Eduweb, 2026, abril-junio, v.20, n.2. ISSN: 1856-7576
Doi: https://doi.org/10.46502/issn.1856-7576/2026.20.02.15

Original Article

# Entornos de aprendizaje inmersivos: Realidad virtual para el desarrollo de habilidades de toma de decisiones en ocupaciones de alto estrés

## Immersive learning environments: Virtual reality for developing decision-making skills in high-stress occupations

**Ruslan Sich**[1] **Oleh Reznik**[2] **Oleksandr Olytskyi**[3] **Andrii Biliavets**[4] **Petro Horpynych**[5]

**Afiliación autor:**
[1] PhD, Bogdan Khmelnytskyi National Academy of the State Border Guard Service of Ukraine, Khmelnytskyi, Ukraine. r.sich75@gmail.com
[2] PhD, Bogdan Khmelnytskyi National Academy of the State Border Guard Service of Ukraine, Khmelnytskyi, Ukraine. aleg05021982@gmail.com
[3] PhD, Bogdan Khmelnytskyi National Academy of the State Border Guard Service of Ukraine, Khmelnytskyi, Ukraine. olytskiyo@ukr.net
[4] PhD, Bogdan Khmelnytskyi National Academy of the State Border Guard Service of Ukraine, Khmelnytskyi, Ukraine. biliavets1986@gmail.com
[5] Senior lecturer, Bogdan Khmelnytskyi National Academy of the State Border Guard Service of Ukraine, Khmelnytskyi, Ukraine. gorpynychpetro@gmail.com

Recibido: 20/03/26
Aceptado: 30/05/26

**Cómo citar:**
Sich, R., Reznik, O., Olytskyi, O., Biliavets, A., & Horpynych, P. (2026). Immersive learning environments: Virtual reality for developing decision-making skills in high-stress occupations. *Revista Eduweb, 20*(2), 253-271. https://doi.org/10.46502/issn.1856-7576/2026.20.02.15



### Resumen

Los entornos de aprendizaje inmersivos basados en tecnologías de realidad virtual (RV) han abierto nuevas oportunidades para la formación de profesionales cuyas actividades se desarrollan en condiciones complejas y dinámicas. El objetivo de este estudio fue evaluar la eficacia del entrenamiento en RV para desarrollar habilidades de toma de decisiones en situaciones profesionales complejas e identificar los factores psicológicos que influyen en la eficacia de las actividades en dichos entornos. El estudio incluyó a 300 personas, divididas en un grupo experimental (entrenamiento en RV) y un grupo de control (entrenamiento tradicional con escenarios). El análisis de los resultados mostró diferencias estadísticamente significativas entre los grupos. Los participantes que recibieron entrenamiento en un entorno de RV obtuvieron mejores resultados en cuanto a conciencia situacional, velocidad de análisis de situaciones, precisión en la toma de decisiones y autorregulación emocional. Los resultados del análisis de regresión indicaron que la intensidad del uso de la RV ($\beta = 0,34$, $p < 0,001$), la resiliencia psicológica ($\beta = 0,30$, $p < 0,001$) y la autorregulación emocional ($\beta = 0,26$, $p < 0,001$) tuvieron el mayor impacto. Esto subraya la importancia tanto de las condiciones pedagógicas de aprendizaje como de los recursos psicológicos individuales de los participantes. Los hallazgos destacan que la combinación de tecnologías inmersivas y los recursos psicológicos de los participantes contribuyó a la formación de estrategias cognitivas más eficaces para el análisis de situaciones.

**Palabras clave:** entornos de aprendizaje inmersivos, aprendizaje en realidad virtual, toma de decisiones, conciencia situacional, formación profesional, tecnologías educativas.

### Abstract

Immersive learning environments based on virtual reality (VR) technologies have opened up new opportunities for training professionals whose activities are related to work in complex and dynamic conditions. The purpose of the study was to assess the effectiveness of using VR training to develop decision-making skills in complex professional situations, to identify psychological factors that influenced the effectiveness of activities in such environments. The study involved 300 people who were divided into an experimental group (VR training) and a control group (traditional scenario training). Analysis of the results showed the presence of significant differences between the groups. Participants who underwent training in a

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

VR environment had better indicators of situational awareness, speed of situation analysis, accuracy of decision-making. Additionally, analysis of variance indicated that the effectiveness of scenario tasks increased in accordance with the intensity of VR scenario use in the learning process. The results of regression analysis indicated that the intensity of VR use ($\beta = 0.34$, $p < 0.001$), psychological resilience ($\beta = 0.30$, $p < 0.001$) and emotional self-regulation ($\beta = 0.26$, $p < 0.001$) had the greatest impact. This indicates the important role of both pedagogical learning conditions and individual psychological resources of participants. The findings emphasize that the combination of immersive technologies and participants' psychological resources contributed to the formation of more effective cognitive strategies for analyzing situations.

**Keywords:** immersive learning environments, VR learning, decision-making, situational awareness, professional training, educational technologies.

## Introduction

The rapid development of digital technologies has significantly influenced the formation of modern educational practices, including in the field of professional training of specialists in high-responsibility fields. In many emergency professions, the effectiveness of activities depended on the ability of specialists to quickly analyze the situation, make informed decisions in limited time conditions and control their own emotional reactions. Traditional educational models, which were based on lecture and seminar forms of training, did not always provide a sufficient level of practical training for such situations, which led to the need to find new pedagogical approaches.

One of the promising areas was the use of immersive learning environments, in particular virtual reality technologies (Virtual Reality, VR). Immersive technologies made it possible to create interactive learning spaces in which students could interact with dynamic simulated scenarios.

In modern scientific literature, interest has been formed in researching the potential of immersive technologies in the education system (Zechner et al., 2023). Studies have shown that VR has increased the engagement of learners, contributed to a deeper understanding of complex processes, and created conditions for practice-oriented learning (Clifford et al., 2019; Dubreucq et al., 2025). In particular, immersive simulations have made it possible to integrate cognitive, behavioral, and emotional components of learning. At the same time, many available studies have focused on the technical aspects of VR or on general indicators of the effectiveness of digital educational tools (Hurrell & Baker, 2020; Kleygrewe et al., 2022). However, the problems of pedagogical design of immersive learning environments and their impact on the development of decision-making skills in complex situations have remained insufficiently studied (Llanos-Ruiz et al., 2025). The latest educational models have taken into account the technological capabilities of VR, pedagogical principles of organizing the educational process, and the features of user interaction with the digital environment. At the same time, an important but under-researched aspect is the economic and organizational feasibility of implementing VR in the educational process (Tsymbal-Slatvinska et al., 2022). Despite the high initial costs of equipment and development, VR technologies can reduce long-term costs due to scalability, repeatability of scenarios, and a reduction in the need for costly practical training.

