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***Research Article***

# DIGITALIZATION OF EARTHQUAKE PREPARATION PROCESSES

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## ABSTRACT
This article explores how digital tools can significantly improve earthquake preparedness among the general public. It highlights the value of various technologies, including mobile apps, online and offline training, educational modules, virtual simulations, and AI systems, in raising awareness and building practical skills needed during earthquakes. The authors have developed several digital solutions: a multimedia software tool, an online learning platform, and virtual training simulators. The paper discusses the benefits of using these digital resources to enhance earthquake preparedness and offers recommendations for their successful implementation.

***Keywords:*** *Earthquake, Safety, Digital Technologies, Mobile Application, Online and Offline Training, Educational Module, Virtual Simulation*

## INTRODUCTION
Earthquakes are devastating natural disasters, known for their potential to inflict massive casualties and crippling economic damage in mere moments. Recognizing this, significant efforts are dedicated to disaster recovery and resilience-building programs, particularly for communities residing in earthquake-prone regions. These initiatives aim to help people rebuild their lives and economies while also enhancing their preparedness for future seismic events.

In a number of developed countries of the world, in particular Japan, the USA, China, the Russian Federation and most countries located in the seismically active regions of Europe and Asia, a culture of independent training of the population has been formed, using various methods to teach the population how to behave properly in emergency situations associated with a strong earthquake, protect it from its severe and tragic consequences, and minimize losses, including one of the most common methods, using digital software tools, special educational platforms, and simulation training simulators operating on the global network.

Also, in countries located in areas with high seismic risk, practical training exercises are regularly conducted to assess in advance the possible situations that may arise due to strong earthquakes, consider them in a realistic manner, eliminate their negative consequences, and teach them how to move correctly, with the broad involvement of all segments of the population.

Several countries have implemented continuous earthquake preparedness and response systems. These include: Japan's comprehensive "Preparation and Response" program; the US FEMA's extensive resource, guidance, and training framework; Turkey's AFAD, which uses mobile apps and websites for real-time information dissemination; Germany's "Katastrophenschutz," focusing on community involvement in rescue; Italy's "Protezione Civile," emphasizing public education and community engagement; New Zealand's "ShakeOut" drills for earthquake response; Hong Kong's "Smart City" initiative, employing mobile applications and smart sensors; Singapore's "Smart Nation" program, leveraging technology for improved preparedness; South Korea's earthquake simulations; Canada's "Great ShakeOut" simulation; India's local "Disaster Management Committees;" Spain's earthquake education initiatives; Australia's "Mental Health First Aid" program; and the Philippines' community-based psychological support systems.

All of these developed systems include digitization of the processes of preparing the population for earthquakes.

The devastation caused by severe earthquakes, exemplified by events in Kobe (1995), Tashkent (1966), Spitak (1988), and Turkey (2023), necessitates international collaboration for effective disaster relief [Balasanyan *et al.,* 2014). Post-earthquake survival rates underscore the urgency of rapid response; statistical analyses, notably derived from the 1988 Spitak earthquake and other similar events, indicate that survival probabilities for individuals trapped in rubble decline significantly over time, with approximately 60% surviving within the first 24 hours, 48% after four days, and less than 5% after seven days (Shoigu, 1997).

The high probability (70%) of a major earthquake occurring in Tokyo within the next three decades [Kurbanov and Mustafoyev, 2022) highlights the constant potential for seismic events. Japan's proactive approach, characterized by regular disaster preparedness drills aimed at promoting informed responses and mitigating panic [Kurbanov and Kim, 2021] serves as a valuable model.

Furthermore, the integration of advanced computational technologies for seismic risk assessment, as demonstrated in developed nations, contributes to a demonstrable reduction in casualties and damages, even under adverse circumstances. This evidence underscores the importance of a multi-faceted strategy towards enhancing earthquake preparedness, tailored to specific national contexts. Continuous learning and adaptation of best practices from global experiences are crucial for further improving resilience and minimizing the impact of future seismic events. Furthermore, the integration of advanced computational technologies for seismic risk assessment, as demonstrated in developed nations, contributes to a demonstrable reduction in casualties and damages, even under adverse circumstances. This evidence underscores the importance of a multi-faceted strategy towards enhancing earthquake preparedness, tailored to specific national contexts. Continuous learning and adaptation of best practices from global experiences are crucial for further improving resilience and minimizing the impact of future seismic events.

