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Research paper

Effectiveness of occupational safety and health training in virtual reality: a comparative study with traditional methods

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Abstract: This article analyses the effectiveness and perception of occupational safety and health (OSH) training using virtual reality (VR) compared to traditional methods. The aim of the study was to verify the effectiveness of VR training compared to traditional methods (Research No. 1) and to analyse the impressions of participants with different experiences with VR in the training system (Research No. 2). Research No. 1, conducted on students in the fields of construction and occupational health and safety, compared test results after traditional training (in person / online training) and VR (the "VR training at work at height" application). Research No. 2 included active construction workers, analysing their opinions on the usefulness, engagement, and impact of VR training on hazard knowledge, using questionnaires and participant observation. Research No. 1's results showed a significant improvement in test scores after VR training (an average increase of 22%), suggesting a higher effectiveness of this method. In Research No. 2, participants rated highly the usefulness of VR in health and safety training, comfort with VR devices, and their own participation. The results of the study confirm the effectiveness of VR training in occupational safety and health, increasing the effectiveness and participation of participants. Immersion, visualisation, and simulation of harsh working conditions are key advantages of this technology. The VR training system combines the experience of virtual reality with learning theory, simulating emergency response procedures and procedures for the use of personal protective equipment.

Keywords: construction industry, occupational health and safety, training, virtual reality

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1. Introduction

The work environment, especially in high-risk sectors such as construction, presents employers and training institutions with significant challenges in providing effective and engaging occupational safety and health (OSH) training. Workplace accident statistics indicate that improper employee behaviour, often the result of insufficient knowledge or superficial understanding, is one of the main causes of workplace hazards. Meanwhile, traditional forms of training, such as lectures, presentations, or instructional sessions, are increasingly proving insufficient, particularly for the younger generation of workers raised in a digital world and expecting interactive, engaging learning methods.

One solution that is gaining popularity and finding application in modern educational systems is virtual reality (VR) technology. Due to its immersive properties, VR enables the simulation of realistic event scenarios in a safe, controlled environment. This approach not only increases the engagement of training participants but also facilitates knowledge acquisition through experience, following the principles of Kolb's experiential learning cycle and the knowledge retention pyramid. In the context of andragogy, the science of adult education, VR aligns with the model of effective learning through practice, emotion, and reflection.

Despite the dynamic growth in the number of publications on the use of VR in education, the scientific literature points to a relatively limited number of empirical studies focused on evaluating the effectiveness of this technology in OSH training, particularly under conditions specific to the construction industry. Many existing studies focus on the applications of VR in fields such as medicine, aviation or general education, while systematic comparative analyses of the effectiveness of VR versus traditional training methods in the context of labour law regulations, the needs of young workers, and the effectiveness of professional knowledge acquisition are still lacking.

An additional research gap is the insufficient number of studies that take into account not only cognitive effectiveness (i.e., memorisation and understanding of content) but also affective effectiveness (levels of engagement, motivation, sense of safety, and self-confidence among employees after training). This article attempts to address this gap by analysing the results of research comparing classical OSH training with a modern immersive approach using the VR environment.

The subject undertaken is of significant practical and scientific importance, not only in the context of improving workplace safety, but also in optimising training processes in the era of Industry 5.0, which emphasises human-centricity, sustainable development, and organisational resilience. Researching the effectiveness of VR technology in the workplace environment can therefore contribute not only to reducing the number of accidents, but also to designing forward-looking educational systems that meet the needs of contemporary workers and employers.

2. State of the art

Virtual reality (VR) technology, defined as an immersive computer generated environment that enables users to interact with a digitally created reality [1], is finding increasingly wide application across many fields – from entertainment and marketing, through education, to specialised industry training. Initially associated mainly with the video game industry, virtual reality has now become an important didactic tool, allowing users to learn through experience, simulation, and exploration of realistic, yet safe scenarios.