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces



In such circumstances, the study of the possibilities of using immersive learning environments to develop decision-making skills in professions with a high level of stress has become relevant in the future.

The purpose of the study is to analyze the potential of immersive learning environments based on virtual reality technologies for the development of decision-making skills in professions with a high level of stress. To achieve the goal, the following research objectives were defined:

1. To analyze modern approaches to the use of immersive technologies in professional training.
2. To identify pedagogical principles for designing training scenarios in a virtual reality environment.
3. To investigate the impact of an immersive training environment on the development of decision-making skills in complex situations.
4. To determine the relationship between the psychological characteristics of training participants and the effectiveness of performing scenario tasks in a VR environment.

The study proposed the following hypotheses:

1. The use of immersive training environments based on virtual reality technologies will contribute to an increase in the level of formation of decision-making skills in complex situations.
2. Participants who underwent training in a VR environment demonstrated a higher level of situational awareness and speed of decision-making compared to traditional forms of training.
3. Psychological characteristics, in particular the level of stress resistance and the ability to self-regulate, are positively correlated with the effectiveness of performing scenario tasks in an immersive learning environment.

**Literature Review**

At the current stage of development of research in the field of vocational education, significant attention has been paid to the issue of finding effective pedagogical approaches for training specialists whose activities take place in conditions of increased risk and uncertainty. Since approximately 2020, there has been a noticeable increase in interest in research in the scientific literature that combined pedagogical, psychological and technological approaches to training specialists in complex and stressful situations. Researchers have paid particular attention to the use of digital simulations, immersive learning environments and professional scenario modeling technologies as tools for developing decision-making skills (Vieira et al., 2025; Steingräber et al., 2021; Semenova et al., 2023).

In this context, an important area of research has been the study of psychological and cognitive factors that influenced the effectiveness of professional activity in complex conditions. In particular, recent review studies have shown that the ability to be psychologically resilient and emotionally self-regulating was an important part of decision-making in situations of increased workload (Moreno et al., 2024). In pedagogical practice, training programs aimed at developing these competencies were increasingly used, in particular, trainings that integrated cognitive-behavioral approaches, mindfulness techniques, and emotion management strategies (Filipenko et al., 2024). Researchers have emphasized the effectiveness of such programs, noting the dependence on the possibility of individualizing learning and adapting educational trajectories to the characteristics of participants in the

Eduweb
https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces



educational process. At the same time, the development of digital educational technologies has significantly expanded the possibilities of pedagogical modeling of complex professional situations (Reale et al., 2023; Vittadello et al., 2025). One of the most promising areas in this context was the use of scenario-based and simulation-based learning, which allowed for the reproduction of realistic work situations in a controlled educational environment. Immersive technologies (such as virtual reality) created conditions for interactive interaction of users with educational scenarios and allowed the formation of practical skills in a safe digital environment.

However, one of the key issues in the study of immersive technologies has become the problem of transferring learning outcomes from a virtual environment to real professional activity. Modern pedagogical research has determined that the effectiveness of VR training cannot be assessed solely through the level of involvement or realism of the simulation. The category of effectiveness should be described based on the ability to form stable cognitive and behavioral patterns that are reproduced in real conditions of activity.

From this point of view, the integration of immersive technologies with psychological and pedagogical approaches to learning is of particular importance (Ocaña-Zuñiga et al., 2023; Ramdani & Kotsou, 2025). For example, the formation of stress resistance, emotional self-regulation and situational awareness has become an important factor that ensured the effective transfer of the formed skills into practical activities. Immersive environments also make it possible to model conditions of uncertainty, limited time and a high level of responsibility.

In addition, the issue of harmonizing individual and socio-organizational factors of learning has become important. Studies have shown that the effectiveness of training in difficult conditions depends on individual characteristics (level of self-regulation, cognitive flexibility) and on the learning space. In particular, the factors of team interaction, organizational culture and after-action review practices have become important. Accordingly, VR environments play the role of an integrative platform that combines individual and collective learning (Ramdani & Kotsou, 2025). Therefore, immersive technologies should be considered as a visualization tool and as a pedagogical environment that provides conditions for the formation, consolidation and transfer of professional competencies.

Several studies have shown that the combination of immersive technologies with pedagogical learning models that were focused on the development of stress resistance significantly increased the effectiveness of specialist training (Andersen et al., 2024; Caudillo-Melgoza & Caudillo Melgoza, 2025). In particular, an increase in attention concentration and a decrease in the number of errors when performing complex tasks in simulated scenarios were confirmed (Gamito et al., 2024). European research projects have also proposed comprehensive training models that combine psychoeducational modules, self-regulation training, situational scenario analysis, and group interaction in digital simulation environments (Steingräber et al., 2021). Such approaches have integrated individual learning, team interaction, and dynamic assessment of professional competencies. A separate area of research has been related to the consolidation of the role of socio-organizational factors in shaping readiness for activity in conditions of increased risk. In particular, studies have shown that organizational climate, management style, safety culture, and the level of collegial support could significantly affect professional resilience and effectiveness in complex situations (Dubiel et al., 2025). Organizations that implemented team incident analysis, after-action review, and horizontal communication practices

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces



showed significantly better adaptability and psychological preparedness for unforeseen situations (Fedorenko et al., 2023; Jongbloed et al., 2024). These results confirmed the need for further training programs with special modules aimed at developing team interaction, communication, and collective resilience in complex work environments. At the same time, despite the significant amount of research in this area, a number of significant research gaps remained in the scientific literature. First of all, this concerned a limited number of empirical studies aimed at comprehensively assessing the effectiveness of immersive learning environments for developing decision-making skills in complex situations. Existing training programs differed significantly from the existing standardized criteria for assessing the formation of relevant competencies. Therefore, it remains relevant to conduct further research aimed at empirically verifying pedagogical models of using immersive technologies in the professional training of specialists whose activities are related to work in stressful conditions.

