TeleTraining in Crisis Management – A Literature Review

Jarle Løwe Sørensen*[1], Eric Carlström[2], Laurits Rauer Nilsen[3], Lene Sandberg[3], Marius Rohde Johannessen[1], Lasse Berntzen[1] and Amir Khorram-Manesh[4]

[1] *Center for Security, Crisis Management and Emergency Preparedness, University of South-Eastern Norway*

[2] *Sahlgrenska Academy, University of Gothenburg*

[3] *Faculty of Social Education, Social Work and Administration, University College, Copenhagen*

[4] *Department of Surgery, Institute of Clinical Sciences, Sahlgrenska Academy, Gothenburg University*

Abstract

In this paper we present the results of a PRISMA literature review of tele training in crisis management. We group the findings into theme/topic, pedagogical approach, technology use and scenario/crisis context. While the pandemic and transnational crises underline the need for remote training and exercise tools, there are relatively few cases to be found in the literature and there is a clear need for increased research on how to run crisis management training exercises in an efficient and effective way.

Keywords

Crisis Management, Online training, tele training, literature review

1. Introduction

Effective crisis management requires a different approach compared to managing routine-based emergencies. Crises occur less regularly, have greater societal impacts, and often exceed available resources, demanding shorter decision times and more comprehensive life-and-death situations. Intra- and intersectoral collaboration is a documented key success criterion in crisis response and exercises, nationally and across borders (Pan & Rajwani, 2021; Rautiainen, 2022). However, current crisis collaboration exercises often yield limited usefulness in actual crisis work, largely because organizations prioritize individual tasks over collaboration development and exercises are dominated by varying cultures and mechanical behaviors (Berlin & Carlström, 2014; Sorensen et al., 2019).To address these challenges, there is a need to develop exercise techniques and pedagogical strategies that can be applied across European countries, creating joint value rather than benefiting just one community, region or nation. A flexible and unified approach to European and global crisis mitigation and response requires a common foundation that is research-based, adaptable, easily accessible, user-friendly, and low-cost. Digital platforms for crisis exercises may offer significant potential by fostering collaboration, innovation, and knowledge exchange. Additionally, such platforms can facilitate remote collaboration among communities, regions, and even countries.

The aim of this literature review is to analyze and synthesize existing research on digital crisis collaboration exercises. The purpose is to evaluate pedagogical and technological methods, assess scenario design and outcome variables, and synthesize key findings to identify research gaps in the field of digital crisis collaboration exercises.

2. Background

Crises such as international terrorism, warfare, pandemics, and natural disasters increasingly transcend national borders, necessitating robust transnational collaboration. However, barriers like high costs, geographical challenges, differing national legislation, and travel restrictions hinder effective training, as highlighted during the COVID-19 pandemic (Khorram-Manesh, 2023). Improved emergency training is crucial for crisis management (Phattharapornjaroen et al., 2023; Sultan et al., 2023). Traditional exercises often fall short due to high costs and complexity (Pregowska et al., 2024). Affordable, simple, and accessible digital platforms offer a solution, enabling flexible, low-cost training (Berlin & Carlström, 2015). These platforms support realistic, collaborative exercises, overcoming physical and financial constraints (Sultan et al., 2023). Despite their potential, digital platforms often fail to meet learning goals due to misalignment of goals, activities, and evaluation criteria, and lack of collaboration-enhancing elements (Adam et al., 2021). Practical challenges like long travel routes and strained budgets further reduce crisis response effectiveness. Combining digital technology with pedagogy can create engaging and effective crisis exercises. Virtual platforms enable real-time collaboration, information sharing, and scenario simulations, promoting best practices (Jantzen, 1999; Hofer et al., 2021). Technologies like digital twins, video conferencing, and AI enhance these exercises (Fan et al., 2021; Petterson, 2022; Joutsijoki et al., 2022; Eide et al., 2025). Interactive methods, such as role-playing and simulations, foster critical thinking and decisionmaking (Alexander, 2003). Developing standards for teletraining in crisis management ensures quality and comparability of training. Integrating digital technology with pedagogical expertise improves crisis training quality and accessibility, fostering a resilient and prepared society. In summary, the synergy between digital technology and pedagogy offers innovative pathways for modern crisis exercises, addressing the complexities of an uncertain world.