In the literature, VR is applied in pilot training (flight simulators) [2], military personnel [3,4], medical professionals (training in medical procedures) [5,6], firefighters [7], paramedics [8], crane operators [9] and railway industry workers [10]. VR is also increasingly entering higher education institutions, where it is used to conduct laboratory exercises, explore spatial data [11], or simulate social and legal behaviours (eg, criminalistics or criminal law training) [12, 13]. Virtual reality is also used in training programmes focused on reducing social risk before natural disasters (such as earthquakes) and human-induced disasters [14].

In the educational context, VR technology addresses the needs of the so- called digital generation (Generation Z), characterised by high expectations regarding interactivity, multimedia content, and autonomy in the learning process [15–17]. According to D. According to Kolb's experiential learning cycle theory, adults learn most effectively through experience, reflection, and the practical application of acquired knowledge, elements that VR is capable of delivering in a dynamic and engaging form [18]. Innovative technologies not only transform the learning process but elevate it to a higher level [19].

Traditional training forms (including lectures and instructional videos) often prove insufficient to foster active participation among participants and realistically prepare them to recognise occupational hazards [20]. The use of an active form of training through virtual reality suggests that novices acquire knowledge more effectively through the mechanism of embodied cognition, which enables a deeper understanding of hazards by simulating physical reactions in a virtual environment. Meanwhile, more experienced individuals achieve better results in immersive experiential formats due to emotional arousal, which in turn enhances memory retention and promotes reflection on real-world risks [21]. Training programmes should not only present hazards, but also shape the way individuals think about them, a goal achievable through the use of immersive storytelling as an innovative component of OSH training in the virtual reality environment [22].

Although the number of studies on the use of VR in vocational education is growing, including in the area of OSH training in construction (Figure 1), most of these studies focus on inexperienced groups, mainly students, students, or individuals preparing to enter the labour market [23]. Professional groups with existing practical experience, such as construction workers [24], assemblers [25], or machine operators [26], are analysed to a much lesser extent. As a result, there is still a lack of data on the actual effectiveness of VR in relation to the real occupational situations encountered by workers in different industries [27]. This trend of growing academic interest is illustrated in Figure 1, which shows the number of publications related to the use of VR in construction safety training over the past two decades.

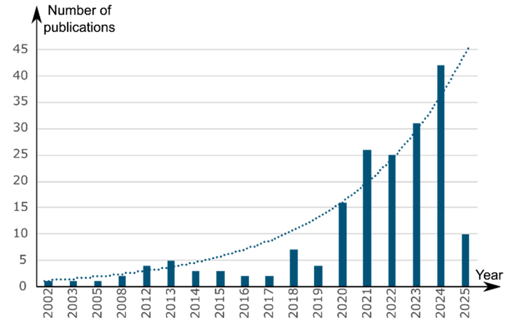

Fig. 1. Number of publications on virtual reality from 2002 to 2025 [source: Web of Science: Title-Abstract-Keywords: virtual reality, construction, safety, training; limited to: article]

3. Research methodology

The research was based on analysing the increase in knowledge level and the satisfaction with using virtual reality technology in the area of occupational safety in construction.

The objectives of the study were the following.

– to verify the effectiveness of training conducted in virtual reality compared to traditional methods (Research No. 1), and
– analyse the impressions of training participants with varied experience in virtual reality technology when using a training system that employs this technology (Research No. 2).

The training topics in both traditional and virtual reality-based formats in both studies (Research No. 1 and 2) focused on working at height. The studies were carried out in two independent research groups.

The increase in knowledge level and the evaluation of participants' impressions were examined using traditional methods, by taking a written knowledge test and a survey.

3.1. Research no. 1

In Research No. 1, the target group consisted of students, potential users of VR technology in occupational safety and health (OSH) training. Participants in this group represented students from the fields of construction and OSH, who, during their studies, take courses that address safety issues in the workplace. According to the research methodology, participants in the training could choose between attending traditional training in the form of a lecture, either in person (in a lecture hall) or online, synchronously (via an online meeting application, such as Zoom, Teams, etc.).