## Methodology

### Research Design

The study was conducted using a mixed-methods design. It combined quantitative and qualitative approaches to analyze the effectiveness of immersive learning environments based on virtual reality (VR) technologies in developing decision-making skills in situations of increased complexity. This design made it possible to combine statistical measurement of changes in learning outcomes with a deeper analysis of participants' behavioral responses while performing scenario tasks in a virtual environment.

The study was quasi-experimental in nature and included a comparison of two training models: traditional training and training using an immersive VR environment. In general, the study was implemented in three stages.

The first stage involved a quantitative study to determine the initial level of psychological characteristics related to decision-making in stressful situations (stress tolerance, emotional self-regulation, coping strategies).

In the second stage, participants participated in scenario training tasks. For the experimental group, these scenarios were implemented in VR environments. Participants from the control group performed similar tasks in the traditional format of training simulations. The scenarios consisted of modeling complex professional situations that required rapid response, information analysis, and risk assessment.

The VR scenarios used were to:

- Respond to sudden crisis situations in a complex environment;
- Make decisions in complex situations of information uncertainty;
- Perform tasks in an environment with an increased level of sensory load (noise, limited visibility, dynamic changes in the situation);
- Participants demonstrated team interaction in complex scenarios.

The assessment was carried out using standardized observation cards that were filled out by instructors after each scenario.

The VR environment was used with stand-alone VR headsets, which allowed users to immerse themselves in simulated scenarios without the need to connect to external computing systems. The devices are equipped with built-in displays with a

Eduweb
https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

resolution of 1832×1920 pixels per eye, a refresh rate of 72–90 Hz, and real-time head and hand movement tracking systems.

Hand-held controllers were also used to interact with the virtual environment, allowing for navigation, selection of actions, and manipulation of objects in the scenarios. Audio support was based on integrated spatial audio systems, which increased the level of sensory load and realism of situations.

The VR scenario software was developed taking into account the principles of interactivity, dynamic situations, and variability of events. This ensured the adaptation of the learning environment to the actions of the participants.

The final stage involved qualitative research in the form of semi-structured interviews with participants and instructors to delve deeper into the experience of using the immersive learning environment and assess its impact on the learning process.

**Participants**

The study involved 300 people who had undergone professional training or worked in areas of activity associated with a high level of responsibility and the need to make decisions in difficult situations.

The sample structure was as follows:

students and cadets of professional educational programs - 150 people
professionals with practical experience in the relevant professional fields - 150 people

Participants were divided into two groups:

experimental group (VR training) - 150 people
control group (traditional training) - 150 people
Inclusion and exclusion criteria were applied to those wishing to participate in the experiment (See Table 1).

**Table 1.**
*Inclusion and Exclusion criteria*

| Inclusion Criteria | Exclusion Criteria |
|---|---|
| age from 18 to 45 years | presence of diagnosed mental disorders |
| experience in participating in professional or educational programs that provide preparation for work in difficult situations | refusal to participate in VR scenarios |
| regular participation in training or simulation training tasks | participation in parallel intensive psychological rehabilitation programs |
| voluntary consent to participate in the study | |

Source: Author’s development

It is worth noting that the average age of the participants was 27.4 years (SD = 5.8). The proportion of women in the sample was approximately 20%.

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces



### Instruments and Procedure

A range of research tools was used to assess the impact of an immersive learning environment on the development of decision-making skills. It included standardized psychodiagnostic techniques, author's questionnaires, behavioral observation maps in VR scenarios, and semi-structured interviews. In particular, the Connor–Davidson Resilience Scale (CD-RISC-25) was used to assess psychological resilience, which allowed us to measure the ability to adapt, emotional self-regulation, and recovery from stress. Psychological resilience was also assessed using the Hardiness Survey, which consisted of three main components: commitment, control, and challenge. The level of anxiety was measured using the State–Trait Anxiety Inventory (STAI), which allowed us to assess situational and personal anxiety in the process of performing complex tasks. To determine the dominant coping strategies, the Coping Inventory for Stressful Situations (CISS) was used, which differentiated problem-oriented, emotion-oriented, and unique coping strategies.

The author's Decision-Making under Pressure Questionnaire was used to assess decision-making skills. This questionnaire consisted of 12 scenario situations with time constraints and information uncertainty.

An important tool was the behavioral observation map during the execution of VR scenarios. Instructors assessed the participants on a five-point scale according to the following indicators:

- Speed of situation analysis;
- Rationality of decision-making;
- Emotional self-regulation;
- Effectiveness of team interaction;
- Overall effectiveness of task performance.

Semi-structured interviews with study participants were aimed at analyzing their experience of interacting with the VR environment, their perception of the realism of the scenarios, and assessing the impact of immersive learning on the formation of professional skills.

### Research procedure

The study took place over a period of four months. In particular, during the first stage, the organizers conducted initial psychodiagnostic testing of the participants. The survey was conducted in both group and individual formats. The average time to complete all instruments was 55–70 minutes.

During the second stage, the participants implemented training scenarios. The experimental group completed tasks in a VR environment using immersive simulations, while the control group worked with traditional training scenarios. Each scenario was evaluated by two independent instructors.

At the third stage, qualitative interviews were conducted with the participants and instructors. The sample for the interview was formed according to the principle of maximum variability. The duration of the interview was from 25 to 40 minutes.

### Data analysis

Quantitative data were analyzed using the SPSS 28 statistical package.

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

At the first stage, data cleaning, checking for omissions, detecting outliers, and testing for normal distribution (Shapiro–Wilk test) were organized. To assess the reliability of the scales, Cronbach's α coefficients were calculated (critical value $\alpha \geq 0.70$).

Subsequently, descriptive statistics were calculated. Therefore, the Pearson correlation coefficient was used to analyze the relationships between variables. With its help, the relationships between:

- Psychological stability and the effectiveness of VR scenario execution;
- Emotional self-regulation and the quality of decision-making;
- Coping strategies and the results of scenario tasks were analyzed.

Independent samples t-tests were used to compare experimental and control groups. Regression analysis was also conducted to determine the main predictors of decision-making effectiveness in the VR environment.

Qualitative interview data were analyzed using the thematic analysis method, which consisted of coding significant fragments of text, forming thematic categories, and summarizing the results. The integration of quantitative and qualitative results made it possible to formulate recommendations for the use of immersive educational technologies in professional training of specialists.