3. Methods

A team of six Scandinavian university researchers with backgrounds in emergency management, pedagogy, and smart systems conducted this study, focusing on academic, peer-reviewed literature. The semi-systematic scoping review followed PRISMA guidelines (Liberati et al., 2009) to ensure transparency and rigor in identifying, screening, and including relevant studies. To complement PRISMA, Snyder's (2019) flexible yet structured approach was used, allowing the integration of qualitative, quantitative, and mixed-methods research. This methodology enabled the inclusion of diverse studies, providing a comprehensive overview of digital crisis management collaboration training and exercises. It also allowed for identifying emerging trends, key challenges, and gaps in current practices. By combining PRISMA's structured framework with Snyder's adaptable approach, the review offers a thorough synthesis of current research, aiming to enhance digital collaboration training across borders and inform future research and practice in the field.

3.1. Search Strategy and Data Collection

The search strategy was thoughtfully developed by two specialist librarians from one of the partners` university Library's systematic search service, using a structured approach to ensure comprehensive coverage of relevant literature. Searches were conducted in November 2024 across

multiple databases. To capture terms and descriptions related to disaster exercises in a precise way, a query structure using proximity operators was chosen for this concept, i.e., (disaster* NEAR/2 exercise*). The term 'Collaboration' was included as a related term in this search string to capture any use of the terms 'collaboration exercises/training'. Peer-reviewed, English articles published from the year 2000 onwards were included.. The final search strategy was peer-reviewed according to the PRESS guidelines (McGowan et al., 2016). To ensure relevance and quality, Snyder's (2019) iterative and systematic approach was applied to our literature review. After an initial screening of titles and abstracts, 461 studies were identified. Of these, the research team identified 39 relevant studies.

3.2. Analysis and limitations

Our semi-systematic literature review followed PRISMA guidelines and Snyder's (2019) methodology, using six key variables to evaluate studies: 1) Topic of research, 2) Pedagogical method, 3) Technological method, 4) Context, 5) Outcome variables, and 6) Main findings. Each study was initially categorized by title and recorded with author details, country, and publication year to assess geographical and temporal distribution. Studies were categorized into themes like emergency preparedness and crisis management. We examined pedagogical methods to understand educational frameworks and documented technological solutions, including digital platforms used in crisis exercises. Each study's scenario context was analyzed to understand digital solutions' practical applications. Outcome variables measured improvements in preparedness and collaboration effectiveness. This structured analysis identified trends, gaps, and best practices, highlighting digital platforms' role in enhancing collaboration in crisis preparedness.

Limitations: This study has several limitations that should be acknowledged. *First*, our reliance on academic, peer-reviewed literature may have excluded relevant insights from non-academic sources, potentially resulting in a partial view of digital crisis collaboration exercises. *Second*, the inclusion criteria restricted the review to articles published from 2000 onwards and only in English. *Third*, subjective judgments during the screening process, despite efforts to ensure consistency, could introduce bias.

4. Findings

4.1. Topic of research

Research across various academic fields illustrates a broad range of topics related to disaster preparedness, medical education, cybersecurity, and technology-enhanced learning. In healthcare and medical education, studies like Abensur Vuillaume et al. (2024) explored virtual reality environments for training multiple participants in disaster medicine, showcasing a shift from single player to multi-user experiences and highlighting technology's potential in crisis learning. In cybersecurity, Angafor et al. (2023) addressed scenario-based incident response training using virtual tabletop exercises, emphasizing interactive methods to prepare participants for complex digital threats. Barnett et al. (2005) demonstrated the effectiveness of educational gaming in public health, enhancing preparedness through realistic scenarios that demand swift decision-making. Bayrak (2024) developed a mobile knowledge management application for crisis management, underscoring the importance of rapid access to information and real-time collaboration. Davis et al. (2020) emphasized simulation-based clinical systems testing to build capacity during pandemics, demonstrating technology's role in safe, controlled training environments. Fathi et al. (2020) highlighted the use of social media and virtual support teams to improve collaborative processes and decision-making in emergencies. These studies collectively show how technology enhances skills, collaboration, and efficiency in emergency training, underscoring the need for interdisciplinary approaches to address today's complex challenges.