To ensure comparable results, each participant in the training group was subjected to training under the same conditions (one lecture hall) and trained using the same methods (a lecture using multimedia presentations). All participants, regardless of the group, completed the research questionnaires. A survey link was provided to users (via an online platform). The main principle for the participants during the training was to behave as they would in other training sessions. The training content focused on the navigation of the workplace (construction site), accident hazards, health hazards, and basic OSH principles related to the operation of technical equipment. In-person and remote, synchronous training, without the use of virtual reality elements, lasted about 45 minutes.

The second stage of the research involved conducting virtual reality training. All participants in the traditional training group were eligible to participate in the second stage. The VR training did not take place more than two weeks after completing the previous training. Before VR training began, participants were familiarised with the operation of the goggles and the application interface in the form of a short instruction that lasted approximately 5 minutes. Each VR session took place in a separate quiet room measuring at least 2×2 m, according to the recommendations of the application and the equipment manufacturer. Ventilation, minimal noise levels, and technical support were provided.

The VR-based training relied on the "VR Training for Working at Heights" application developed by EHS VR. The "VR Training for Working at Heights" is a solution in occupational health and safety designed for high-risk work environments. Training simulates real scenarios, including equipment inspection, fall protection, and emergency evacuation. Workers practice proper selection of protective equipment, use of harnesses, and rescue operations in an interactive, risk-free VR environment. Training helps prevent falls, ensures compliance with safety regulations, and minimises workplace accidents. A minimum space of 2×2 meters and the application installed on VR headsets, such as the OCULUS Meta Quest 3 goggles, are required to conduct the training. The same application was used in Research No. 2, which analysed participants' impressions of the training system. Sample views from the participant's perspective within the application are shown in Figure 2, highlighting the realistic simulation of working-at- height scenarios and user interaction in the VR environment.

Fig. 2. Sample views from the perspective of a training participant in the "VR Training for Working at Heights" application developed by EHS VR

After training, the participants completed a test consisting of 11 questions, 10 of which were single choice and 1 multiple choice. The knowledge test used was prepared in collaboration with health and safety experts. The questions were selected to cover key issues related to working at height and impacted elements such as safety harnesses, self-locking devices, safety shock absorbers, height safety barriers, and protective railings. To preliminarily assess the accuracy of the content and clarity of the questions, independent health and safety specialists evaluated the test.

3.2. Research No. 2

In the Research No. 2, the key role was played by selecting the participant group, which consisted of professionally active workers in the construction sector, with at least one year of experience in the industry. The decision to include this group was based on an analysis of the state of knowledge, which revealed a significant research gap – most existing studies on the use of virtual reality technology in OSH training were conducted in academic settings, primarily among students or individuals without practical work experience [20]. This sample selection limits the ability to generalise the results to real work conditions and organisational contexts.

The study was carried out among employees of one of Poland's leading construction companies, specialising in both the design and general contracting of construction projects. This company also employs general construction workers who perform tasks on construction sites, which allowed for a broad spectrum of roles to be included. This sample selection enables a more realistic assessment of the functionality, usability, and reception of virtual reality training, taking into account the diverse needs and expectations of users.

The aim of this research was to analyse the impressions and opinions of participants with varying levels of experience with virtual reality technology after completing the immersive training. Specifically, the focus was on three main aspects: the perception of the usability and intuitiveness of the VR training system, the level of participation and immersion, and the perceived impact of the training on hazard awareness and knowledge. The same application used in Research No. 1 was used for this study.

A questionnaire based on a 5-point Likert scale was used to measure subjective usability, comfort, immersion, and satisfaction ratings. A pilot version of the questionnaire was tested with five participants, and their feedback was incorporated into the final version of the tool. Additionally, a participant observation method was applied, during which users' behaviours and reactions were analysed while using virtual reality. The use of a triangulation approach, which combined quantitative and qualitative data, allowed a comprehensive picture of the effectiveness and reception of the training, as well as the identification of potential technological barriers and preferences arising from the level of experience with new technologies.