To summarize the logic of the experimental design and clearly present the differences between the training conditions, the main elements of the study were systematized. Table 2 presents the structure of the experimental design, which reflected the features of the organization of the training process in the experimental and control groups.

**Table 2.**
*Experimental Design of the Study (Experimental Group vs Control Group)*

| Design Element | Experimental group (EG) | Control Group (CG) |
|---|---|---|
| Number of Participants | n = 150 | n = 150 |
| Type of Training | Immersive learning in VR environment | Traditional training |
| Format of Training Scenarios | Interactive VR simulations with dynamic situations and sensory stimuli | Scenario exercises and case methods without VR |
| Type of Environment | Virtual reality using VR headsets and interactive scenarios | Audience training and group simulations |
| Duration of Training | 4 weeks (8 training sessions) | 4 weeks (8 training sessions) |
| Main Learning Objectives | Decision-making in VR scenarios; risk analysis; team interaction in simulated situations | Case analysis; role-playing; discussion of scenario situations |
| Pre-experimental Testing | CD-RISC-25, Hardiness Survey, STAI, CISS, Decision-Making Questionnaire | CD-RISC-25, Hardiness Survey, STAI, CISS, Decision-Making Questionnaire |
| Post-experimental | Repeated measurement of | Repeated measurement |

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces



| | | |
|---|---|---|
| Testing | the same indicators + assessment of behavior in VR scenarios | of the same indicators |
| Behavioral Assessment | Observation of instructors during the execution of VR scenarios | Observation of instructors during traditional scenario exercises |
| Main Dependent Variables | Quality of decision-making; speed of situation analysis; emotional self-regulation; situational awareness | Quality of decision-making; speed of situation analysis; emotional self-regulation |
| Analysis Methods | t-tests, Pearson correlation, regression analysis, thematic analysis | t-tests, Pearson correlation |

Source: Author's development

In addition, to ensure transparency of the research procedure and reproducibility of the results, the main research variables and their measurement instruments were compiled (See Table 3).

**Table 3.**
*Variables and Measurement Instruments*

| Variable | Instruments | Key indicators |
|---|---|---|
| Psychological resilience | Connor–Davidson Resilience Scale (CD-RISC-25) | Cognitive flexibility, adaptability, emotional control |
| Psychological endurance | Hardiness Survey | Commitment, Control, Challenge |
| Anxiety level | State–Trait Anxiety Inventory (STAI) | Situational and personal anxiety |
| Coping strategies | Coping Inventory for Stressful Situations (CISS) | Problem-oriented, emotionally-oriented and unique strategies |
| Decision-making skills | Decision-Making under Pressure Questionnaire (авторська модифікація) | Quality of decision-making in time-constrained scenarios |
| Behavioral responses in scenarios | Observation checklist (інструкторська оцінка) | Speed of situation analysis, rationality of decisions, self-regulation |
| Team interaction | Observation checklist | Communication, coordination of actions, support |
| Overall task performance effectiveness | Instructor rating scale | Integral performance indicator |

Source: Author's development

The selected instruments allowed a comprehensive assessment of both psychological characteristics and behavioral indicators of decision-making performance within immersive learning environments.

Eduweb
https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces



## Results and Discussion

### Psychological predictors of decision-making effectiveness in an immersive learning environment

To determine the main psychological factors that were associated with the effectiveness of decision-making in complex professional situations, the results of several psychodiagnostic methods were analyzed. CD-RISC (psychological resilience), Hardiness Survey (psychological endurance), STAI (anxiety level), CISS (coping strategies) were used. The author's scales for assessing decision-making skills in situations of increased workload were also used. Additionally, expert behavioral observation cards were used during the implementation of training scenarios.

In general, the participants demonstrated an average and average-high level of psychological resilience, emotional self-regulation and psychological endurance. At the same time, there was a noticeable individual variability in the indicators, which made it possible to identify key psychological predictors of the effectiveness of performing scenario tasks in the learning environment.

**Table 4.**
*Descriptive statistics of psychological indicators*

| Indicator | M | SD | Min | Max |
|---|---|---|---|---|
| Psychological resilience (CD-RISC) | 68.42 | 12.11 | 34 | 96 |
| Psychological endurance | 3.71 | 0.54 | 2.10 | 4.80 |
| Emotional self-regulation | 3.89 | 0.62 | 2.30 | 5.00 |
| Anxiety (STAI-State) | 41.22 | 10.45 | 22 | 73 |
| Problem-focused coping | 3.72 | 0.67 | 2.10 | 5.00 |
| Emotional-focused coping | 2.91 | 0.73 | 1.30 | 5.00 |
| Avoidance | 2.78 | 0.69 | 1.10 | 5.00 |
| Effectiveness of decision-making in scenarios | 4.01 | 0.56 | 2.60 | 5.00 |

Source: Author's development

As can be seen from Table 4, despite the generally high level of psychological preparedness of the participants, factors of anxiety and emotional instability could negatively affect the effectiveness of behavior in difficult learning situations. To determine the relationships between psychological characteristics and the results of performing scenario tasks, a correlation analysis using the Pearson coefficient was conducted (See Table 5).

**Table 5.**
*Correlations between psychological indicators and the effectiveness of performing scenario tasks (r-coefficients).*

| Psychological indicator | Stress resistance | Script execution efficiency |
|---|---|---|
| Psychological resilience | 0.62* | 0.54* |
| Emotional self-regulation | 0.56* | 0.49* |
| Psychological endurance | 0.49* | 0.47* |
| Problem-focused coping | 0.41 | 0.44 |
| Emotional-focused coping | –0.32* | –0.28* |
| Avoidance | –0.37* | –0.35* |
| Situational anxiety | –0.45* | –0.39* |

Notes: *p < 0.05; **p < 0.01; ***p < 0.001
Source: Author's development

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces



The results showed a high level of psychological resilience and emotional self-regulation, which is directly related to greater effectiveness in performing scenario tasks in the learning environment. Participants with developed self-regulation skills demonstrated more stable behavioral reactions and made more informed decisions in stressful situations.

On the other hand, emotionally oriented coping strategies and avoidance were associated with reduced decision-making accuracy and increased uncertainty during scenario tasks. Increased level of situational anxiety hurt the participants' ability to quickly analyze the situation and quickly make the necessary decisions.