## MATERIALS AND METHODS

The integration of digital technologies into educational curricula aimed at earthquake preparedness offers a significant opportunity to cultivate specific cognitive schemas, motivations, and psychomotor skills relevant to the subject matter being taught. These technologies, by engaging both auditory and visual sensory modalities simultaneously, leverage a multisensory learning approach which can lead to enhanced knowledge acquisition and retention. This dual sensory input has the potential to optimize information processing and ultimately improve student competency in earthquake preparedness strategies.

The effectiveness of the teaching process based on digital technology is very high. It is worth noting that the throughput of the “ear-brain” system is 50,000 bit/s (data unit), and that of the “eye-brain” system is 5,000,000 bit/s, in other words, the data throughput of the eye analyzer is 100 times higher than that of the ear analyzer. Therefore, adding multimedia tools to the verbal teaching method increases the amount of information received. According to psychologists, people receive 90% of information about the external environment through the eyes, 9% through the ears, and 1% through touch [5, p. 86]. Mobile applications, online and offline training, learning modules and virtual simulation systems for earthquake preparedness provide an opportunity to provide interesting and effective education to the population.

Mobile applications: A large part of the world’s population uses mobile phones. With the help of mobile applications, people can access information from anywhere and at any time. Information about earthquakes can be distributed in real time through mobile applications and social networks. For example, in emergency situations, it is possible to increase public awareness by quickly delivering warnings, advice and safety measures.

Online and offline training: Using digital learning platforms, it is easier and more effective to provide educational materials in an interactive format for the population. Through such materials, students can more easily master practical skills.

Digital training modules: These modules prepare users with interactive training materials, video lessons, and tests. Online platforms can develop training modules on how to behave and take safety measures during earthquakes. Virtual simulations: With the help of such systems, the population can learn practically how to behave during an earthquake. Through simulation games and VR (virtual reality) technologies, users have the opportunity to experience situations that can occur in real life. Through the “Earthquake Preparedness Simulator” game, users can learn to adapt to different situations.

Forecasting with artificial intelligence: Using artificial intelligence and machine learning, it is possible to provide accurate forecasts of earthquakes. In this case, large volumes of seismic data are analyzed and recommendations are developed on how to act in difficult situations.

Using of modern digital technology tools in educational processes:

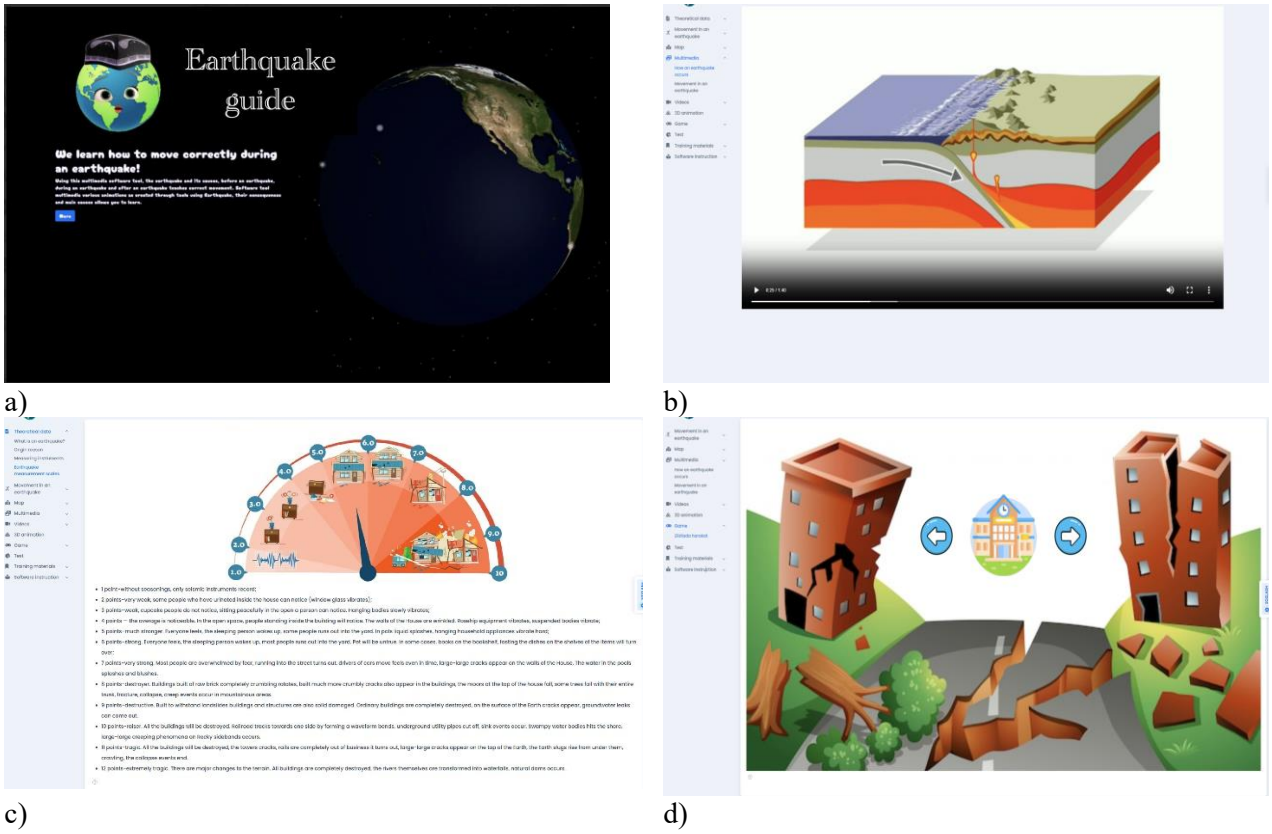
- improves the pedagogical skills of teachers;
- creates new electronic pedagogical technologies;
- automates the educational process;
- leads to the creation of mobile applications, online and offline training, training modules and virtual simulations, e-learning platforms.