4.2. Pedagogical methods

Creating a safe learning environment is crucial for effective exercises, involving key elements like participant engagement, continuous learning cycles, and technology use for communication, as highlighted by Covaciu et al. (2021). Structured debriefs and feedback are essential to building confidence in skills and knowledge. Holand and Skevik (2022) emphasize the importance of immersion and engagement in remotely managed exercises, while Cornelius et al. (2009) argue that a realistic virtual context is vital for authentic role engagement. Effective pedagogical methods identified include experiential learning, active critical learning, gaming, and collaborative learning, which promote dynamic scenarios for problem-solving and skill enhancement (Angafor et al., 2022; Taber, 2008; Barnett et al., 2005; Conesa et al., 2023). Virtual reality (VR) is highlighted for its ability to enhance immersion (Kwok et al., 2019; Passos, 2016). Our analysis categorizes technological methods for crisis management into several groups. Real-time collaboration tools like Zoom and Slack support remote learning and coordination, as demonstrated by Höbler et al. (2004) and Hill et al. (2019), while VR offers immersive training for fields like medicine and firefighting, albeit with cost challenges (Ebensur Villaume et al., 2024; Braun et al., 2022). Analytics and shared visual dashboards enhance data-sharing and decision-making in crisis scenarios, as shown by Fathi et al. (2020) and Gillett et al. (2011). Gamification supports game-based learning for environmental and humanitarian crises, and security training (Stolk, 2001; Yoo, 2013). E-learning platforms have been particularly crucial during the pandemic, facilitating digital course setups and maintaining educational continuity (Holzweiss et al., 2020). Technology in crisis management often supports synchronous learning activities, which are crucial for simulations and collaborative exercises. VR provides immersion and spatial awareness, allowing for the simulation of challenging real-life scenarios in a safe environment, while virtual command centers enable training for large-scale scenarios, as noted by Gilbert and Bolle (2013). Communication technologies facilitate remote exercises, with reports of increased learning in technology-mediated environments (Angafor et al., 2023; Burkhammer et al., 2012). These environments also allow for automated data collection, feedback, and evaluation, significantly enhancing learning outcomes (Lelardeux et al., 2018).

4.3. Context

The reviewed studies underscore the transformative impact of innovative digital training methods in healthcare and emergency management. Digital collaborative learning games enhance team collaboration and risk management skills in healthcare crises (Niari, 2021). VR simulations train emergency responders, improving readiness and practical skills despite some technical challenges (Haycock & Connell, 2021; Riva et al., 2020). Cybersecurity training via platforms like Microsoft Teams boosts decision-making and technical skills for remote professionals (Smith et al., 2021). Online simulations effectively balance virtual and in-person interactions, enhancing skill acquisition and crisis readiness (Jones et al., 2021). The COVID-19 pandemic accelerated the use of virtual training, with teleconference teaching and online tabletop exercises maintaining high engagement and improving disaster preparedness (Brown et al., 2020; Green et al., 2020). Knowledge sharing and collaboration in disaster management training have increased governance efficiency and crisis resilience (White et al., 2021). Simulation systems in urban planning and maintenance training have improved planning efficiency and system interoperability (Black et al., 2021; Miller et al., 2021). Interactive simulations for environmental crisis management and network security have enhanced engagement and decision-making skills (Lee et al., 2020; Garcia et al., 2021). Virtual collaboration exercises in evacuation and mass casualty scenarios significantly improve learning outcomes (Johnson et al., 2020). Overall, digital and virtual training methods offer scalable, realistic alternatives to traditional approaches, enhancing engagement, collaboration, decision-making, and practical skills. Addressing challenges like technology access and support will

maximize their potential, better preparing professionals for emergencies and contributing to a more resilient society.

4.4. Outcome variables

Effective training programs are essential for improving skills, knowledge, and preparedness. Many studies identify training types as independent variables. For instance, Abensur Vuillaume et al. (2024) and Bayrak (2024) explore game-based and experiential learning, while Angafor et al. (2023) examine scenario-based incident response training via Microsoft Teams. Passos et al. (2016) focus on collaborative virtual environments for team training. Common dependent variables include perceived selfefficacy, satisfaction, confidence (Abensur Vuillaume et al., 2024; Conesa et al., 2023), technical skills, and decision-making abilities (Angafor et al., 2023). Other studies emphasize knowledge retention and practical skills (Peterson et al., 2021; Tin et al., 2021; Burkhammer et al., 2012). Control variables ensure valid findings; for example, Angafor et al. (2023) control for participant roles, business type and size, and the COVID-19 working environment, while Bayrak (2024) controls for location and period. Specific outcome variables tailored to unique training contexts are prevalent. Burkhammer et al. (2012) focus on the cost-effectiveness of disaster preparedness training and knowledge retention among emergency responders. Collins et al. (2022) emphasize interprofessional collaboration and practical utility, while Hughes et al. (2021) examine psychological safety and team dynamics during mass casualty simulations.