**Comparison of the results of the experimental and control groups**

To test the hypothesis about the impact of the immersive learning environment on the development of decision-making skills, a comparative analysis of the results of the experimental (VR) and control groups was conducted. Therefore, t-tests for independent samples were used for this purpose. This approach made it possible to determine statistically significant differences between the groups in the main indicators of the effectiveness of performing scenario tasks (See Table 6).

**Table 6.**
*Comparison of effectiveness indicators between the experimental and control groups (t-test)*

| Indicator | Control Group (M) | Experimental Group (M) | t | p |
|---|---|---|---|---|
| Speed of situation analysis | 3.54 | 4.12 | –4.38 | < 0.001 |
| Quality of decision-making | 3.61 | 4.21 | –4.75 | < 0.001 |
| Emotional self-regulation | 3.67 | 4.18 | –4.11 | < 0.001 |
| Situational awareness | 3.49 | 4.09 | –4.52 | < 0.001 |
| Overall task performance effectiveness | 3.58 | 4.24 | –4.87 | < 0.001 |

Source: Author's development

The proposed results showed the existence of differences between the groups in all studied indicators ($p < 0.001$). Participants in the experimental group, who used VR environments in training, showed significantly better results in the speed of situation analysis, accuracy of decision-making, level of emotional self-regulation and situational awareness.

The most noticeable difference between the groups was recorded in the indicator of overall task performance ($M = 4.24$ in the VR group versus $M = 3.58$ in the control group). This indicated a positive impact of the immersive learning environment on the formation of practical decision-making skills.

Therefore, the results confirmed the proposed hypothesis that the use of virtual reality technologies in the educational process contributed to increasing the efficiency of performing complex scenario tasks.

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

### The effect of the intensity of immersive training on the results of performing tasks

To determine how the frequency of using VR scenarios affected the effectiveness of training, an analysis of variance (ANOVA) was used. The participants of the experimental group were conditionally divided into three subgroups depending on the intensity of using VR scenarios in the training process: low, medium and high frequency of training.

**Table 7.**
*The effect of the intensity of VR training on the results of performing scenario tasks*

| VR Training Frequency | Task performance efficiency | Quality of decision-making | Selfregulation |
|---|---|---|---|
| Low | 3.42 | 3.37 | 3.51 |
| Medium | 3.87 | 3.92 | 3.98 |
| High | 4.28 | 4.31 | 4.36 |

ANOVA: $F = 19.6$; $p < 0.001$
Source: Author's development

As can be seen from Table 7, the effectiveness of scenario tasks increased depending on the frequency of use of immersive training scenarios. Participants who participated in high-intensity VR training showed better results. First of all, they were better in decision-making accuracy, levels of emotional self-regulation.

The obtained statistically significant result ($F = 19.6$; $p < 0.001$) indicated that the regular use of immersive training environments contributed to the formation of stable behavioral strategies in difficult situations.

In addition, the results of the study demonstrated that repeated execution of scenario tasks in a VR environment allowed participants to recognize critical situations faster, assess risks more effectively and make more informed decisions.

### Regression analysis of predictors of decision-making effectiveness in a VR learning environment

To determine the factors that had the greatest impact on the effectiveness of decision-making in complex scenario situations, a multiple regression analysis was conducted. The corresponding variable was the overall effectiveness of performing scenario tasks in the learning environment (an integral indicator formed on the basis of instructors' assessments and the results of the author's decision-making test).

The model included such predictors as the level of psychological stability, emotional self-regulation, psychological endurance, problem-oriented coping strategies, and subjective assessment of the quality of learning. The intensity of the use of VR scenarios in the learning process was also taken into account (See table 8).

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

**Table 8.**
*Results of regression analysis of predictors of decision-making effectiveness*

| Predictor | β | p | Interpretation |
|---|---|---|---|
| Psychological resilience | 0.30 | < 0.001 | The strongest psychological predictor of decision-making effectiveness |
| Emotional self-regulation | 0.26 | < 0.001 | Provides control of impulsive reactions and stability of behavior |
| Psychological endurance | 0.17 | 0.006 | Promotes the perception of difficult situations as a professional challenge |
| Problem-focused coping | 0.13 | 0.021 | Strengthens a rational approach to analyzing situations |
| Quality of training | 0.21 | < 0.001 | Increases confidence in one's own professional actions |
| Intensity of VR training | 0.34 | < 0.001 | The strongest pedagogical factor for increasing effectiveness |

Model: $R^2 = 0.49$; $F(6, 293) = 46.8$; $p < 0.001$
Source: Author's development

The obtained value of $R^2 = 0.49$ is indicated as follows: almost half of the variability in the effectiveness of decision-making in complex scenario situations was explained by a combination of psychological and pedagogical factors included in the model.

A particularly important result was that the intensity of the use of VR scenarios was a significant pedagogical predictor of effective activity. This showed that regular interaction with immersive simulations contributed to the creation of more stable cognitive strategies for analyzing situations. It also increased the accuracy of decision-making.

At the same time, among the psychological factors, psychological resilience and emotional self-regulation made the greatest contribution to the model. This emphasized the importance of developing these characteristics in the process of professional training.

Overall, the results of the regression analysis demonstrated that the effectiveness of decision-making in complex learning scenarios was the result of the interaction of several key components, namely - individual psychological resources and pedagogical learning technologies (immersive VR environments).

## Discussion

The proposed results confirmed the important role of immersive learning environments in developing decision-making skills in complex professional situations. In general, the results of the study made it possible to establish that the use of virtual reality technologies contributed to increasing the efficiency of performing scenario tasks, improving situational awareness and developing the ability to quickly analyze complex situations. Participants in the experimental group who were trained in the VR environment showed better results in the processes of speed of situation analysis, accuracy of decision-making and the level of emotional self-regulation (when compared with representatives of the control group). Such results fully confirmed the results of previous studies, which emphasized the potential of immersive technologies for increasing the effectiveness of learning in complex professional environments (Hindman et al., 2025). First, several researchers noted that VR simulations made it possible to form realistic learning scenarios that contributed to the formation of situational awareness and the