4. Results

4.1. Research No. 1

In the first stage of the investigation, 24 participants participated in traditional training, including 11 in person and the remaining 13 remotely. The study involved 15 women (62.5% of all participants) and 9 men (37.5% of participants). The largest group of participants (18 people, or 75% of all participants in the study) had higher education, with bachelor's degree graduates accounting for 13 people and engineering degree holders for 9 people. The second largest group consisted of people with secondary education, 5 individuals (20.8%) and 1 person who completed a master's degree programme in engineering. Seventeen participants were studying or had studied a field directly related to occupational health and safety (OHS), while nine participants had no direct connection to the OHS field. Participation in the study was voluntary and a total of 17 completed questionnaires were obtained, with 9 people attending the training in person and 8 remotely.

In the second stage of the research, involving virtual reality, 17 participants participated. In the subsequent analysis, only the results obtained from participants who participated in both stages of the investigation (traditional training and virtual reality training) were included. Table 1 presents the collective data on the participants who participated in both traditional training (test result No. 1) and VR-based training (test result No. 2). The table presents the results of the test conducted after traditional training as well as after VR training.

Table 1. Summary of the results of research No. 1

No.	Geder	Traditional training method	Education	Test result no. 1	Test result no. 2
1	Female	In person	Secondary	9	9
2	Female	On-line	Bachelor’s	10	9
3	Female	On-line	Secondary	5	9
4	Male	On-line	Secondary	7	10
5	Female	On-line	Bachelor’s	9	10
6	Male	On-line	Bachelor’s	7	10
7	Male	In person	Bachelor’s	10	11
8	Male	On-line	Secondary	8	10
9	Female	On-line	Bachelor’s	3	8
10	Female	In person	Bachelor’s	5	8
11	Female	In person	Bachelor’s	6	11
12	Male	In person	Bachelor’s	5	10
13	Male	On-line	Bachelor’s	9	11
14	Male	In person	Secondary	7	11
15	Female	In person	Master’s	8	8
16	Male	In person	Bachelor’s	8	10
17	Female	In person	Bachelor’s	6	8

Figure 3 shows the collective results obtained by the participants after traditional training (represented in blue) and after virtual reality training (represented in green). Figure 3 presents a complete comparison of the test results after both training methods, clearly illustrating the improvement and reduced variance in the scores after the virtual reality- based instruction.

To quantitatively assess the effectiveness of training using virtual reality (VR) technology, a comparison was made between the knowledge test results obtained by the participants after traditional theoretical training and after training conducted in an immersive environment. The analysis included 17 participants who participated in both stages of the study, which allowed the use of a paired sample t-test.

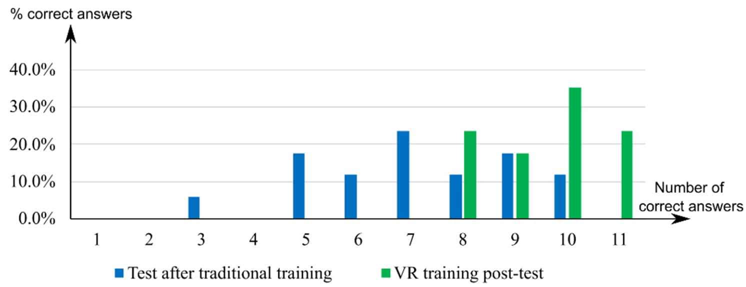

Fig. 3. Overall results of training participants

The results obtained after traditional training (shown in blue in Figure 3) were highly dispersed, ranging from 3 to 10 points. The arithmetic mean was 7.1 (standard deviation SD = 1.98) and the median was 7 points. After training carried out in the VR environment (green in Figure 3), significantly higher and more homogeneous results were recorded, ranging from 8 to 11 points, with a mean of 9.58 (SD = 1.12) and a median of 10. The difference in mean test scores was 2.48 points, representing an improvement of approximately 22%, indicating an increase in the effectiveness of the training process.

To assess the statistical significance of this difference, a paired-sample t-test was conducted. The test result ($t = -5.41$; $p = 0.00012$) indicates a high level of statistical significance for the observed improvement, which allows the rejection of the null hypothesis of no difference in the effectiveness of teaching methods. The values obtained allow us to state, with 95% confidence ($\alpha = 0.05$), that the use of VR as a teaching tool leads to significantly better educational outcomes.