Embracing digital solutions is vital for boosting earthquake readiness among citizens. Modern tech, like engaging online education, realistic virtual exercises, and intelligent systems, offers novel ways to educate and empower the public. These methods go beyond simple awareness campaigns, fostering more robust preparedness. By prioritizing the incorporation of digital tools in earthquake preparation, we can substantially improve citizen safety.

## RESULTS AND DISCUSSION

This article leverages global best practices in digital transformation to develop innovative software solutions for earthquake preparedness education in Uzbekistan. Specifically, the study resulted in the creation of several digital learning tools: a multimedia educational resource for students across all educational levels, designed to convey appropriate earthquake response behaviors; a remote learning platform intended to disseminate knowledge and skills related to earthquake preparedness; and a virtual reality training simulator providing practical, immersive experience in emergency response procedures relevant to high-magnitude seismic events.

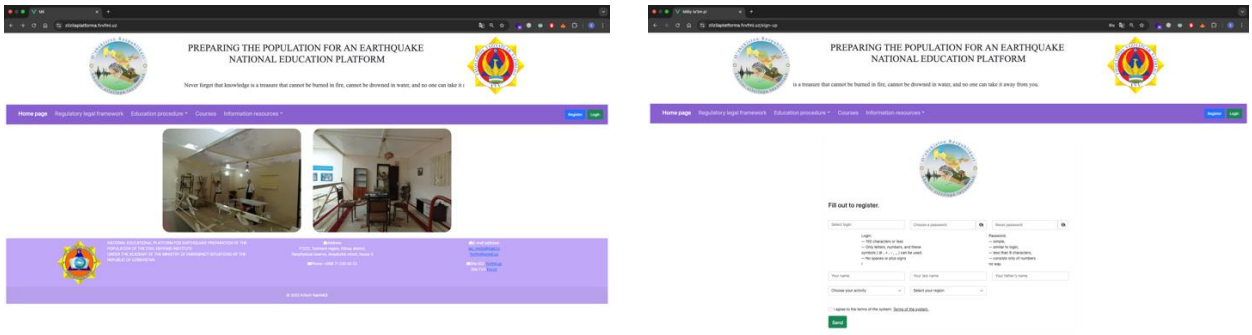
The working window of the multimedia software tool designed to teach students of preschool education and secondary education institutions how to move correctly during an earthquake (picture1).




a) b) c) d)

(Picture 1): Multimedia software tool designed to teach proper behavior during an earthquake