Eduweb
https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces



development of practical decision-making skills in dynamic conditions (Cabrera-Duffaut et al., 2024; Kluge et al., 2023). Similar results were formed in studies that were devoted to the use of simulation training in vocational education (Oliveira et al., 2024). It was also shown here that immersive scenarios contributed to the formation of more stable cognitive strategies for analyzing situations (Mao et al., 2021; Radhakrishnan et al., 2021). Accordingly, the proposed results became a kind of litmus test for the hypotheses existing in the scientific literature. An important result was the confirmation that the effectiveness of decision-making depended not only on the use of innovative educational technologies. It also depended on the individual psychological characteristics of the training participants. First, the results of correlation and regression analysis demonstrated that psychological stability and emotional self-regulation were important predictors of the success of performing scenario tasks. This result is consistent with studies that emphasize the importance of psychological resources in the process of professional activity in difficult conditions (Ricci et al., 2022; Varshney et al., 2024). Some authors also noted that the development of emotional self-regulation skills significantly reduced the impact of stress factors on the decision-making process (Wee et al., 2021). Accordingly, they indicated an improvement in cognitive control in situations of uncertainty (Rushton et al., 2020; Maksymchuk et al., 2022). At the same time, the results of the regression analysis demonstrated that one of the most important pedagogical factors that had an impact on the effectiveness of decision-making was the intensity of the use of VR scenarios in the educational process. This indicated regular interaction with immersive learning environments, which contributed to the formation of more stable behavioral algorithms and improved the ability to quickly analyze complex situations. Similar results were obtained in those studies that discussed the use of simulation technologies in education (Sung et al., 2024). Accordingly, other researchers have also demonstrated that the repeated execution of scenario tasks in digital environments contributed to the formation of automated behavioral strategies (Singh et al., 2025).

At the same time, when using immersive VR environments, some technical limitations and physiological effects were noticeable. In particular, some participants reported short-term discomfort during scenario execution, including dizziness, visual fatigue, and mild cybersickness (motion sickness).

Analysis of behavioral indicators indicated that at the initial stages of the execution of the scenarios, participants who had physical discomfort showed a lower speed of orientation in the situation and a greater number of errors in initial decision-making. Thus, there was a noticeable increase in cognitive loads associated with adaptation to the immersives.

However, these effects were mostly temporary and did not lead to the termination of participation in the study.

It is important to note that at the initial stages of interaction with the VR environment, such factors could affect the speed of orientation in the scenario and the efficiency of task performance. At the same time, during the repeated execution of the scenarios, participants' adaptation to the conditions of the immersive environment was observed, which was accompanied by a decrease in the level of discomfort and stabilization of behavioral indicators.

Thus, despite the fact that the physiological limitations of VR technologies required consideration in the organization of the educational process, their impact is not

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces



critical and can be minimized by gradual immersion, optimizing the duration of sessions, and taking into account the individual characteristics of users.

In addition, the proposed research results demonstrated the importance of combining technological innovations with pedagogical learning models. For example, the effectiveness of VR learning depended on the quality of scenario development, the level of interactivity of the environment, and the ability to receive feedback during task completion. Similar approaches have received positive reviews in modern studies on digital pedagogy (Ramdani & Kotsou, 2025; Omelchuk et al., 2022). Researchers have repeatedly emphasized that technologies in themselves do not guarantee an increase in the quality of learning without appropriate pedagogical design (Murthy et al., 2025; Miloradova et al., 2022). It is important to take this into account in subsequent experiments. An important aspect of the study was also the fact that immersive learning environments created conditions for the integration of cognitive, behavioral, and emotional components of learning. This made it possible to form complex professional competencies that were difficult to develop in traditional educational formats. Accordingly, the proposed research results confirmed the thesis that VR technologies effectively developed decision-making skills in complex professional situations (Ocaña-Zuñiga et al., 2023; Carvalho et al., 2025). Therefore, the results of the study indicated that the effectiveness of decision-making in complex educational scenarios was formed as a result of the interaction of two key groups of factors: individual psychological resources and pedagogical learning technologies. Accordingly, immersive VR environments fostered the development of situational awareness and practical skills for analyzing complex situations.

Despite the valuable results, the study has its limitations. It is worth recognizing that self-report data (questionnaires) may contain socially desirable responses. In addition, the study did not consider long-term changes. It should also be considered that the simulation of combat situations in training conditions did not always fully reproduce actual circumstances. In the future, it is worth conducting longitudinal studies to study the dynamics of the formation of professional readiness

**Conclusions**

Thus, the study indicated the effectiveness of using immersive learning environments based on virtual reality technologies for developing decision-making skills in complex professional situations. Participants who were trained in a VR environment had higher indicators of the speed of situation analysis, decision-making accuracy, level of emotional self-regulation and overall task performance efficiency compared to traditional forms of training.

The research indicates that the effectiveness of decision-making is formed mainly under the influence of the interaction of psychological characteristics (stress tolerance, self-regulation) and pedagogical conditions: the intensity of the use of VR scenarios in the educational process.

The practical significance of the study is determined by the possibility of integrating immersive VR technologies into the system of professional training of specialists whose activities are associated with work in conditions of increased risk and uncertainty.

Special attention should be paid to managerial and educational decisions at the level of educational policy. In particular, it is advisable to include VR technologies in educational standards and training programs, and develop methodological

Eduweb
https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces



recommendations for their use. A separate important direction will be investing in technical infrastructure and training teachers to work with immersive environments. The implementation of such solutions will allow in the future to improve the quality of professional training and form practically oriented competencies. Prospects for further research are related to the development of adaptive VR-training systems that would take into account the individual psychological characteristics of users and ensure high-quality personalization of the educational process.