Another important conclusion from the analysis is the fact that none of the participants scored below 8 points in the test after VR training, while after traditional training the lowest score was only 3 points. The vast majority of participants improved their scores and only two individuals obtained the same result as before. Furthermore, the lower standard deviation after VR training may indicate a greater standardisation of educational outcomes with this method.

The observed effectiveness of virtual reality training, conducted among students of 'construction' and 'occupational health and safety' programmes at Wrocław University of Science and Technology, within a group of individuals without professional experience in height work, suggests that similarly positive results can be expected in professional practice. These findings are consistent with experiential learning theory and the concept of embodied cognition, according to which immersive environments support deeper knowledge acquisition and retention of acquired skills.

4.2. Research No. 2

The research involved 59 participants, among whom 52.5% were men (31 people) and 47.5% were women (28 people), indicating a balanced participation of both genders. In terms of age, the largest group was respondents aged 30–39 years, which made up 44.1% of all participants (26 people). The next groups were people aged 20 to 29 years – 28.8% (17 people) and 40 to 49 years – 25.4% (15 people). Only 1.7% of the respondents (1 person) were 50–54 years old.

The most frequently mentioned positions were: procurement specialist (7 people), occupational health and safety specialist (6 people), physical worker – reinforcement worker (4 people), as well as construction manager, site engineer, intern, junior BIM specialist and project coordinator, each of these positions was represented by 3 people. Other positions, such as designer, manager, warranty service specialist, project manager, or design office coordinator, were mentioned individually.

When analysing the work experience in the given position, the largest group was employees with 2 to 3 years of experience (35.6%, 21 people) and those with one year of experience (30.5%, 18 people). The smaller groups included respondents with 4 to 5 years of experience (15.3%), 6 to 10 years (8.5%), and 11 to 15 years (6.8%). The smallest group consisted of employees with 16-20 years of experience, representing 3.4% of the participants.

After completing the virtual reality training, participants were asked to complete a questionnaire to evaluate the training they had completed. The questions used a five-point Likert scale (strongly agree – 5, strongly disagree – 1). The questionnaire consisted of questions related to virtual reality (VR) and its application in safety training. A detailed breakdown of the survey responses from participants in Research No. 2 is presented in Figure 4, illustrating the levels of satisfaction, comfort, engagement and willingness to recommend virtual reality training.

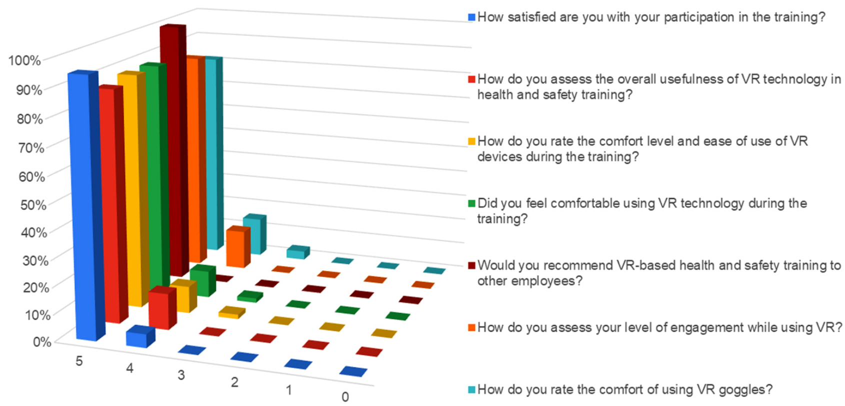

Fig. 4. Results obtained from the study of participants' impressions of training using virtual reality technology

On the question "How satisfied are you with your participation in the training?" The respondents expressed a very high level of satisfaction with their participation in the training (blue colour). 56 participants, representing 95% of the respondents, gave the highest possible rating (5 points), indicating a positive reception of both the content and the format of the course. 5% (3 people) rated the training with a score of 4. No one rated the training lower.

Virtual reality technology was considered very useful in the context of health and safety training. On the question "How do you assess the overall usefulness of VR technology in health and safety training?" (red colour), 51 participants (88% of all participants) gave a rating of 5, which shows that virtual reality is seen not only as a modern tool, but also as something that genuinely increases the effectiveness of learning safety and hygiene principles.

