective training strategies typically combine digital learning tools with practical exercises, ensuring that workers can both understand safety principles and apply them correctly during operational activities.

Looking toward the future, several technological developments are expected to further enhance the effectiveness of software-based OHS training systems. *Artificial intelligence (AI)* is increasingly being integrated into digital learning platforms to provide personalized training experiences. AI-driven systems can analyze learner performance and adapt training content to individual needs, ensuring that workers receive targeted instruction based on their knowledge level and learning progress.

Similarly, *data analytics technologies* are becoming valuable tools for evaluating the impact of safety training programs. By analyzing large datasets related to training performance, incident reports, and operational safety indicators, organizations can identify patterns that help improve safety management strategies. Predictive analytics may also support proactive risk management by identifying potential safety issues before accidents occur.

Finally, advances in *immersive technologies*, including virtual reality and augmented reality, are expected to play an increasingly important role in future OHS training programs. These technologies enable highly realistic simulations of workplace environments, allowing workers to practice complex procedures and emergency responses in safe digital settings. As the cost of immersive technologies continues to decrease and their accessibility improves, their integration into safety training programs will likely become more widespread.

In conclusion, software products have the potential to significantly transform occupational safety training by providing scalable, flexible, and interactive learning environments. While challenges related to cost, technological infrastructure, and user adaptation remain, the continuous evolution of digital technologies is expected to further improve the accessibility and effectiveness of these tools. By combining digital training platforms with practical instruction and strong organizational safety cultures, companies can create comprehensive training systems that contribute to safer workplaces and better protection of workers' health and well-being.

### Research Gaps and Future Directions

Although significant progress has been made in the development of software products for OHS training, several research gaps remain. One important limitation is the lack of *longitudinal studies* evaluating the long-term impact of digital training technologies on workplace safety performance. While many studies demonstrate improvements in knowledge retention and training engagement, fewer investigations examine how these improvements translate into sustained behavioral changes and accident reduction over extended periods.

Another research gap concerns the *standardization of digital safety training tools*. Currently, there are limited guidelines or frameworks for designing, implementing, and evaluating software-based OHS training systems across different industries. Developing standardized best practices would help organizations adopt these technologies more effectively.

*Accessibility and inclusivity* also represent important areas for future research. Ensuring that digital training platforms are accessible to workers with disabilities or limited digital literacy is essential for promoting equitable safety education. Additionally, further studies are needed to examine how software-based training tools can be adapted to different industrial sectors with varying operational risks and safety requirements.

Overall, the literature indicates that software products have fundamentally transformed the landscape of occupational safety training. Digital learning platforms, simulation technologies, immersive VR and AR environments, artificial intelligence systems, and mobile learning applications provide innovative solutions for improving the effectiveness and accessibility of OHS education. These technologies support interactive learning experiences, objective knowledge evaluation, and continuous monitoring of employee competencies. While challenges related to cost, technical complexity, and standardization remain, ongoing technological advancements are expected to further enhance the capabilities of digital safety training systems and contribute to safer and more resilient workplaces.

## 6. Conclusions

Software products developed for training and testing Occupational Health and Safety (OHS) knowledge represent an important step forward in the modernization of workplace safety education. The rapid development of digital technologies has enabled organizations to move beyond traditional training methods and adopt more interactive, flexible, and data-driven learning approaches. Through digital platforms, employees can access structured training materials, participate in realistic safety scenarios, and undergo systematic evaluations of their knowledge and competencies.

The integration of technologies such as e-learning platforms, simulation-based training systems, and virtual reality environments significantly enhances the effectiveness of safety training programs. These tools support active learning processes by allowing workers to interact with training content, practice hazard recognition, and understand the consequences of unsafe behaviors within controlled environments. At the same time, digital assessment systems provide objective and automated mechanisms for evaluating workers' knowledge, enabling organizations to monitor training outcomes and ensure compliance with occupational safety regulations.

By implementing software-based training solutions, organizations can improve the consistency and accessibility of safety education while reducing logistical constraints associated with traditional training methods. In addition, digital platforms allow safety managers to track employee progress, identify knowledge gaps, and continuously improve training strategies based on performance data.

Future research should focus on evaluating the long-term impact of digital training technologies on workplace safety performance, including their influence on worker behavior, risk perception, and accident prevention. Further studies are also needed to explore how emerging technologies, such as artificial intelligence and immersive learning systems, can be integrated into OHS training frameworks to support more personalized and effective safety education programs.

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