## Bibliographic references

Andersen, J. P., Arpaia, J., Gustafsberg, H., Poplawski, S., & Di Nota, P. M. (2024). The International Performance, Resilience and Efficiency Program Protocol for the Application of HRV Biofeedback in Applied Law Enforcement Settings. *Applied Psychophysiology and Biofeedback*, *49,* 483–502. https://doi.org/10.1007/s10484-024-09644-3

Cabrera-Duffaut, A., Pinto-Llorente, A. M., & Iglesias-Rodríguez, A. (2024). Immersive learning platforms: analyzing virtual reality contribution to competence development in higher education—a systematic literature review. *Frontiers in Education, 9*. https://doi.org/10.3389/feduc.2024.1391560

Carvalho, S. A., Conceição, E. S., & Marques, I. C. P. (2025). The Impact of Virtual Reality on Employee Training and Learning in Organisations: A Systematic Literature Review. *Applied Sciences*, *15*(19), 10459. https://doi.org/10.3390/app151910459

Caudillo-Melgoza, M. A., & Caudillo Melgoza, M. A. (2025). Immersive Virtual Reality Experience for Informed Career Decision-Making. *European Conference on Games Based Learning*, *19*(1), 142–148. https://doi.org/10.34190/ecgbl.19.1.4139

Clifford, R. M. S., Jung, S., Hoermann, S., Billinghurst, M., & Lindeman, R. W. (2019). Creating a Stressful Decision Making Environment for Aerial Firefighter Training in Virtual Reality. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*. IEEE. https://doi.org/10.1109/vr.2019.8797889

Dubiel, A., Kamińska, D., Zwoliński, G., Ramić-Brkić, B., Agostini, D., & Zancanaro, M. (2025). Virtual reality for the training of soft skills for professional education: trends and opportunities. *Interactive Learning Environments,* *33*(5), 3261–3281. https://doi.org/10.1080/10494820.2025.2450634

Dubreucq, E., Barlocco De La Vega, S., Bouaoud, J., Philippon, A.-L., & Thiebaud, P.-C. (2025). Impact of virtual, augmented or mixed reality in basic life support training: A scoping review. *Clinical Simulation in Nursing*, *99*, 101672. https://doi.org/10.1016/j.ecns.2024.101672

Fedorenko, O., Miloradova, N., Kharchenko, S., Dotsenko, V., Makarova, O., & Chervonyi, P. (2023). Communicative Competence of Law Enforcement Officers. *Cadernos de Educação, Tecnologia e Sociedade*, *16*(2), 349–360. https://doi.org/10.14571/brajets.v16.n2.349-360

Filipenko, N., Spitsyna, H., Agapova, O., & Palkova, K. (2024). The Concept of Comprehensive Security for Higher Educational Institutions: Ukrainian and European Experience. In *Integrated Computer Technologies in Mechanical Engineering - 2023* (pp. 317–327). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-60549-9_23

Gamito, P., Oliveira, J., Silva, J., Rosa, J., Mendes, M. L. R., Dias, R., Dias, F., Mansuklal, S. A., Cartaxo, J., António, H., & Salvador, Á. (2024). Stress Inoculation in Police Officers Using Virtual Reality: A Controlled

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces



Study. *Cyberpsychology, Behavior, and Social Networking, 27*(4), 253-260. https://doi.org/10.1089/cyber.2023.0385

Hindman, S., King, R., & Pereira, A. (2025). Virtual reality based executive function training in schools: The impact of adaptivity on executive function and motivation. *Computers & Education*, *234*, 105344. https://doi.org/10.1016/j.compedu.2025.105344

Hurrell, C., & Baker, J. (2020). Immersive learning: Applications of virtual reality for undergraduate education. *College & Undergraduate Libraries*, 27(2–4), 197–209. https://doi.org/10.1080/10691316.2020.1796879

Jongbloed, J., Chaker, R., & Lavoué, E. (2024). Immersive procedural training in virtual reality: A systematic literature review. *Computers & Education*, *221*, 105124. https://doi.org/10.1016/j.compedu.2024.105124

Kleygrewe, L., Oudejans, R. R. D., Koedijk, M., & Hutter, R. I. (2022). Police Training in Practice: Organization and Delivery According to European Law Enforcement Agencies. *Frontiers in Psychology, 12.* https://doi.org/10.3389/fpsyg.2021.798067

Kluge, M. G., Maltby, S., Kuhne, C., Walker, N., Bennett, N., Aidman, E., Nalivaiko, E., & Walker, F. R. (2023). Evaluation of a Virtual Reality Platform to Train Stress Management Skills for a Defense Workforce: Multisite, Mixed Methods Feasibility Study. *Journal of Medical Internet Research*, *25*, e46368. https://doi.org/10.2196/46368

Llanos-Ruiz, D., Abella-García, V., & Ausín-Villaverde, V. (2025). Virtual Reality in Higher Education: A Systematic Review Aligned with the Sustainable Development Goals. *Societies,* *15*(9), 251. https://doi.org/10.3390/soc15090251

Maksymchuk, B., Pohrebniak, D., Roshchin, I., Drachuk, A., Romanenko, V., Ovcharuk, V., & Maksymchuk, I. (2022). Effective decision-making for extreme situations in sports coaching. *Revista Românească pentru Educaţie Multidimensională,* *14*(3), 510–521. https://doi.org/10.18662/rrem/14.3/623

Mao, R. Q., Lan, L., Kay, J., Lohre, R., Ayeni, O. R., Goel, D. P., & SA, D. d. (2021). Immersive Virtual Reality for Surgical Training: A Systematic Review. *Journal of Surgical Research*, *268*, 40–58. https://doi.org/10.1016/j.jss.2021.06.045

Miloradova, N., Okhrimenko, I., Dotsenko, V., Matiienko, T., & Rivchachenko, O. (2022). Training Technologies as a Means of Communicative Competences Development of Prejudicial Inquiry Agencies' Investigators. *Postmodern Openings*, *13*(2), 01–22. https://doi.org/10.18662/po/13.2/441

Moreno, A. F., Karanika-Murray, M., Batista, P., Hill, R., Vilalta, S. R., & Oliveira-Silva, P. (2024). Resilience Training Programs with Police Forces: A Systematic Review. *Journal of Police and Criminal Psychology, 39*, 227–252. https://doi.org/10.1007/s11896-023-09633-y

Murthy, V. S. N., Kumar, K. S., Karimikonda, H., & Sree Pokkuluri, K. (2025). Integrating Virtual Reality into Disaster Response Training. In *Virtual Reality, Real Emergency* (pp. 91–103). CRC Press. https://doi.org/10.1201/9781003564904-7

Ocaña-Zuñiga, C. L., Tineo, M., Fernandez-Zarate, F. H., Quiñones-Huatangari, L., Huaccha-Castillo, A. E., Morales-Rojas, E., & Miguel-Miguel, H. W. (2023). Implementing the Sustainable Development Goals in University Higher Education: A Systematic Review. *International Journal of Sustainable Development and Planning,* *18*(6), 1769–1776. https://doi.org/10.18280/ijsdp.180612