On the question "How do you rate the comfort level and ease of use of VR devices during training?" 52 participants (88%) rated the comfort level and intuitiveness of handling the devices very highly (5 points) (yellow colour). Participants did not report significant technical difficulties, which indicates that the equipment was adequately prepared and adequate introductory instructions were provided. The same distribution of answers was given by participants to the question "Do you feel comfortable using VR technology during the training?" (green colour).

All participants in the training responded to the question "Would you recommend VR-based health and safety training to other employees?" All participants declared their willingness to recommend the training to other employees (brown colour). This response not only indicates a positive reception of the experience itself but also a belief in its educational value and potential to improve workplace safety.

On the question "How do you assess your level of engagement while using VR?" 50 participants, i.e., 85% of the training participants, rated their level of engagement as very high (orange colour). Meanwhile, the physical comfort of using virtual reality glasses (on the question 'How do you rate the comfort of using VR glasses?' teal colour) was rated very well by 48 people, i.e. 81% of the participants. Most of the users did not report any problems with adjusting or fitting the device, suggesting the high quality of the equipment used.

Based on the research conducted, very positive reactions were obtained from users regarding the training conducted in the virtual environment. The benefits of using virtual reality in health and safety training include:

- Safety – the ability to simulate dangerous environments and situations without risk to the life and health of the training participants.
- Greater participation of participants – compared to traditional lectures and/or exercises.
- Cognitive and behavioural learning in one – the opportunity to test theoretical knowledge and skills in practice, in realistic situations

5. Discussion

The research conducted reveals a significant research gap on the application of virtual reality in practical vocational training for experienced individuals. There is a lack of studies conducted in larger professional groups from various sectors (eg construction, industrial, transport workers), which would allow a better assessment of the long-term impact of virtual reality, knowledge transfer to real-life job tasks, and the effectiveness of virtual reality as a tool for accident prevention.

Although the results of the study indicate that virtual reality is an innovative tool for increasing awareness of hazards and the effectiveness of training, the research carried out by Umair et al. [28] reveals its potentially negative impact on risk perception. The effectiveness of immersive environments may have neuropsychological underpinnings, such as activation of brain structures related to procedural memory (eg, the striatum) and enhanced emotional encoding (amygdala and hippocampus). At the same time, critical voices in the literature emphasise potential limitations, such as challenges in transferring knowledge from virtual reality to real-world work contexts or the phenomenon of habituation, which can reduce hazard perception in repetitive scenarios. This highlights the importance of designing dynamic and diverse VR environments and avoiding excessive uniformity. It was observed that, although initial experiences of simulated accidents result in an increased sensitivity to risk, with repeated exposure to the same training scenarios, this effect diminishes until the phenomenon of habituation occurs, and participants become less sensitive to the hazards that initially triggered strong reactions. This means that repeated exposure to identical accident simulations reduces the effectiveness of VR training, and participants must be exposed to new scenarios each time. This leads to the necessity of continuously developing new and modifying existing training applications. Therefore, the careful design of training programmes is crucial, taking into account the variability of scenarios, the diversity of stimuli, and the individual predispositions of the participants. When designing scenarios, it is important to ensure that they are realistic and based on actual hazardous events and workplace accidents. Instead of using fictional scenarios, training should be based on real accidents, which significantly increases credibility and has a much more convincing communicative power. In this way, users not only learn procedures, but also understand the causes of incidents, their consequences, and possible prevention methods – which significantly influences attitudes and behaviour changes [29].

A significant limitation of the study is the absence of a control group and the random assignment of participants to experimental conditions. Due to the comparative nature of the study (all participants completed traditional and virtual reality training), randomisation was not feasible, which may introduce a learning effect or order bias. This limitation should be considered when interpreting the results, as it may represent a potential source of systematic error.

The limitation of the investigation no. 1 is the relatively small number of participants ($N = 17$), which limits the possibility of generalising the results. The virtual reality training scenario covered only one subject area, work at heights, which also prevents conclusions about the effectiveness of this technology in other training contexts (for example, work in confined spaces, contact with chemicals, etc.).