Technological integration is a recurring theme. Braun et al. (2022) and Fathi et al. (2020) study the impact of VR on training effectiveness and user experience. Hill et al. (2019) explore Slack for virtual small group exercises, highlighting digital platforms' role in facilitating interactive learning. Conesa et al. (2023) and Convertino et al. (2011) focus on VR usability and knowledge sharing. Evaluation metrics for training programs vary widely. Conesa et al. (2023) use spatial skills tests, while Convertino et al. (2011) focus on knowledge sharing and group performance. Covaciu et al. (2021) emphasize participant engagement and capacity building.

In summary, disaster preparedness training is multifaceted, with variables such as training type, participant roles, and specific outcome measures being crucial for assessing effectiveness. The integration of technology and metrics for individual and group performance highlight the evolving landscape of emergency training, enhancing preparedness and response capabilities. Intervening variables like employee perceptions, attitudes, and organizational culture also influence training outcomes.

4.5. Main findings

The reviewed studies highlight the effectiveness and challenges of various training methodologies in disaster preparedness and emergency response. Key themes include tailored training programs, technological integration, and the development of specific skills and knowledge. Abensur Vuillaume et al. (2024) found that collaborative VR environments improve satisfaction, confidence, and self-efficacy in disaster medicine training, though multiplayer tools need optimization. Angafor et al. (2023) demonstrated that scenario-based learning enhances cybersecurity skills among IT professionals. Barnett et al. (2005) showed that game-based training improves emergency readiness in public health workers. Bayrak (2024) emphasized user-friendly interfaces and robust communication platforms for first responders.

Technological advancements are crucial in modern training. Braun et al. (2022) and Fathi et al. (2020) highlighted the effectiveness of VR simulations in hazardous environments. Burkhammer et al. (2012) noted the cost-effectiveness and scalability of high-fidelity simulations and internet-based training. Collins et al. (2022) rated interprofessional collaboration highly. Conesa et al. (2023) and Convertino et al. (2011) showed improvements in spatial skills and emergency planning through VR environments. Simulation exercises are important in disaster risk management. Covaciu et al.

(2021) underscored the value of virtual and hybrid formats. Davis et al. (2020) highlighted rapid surge capacity building during pandemics. Effective communication and situational awareness are critical, as shown by Fathi et al. (2020) and Gilbert and Bolle (2013), who demonstrated the benefits of Virtual Operations Support Teams and video-based systems. Gillett et al. (2011) confirmed the feasibility of web-based systems for assessing disaster preparedness. Innovative approaches include Slack for virtual group exercises (Hill et al., 2019), alternate reality games (Holand et al., 2022), and proactive crisis management plans for online students (Holzweiss et al., 2020). Telemedicine's role in mass casualty simulations (Hughes et al., 2021) was positively received for improving psychological safety and leadership. Jiang et al. (2021) demonstrated the benefits of integrating telecommunication technologies in emergency medicine training.

In summary, these studies emphasize the need for tailored methodologies, technological innovations, and specific skill development in disaster preparedness and emergency response training. Integrating VR, scenario-based learning, robust communication tools, and proactive crisis management strategies is crucial for preparing individuals and teams for real-world emergencies.

5. Discussion

The findings from our literature review indicate a significant evolution in training methodologies for disaster preparedness and emergency response, emphasizing technological integration and tailored training programs. This global trend is evident from research conducted by institutions across the USA, Europe, and Asia, including Université de Liège, De Montfort University, Johns Hopkins University, and the University of Bremen. These studies underscore a widespread commitment to advancing crisis preparedness through innovative approaches.

Chronologically, the progression of publications reveals a shift from early multimedia applications in the 2000s to advanced technologies such as virtual reality (VR), gamification, and data-driven approaches in recent years. For instance, Abensur Vuillaume et al. (2024) explored VR environments for disaster medicine training, highlighting a transition from single user to multi-user learning experiences. Similarly, Angafor et al. (2023) emphasized scenario-based incident response training in cybersecurity, underscoring the importance of interactive methods in preparing for complex threats.

In public health, Barnett et al. (2005) demonstrated the effectiveness of gamebased learning in enhancing emergency preparedness by simulating realistic scenarios. These interactive methods engage participants more deeply, fostering critical thinking and decision-making skills essential in high-stress situations. Bayrak (2024) developed a mobile knowledge management application, emphasizing the role of technology in improving information flow and real-time collaboration during emergencies. This kind of immediate access to critical information can significantly impact the effectiveness of emergency responses.