Oliveira, J., Aires Dias, J., Correia, R., Pinheiro, R., Reis, V., Sousa, D., Agostinho, D., Simões, M., & Castelo-Branco, M. (2024). Exploring immersive multimodal virtual reality training, affective states, and ecological

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

validity in healthy firefighters: Quasi-experimental study. *JMIR Serious Games, 12*, e53683. https://doi.org/10.2196/53683

Omelchuk, M., Maksymchuk, B., Ihnatenko, S., Navolskyi, N., Kitsak, T., Vitkovskyi, O., Ostrovska, N., Vykhrushch, A., Lukashchuk, M., Lukashchuk, I., Demianchuk, M., Khmeliar, I., Kushnir, L., & Maksymchuk, I. (2022). Developing professional competency in first aid in future coaches in Ukraine. *Revista Românească pentru Educaţie Multidimensională, 14*(3), 392–411. https://doi.org/10.18662/rrem/14.3/615

Radhakrishnan, U., Koumaditis, K., & Chinello, F. (2021). A systematic review of immersive virtual reality for industrial skills training. *Behaviour & Information Technology, 40*(12), 1310–1339. https://doi.org/10.1080/0144929x.2021.1954693

Ramdani, C., & Kotsou, I. (2025). Evaluating the effectiveness of a mindfulness program adapted to French law enforcement personnel “Mindfulness Based Emotion Management, MBEM”: A feasibility study. *Journal of Workplace Behavioral Health*, 1–15. https://doi.org/10.1080/15555240.2025.2541014

Reale, C., Salwei, M. E., Militello, L. G., Weinger, M. B., Burden, A., Sushereba, C., Torsher, L. C., Andreae, M. H., Gaba, D.M., McIvor, W.R., Banerjee, A., Slagle, J., & Anders, S. (2023). Decision-Making During High-Risk Events: A Systematic Literature Review. *Journal of Cognitive Engineering and Decision Making*, *17*(2), 155534342211474. https://doi.org/10.1177/15553434221147415

Ricci, S., Calandrino, A., Borgonovo, G., Chirico, M., & Casadio, M. (2022). Viewpoint: Virtual and Augmented Reality in Basic and Advanced Life Support Training. *JMIR Serious Games*, *10*(1), e28595. https://doi.org/10.2196/28595

Rushton, M. A., Drumm, I. A., Campion, S. P., & O'Hare, J. J. (2020). The Use of Immersive and Virtual Reality Technologies to Enable Nursing Students to Experience Scenario-Based, Basic Life Support Training—Exploring the Impact on Confidence and Skills. *CIN: Computers, Informatics, Nursing*, *38*(6), 281–293. https://doi.org/10.1097/cin.0000000000000608

Semenova, A., Krykun, V., & Korniienko, M. (2023). Psychological and pedagogical content of the implementation of international standards of ethical behavior in the training of police officers in Ukraine. In *Quality parameters of higher education officers of the National Police in the conditions of imperative human-scale values* (pp. 131–148). Technology Center PC. https://doi.org/10.15587/978-617-7319-67-1.ch8

Singh, C., Mahapatra, H., Malini, R., Kavitha, G. L., & Sree Pokkuluri, K. (2025). Simulation-Based Training with Augmented Reality for Paramedics. In *Virtual Reality, Real Emergency* (pp. 61–73). CRC Press. https://doi.org/10.1201/9781003564904-5

Steingräber, A.-M., Tübben, N., Brinkmann, N., Finkeldey, F., Migutin, S., Bürger, A., Laubstein, A., Abel, B., von Lüdinghausen, N., Herzberg, P. Y., Lorei, C., Hanssen, N., & Gorzka, R.-J. (2021). Contributions to Operational Psychology: Psychological Training Model in the Context of Stress Management for Specialized German Military Police Personnel and Specialized Police Personnel. *Journal of Police and Criminal Psychology, 37,* 146–154. https://doi.org/10.1007/s11896-021-09478-3

Sung, H., Kim, M., Park, J., Shin, N., & Han, Y. (2024). Effectiveness of Virtual Reality in Healthcare Education: Systematic Review and Meta-Analysis. *Sustainability*, *16*(19), 8520. https://doi.org/10.3390/su16198520

Tsymbal-Slatvinska, S., Maksymchuk, B., Saienko, V., Babii, I., Behas, L., Lemeshchuk, M., Chepka, O., Dychok, T., & Maksymchuk, I. (2022). Psycho-pedagogical experience of intellectual education in the views of

![Eduweb]
https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces



Ukrainian and foreign pedagogues as the basis of modern neuropedagogy. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience, 13*(4), 321–346. https://doi.org/10.18662/brain/13.4/391

Varshney, A., Munns, M. E., Kasowski, J., Zhou, M., He, C., Grafton, S. T., Giesbrecht, B., Hegarty, M., & Beyeler, M. (2024). Stress affects navigation strategies in immersive virtual reality. *Scientific Reports*, *14*(1), 5949. https://doi.org/10.1038/s41598-024-56048-8

Vieira, E., Lourenção, L. G., Santos, F. B. d., Sasaki, N. S. G. M. d. S., & Arroyo, T. R. (2025). Quality of life and prevalence of burnout among military police officers in southern Brazil: a cross-sectional study. *O Mundo da Saúde*, *49*. https://doi.org/10.15343/0104-7809.202549e17192025i

Vittadello, A., Savino, S., Bressan, S., Costa, M., Boscolo, A., Sella, N., Pettenuzzo, T., Zarantonello, F., De Cassai, A., Chang, T., Navalesi, P., & Mormando, G. (2025). Virtual reality for training emergency medicine residents in emergency scenarios: usefulness of a tutorial to enhance the simulation experience. *Frontiers in Digital Health*, *7*. https://doi.org/10.3389/fdgth.2025.1466866

Wee, C., Yap, K. M., & Lim, W. N. (2021). Haptic Interfaces for Virtual Reality: Challenges and Research Directions. *IEEE Access*, *9*, 112145–112162. https://doi.org/10.1109/access.2021.3103598

Zechner, O., Kleygrewe, L., Jaspaert, E., Schrom-Feiertag, H., Hutter, R. I. V., & Tscheligi, M. (2023). Enhancing Operational Police Training in High Stress Situations with Virtual Reality: Experiences, Tools and Guidelines. *Multimodal Technologies and Interaction*, *7*(2), 14. https://doi.org/10.3390/mti7020014