This study evaluated the effectiveness of training immediately after the end of the teaching process, which does not allow for an assessment of long-term knowledge retention. In subsequent studies, it would be worthwhile to consider measuring the effects weeks or months after training to estimate the durability of the results. From a practical point of view, the costs of purchasing virtual reality equipment and developing diverse scenarios may be a significant barrier to implementation. Furthermore, this technology allows flexible adaptation of training content to different industries and hazards, which, on an appropriate scale, can increase the profitability of the investment.

6. Conclusions

The research conducted as part of this study was innovative and groundbreaking in the field of health and safety training. Until now, there have been no quantitative studies confirming that virtual reality immersion makes training more effective than traditional methods. The new dimension of training allows for the improvement of the educational process by: enhancing training effectiveness, providing visualisation and simulation, and simulating difficult working conditions. The proposed training technology is a groundbreaking method that combines virtual reality experience with learning theory.

Computer simulation is a modern tool for teaching employee response procedures in crisis situations, decision-making training, and the use of personal protective equipment. The use of virtual reality techniques enables employees to develop and practice correct behaviour in hazardous situations under controlled and safe conditions. Visual and auditory stimuli in the virtual environment during realistic and interactive simulations help maintain training interest and facilitate the retention of information and the consolidation of skills related to the tasks being performed.

The developed training system using the virtual environment is characterised by realism, immersion, and gamification. After wearing VR goggles, the participant is cut off from external stimuli and fully focusses on the presented content (effectiveness). Combined with realism and interactivity, this positively impacts the engagement of the training participant. Knowledge retention also increases. The interactive and modern form makes the virtual training more attractive to the user compared to traditional training. The study showed that participants in training using virtual reality technology achieved, on average, 22% better results in final tests than those learning through traditional methods (Research No. 1). The level of participation, assessed using Likert scales by construction industry employees (Research No. 2), was also high.

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Efektywność szkoleń BHP w wirtualnej rzeczywistości: badania porównawcze z metodami tradycyjnymi

Słowa kluczowe: bezpieczeństwo i higiena pracy, budownictwo, szkolenia, wirtualna rzeczywistość

Streszczenie:

W artykule analizie poddano skuteczność i odbiór szkoleń z zakresu bezpieczeństwa i higieny pracy (BHP) z wykorzystaniem wirtualnej rzeczywistości (VR) w porównaniu do metod tradycyjnych. Celem badań była weryfikacja efektywności szkoleń VR w porównaniu do konwencjonalnych metod (badanie 1) oraz analiza wrażeń uczestników o różnym doświadczeniu z VR na temat systemu szkoleniowego (badanie 2). Badanie 1, przeprowadzone na studentach kierunkach budownictwo oraz bezpieczeństwo i higiena pracy, porównywało wyniki testów po szkoleniach tradycyjnych (wykłady stacjonarne/zdalne) i VR (aplikacja "Szkolenie VR w pracy na wysokości"). Badanie 2 objęło aktywnych zawodowo pracowników budowlanych, analizując ich opinie na temat użyteczności, zaangażowania i wpływu szkoleń VR na wiedzę o zagrożeniach, wykorzystując kwestionariusze i obserwację uczestników. Wyniki badania 1 wykazały znaczną poprawę wyników testów po szkoleniu VR (średni wzrost o 22%), co sugeruje wyższą efektywność tej metody. W badaniu 2, uczestnicy ocenili wysoko użyteczność VR w szkoleniach BHP, komfort użytkowania urządzeń VR oraz własne zaangażowanie. Uzyskane wyniki badań potwierdzają skuteczność szkoleń VR w BHP, podnosząc efektywność i zaangażowanie uczestników. Immersja, wizualizacja i symulacja trudnych warunków pracy to kluczowe zalety tej technologii. System szkoleniowy VR łączy doświadczenie wirtualnej rzeczywistości z teorią uczenia się, symulując procedury reagowania w sytuacjach kryzysowych i procedury wykorzystania środków ochrony indywidualnej.

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