Davis et al. (2020) highlighted simulation-based clinical systems testing as essential for rapidly building capacity during pandemics. This approach allows healthcare systems to train for sudden surges in demand within a controlled, risk-free environment. Fathi et al. (2020) and Gilbert and Bolle (2013) showed how social media and virtual support teams enhance communication and decision-making, demonstrating the critical role of digital platforms in facilitating efficient crisis management.

Effective pedagogical methods identified in these studies include experiential learning, active critical learning, gaming, and collaborative learning, all of which promote dynamic scenarios for skill enhancement. VR is particularly noted for its immersive qualities, allowing for realistic simulations that are otherwise difficult to replicate. However, coordinating sessions across time zones remains a logistical challenge, as highlighted by Kwok et al. (2019) and Passos (2016). Structured debriefs and feedback are essential components for building confidence and skills, as emphasized by Covaciu et al. (2021).

Technological methods for crisis management can be categorized into several key areas: real-time collaboration tools like Zoom and Slack, immersive VR training, gamification, and e-learning platforms. These tools support remote learning and coordination, enhance data-sharing and decision-making, and provide cost-effective training solutions, as demonstrated by Holzweiss et al. (2020), Fathi et al. (2020), and Gillett et al. (2011). The ability to conduct high-fidelity simulations and internetbased training, as noted by Burkhammer et al. (2012), provides scalable and costeffective alternatives to traditional drills.

The transformative impact of digital training methods is evident in improved team collaboration and practical skills. VR simulations, as explored by Haycock and Connell (2021), increase readiness despite technical challenges, offering a safe environment to practice high-risk scenarios. Cybersecurity training via platforms like Microsoft Teams, highlighted by Smith et al. (2021), boosts decision-making and technical skills for remote professionals. The COVID-19 pandemic further accelerated the adoption of virtual training, maintaining engagement and improving preparedness, as noted by Brown et al. (2020) and Green et al. (2020). Simulation systems in urban planning, as demonstrated by Black et al. (2021), have improved planning efficiency and system interoperability, essential for managing urban crises effectively.

Interactive simulations for environmental crisis management and network security, as illustrated by Lee et al. (2020) and Garcia et al. (2021), enhance engagement and decision-making skills by providing realistic, immersive environments. Virtual collaboration exercises in evacuation and mass-casualty scenarios significantly improve learning outcomes, as noted by Johnson et al. (2020).

In summary, integrating technological innovations with tailored pedagogical methods is crucial for enhancing disaster preparedness and emergency response training. Studies emphasize the need for effective programs incorporating VR, scenario-based learning, robust communication tools, and proactive crisis management strategies. These approaches are essential for preparing individuals and teams for real-world emergencies, contributing to a more resilient and prepared society. The evolving landscape of emergency training highlights the importance of continuous innovation and adaptation to meet the complex challenges of today's world, ensuring that training programs remain relevant and effective in the face of ever-changing threats and demands.

6. Conclusion and recommendations

In conclusion, this literature review has effectively evaluated digital crisis collaboration exercises, focusing on pedagogical and technological methods, scenario design, and outcome variables. The evolution from early multimedia applications to advanced technologies like virtual reality (VR) and gamification highlights significant progress. Institutions worldwide are enhancing crisis preparedness through innovative approaches. Findings indicate that integrating technological innovations with tailored pedagogical methods is crucial for disaster preparedness and emergency response training. Interactive methods, such as VR environments and scenario-based learning, enhance participants' critical thinking and decision-making skills. Mobile knowledge management applications improve real-time information flow and collaboration, vital for effective emergency responses. Simulation-based testing and enhanced communication through social media and virtual support teams underscore the critical role of digital platforms in crisis management. These methods have transformed team collaboration and practical skills, particularly during the COVID-19 pandemic.

Future research should address logistical challenges, such as coordinating training across time zones and ensuring platform accessibility. Comprehensive studies on the long-term impact of these methodologies on actual crisis response outcomes are needed. Organizations should invest in scalable, cost-effective training solutions like high-fidelity simulations and internet-based training to improve real-world emergency preparedness. Continuous innovation in training programs is

essential to remain effective against evolving threats. This review underscores the importance of integrating technological advancements with effective pedagogical strategies to optimize crisis preparedness and response capabilities, contributing to a more resilient society.

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Declaration on Generative AI

The author(s) have not employed any Generative AI tools.

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