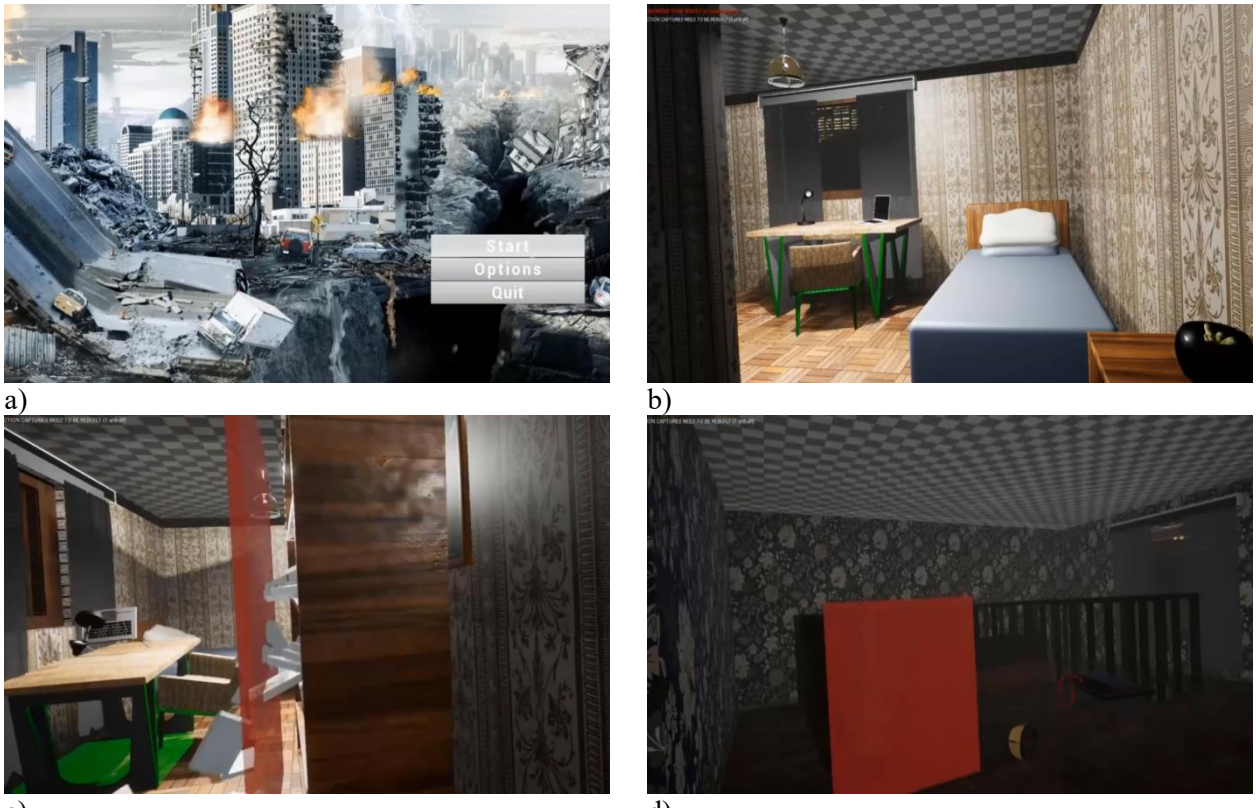
Working window of the distance online education platform (Picture 2)




a) b)

(Picture 2). Online distance learning platform

Working window of a virtual simulation training exercise simulator that teaches the population practical actions in emergency situations associated with strong earthquakes (Picture 3).




a) b)

c) d)

(Picture 3). A virtual simulation training exercise that teaches proper movement during an earthquake.

Based on these three developed software tools, the processes of teaching the population how to move correctly during possible earthquakes were digitized.

Using multimedia software, an educational platform, and a virtual simulation training simulator, recommendations for all segments of the population on how to behave properly during earthquakes were developed and put into practice.

The implementation of a multimedia educational tool designed to instruct students on appropriate earthquake response procedures has achieved significant reach within Uzbekistan's educational landscape. Current adoption rates indicate the tool is being utilized by 7,104 preschool pupils, approximately 10,000 general secondary school students, 1,117 students in secondary specialized vocational institutions, and over 213 higher education students. This widespread integration aims to cultivate and reinforce crucial knowledge and procedural skills related to earthquake safety among the younger demographic.

It is planned to cover both employed and unemployed citizens through a distance online training platform and a virtual simulation training simulator.
By digitizing the processes of preparing the population for an earthquake, it will be possible to preserve the lives and health of the population living in seismic areas in emergency situations and reduce losses.

## CONCLUSION

An investigation into the application of digital technologies in foreign earthquake preparedness programs revealed promising approaches. Building upon these findings, innovative digital software solutions were designed to facilitate optimal movement patterns during seismic events for all population groups. Concurrently, new digitally-mediated methodologies were developed for delivering targeted instructions and recommendations, demonstrating the feasibility of educating diverse populations on appropriate earthquake response strategies."The experience of foreign countries in the field of digitalization in preparing the population for an earthquake was analyzed.

## REFERENCES

**Balasanyan S.Yu. *et al.* (2014).** Seismic Protection and Its Organization. *Gyumri, Eldorado*, 437p.
**Shoigu S.K. (1997).** Fundamentals of State Regulation of Measures to Ensure Seismic Safety in Russia. Moscow: *REFIA*. 136 p.
**Kurbanov B.Y., Mustafoyev A.Q. (2022).** Problems and Solutions for Ensuring Seismic Safety in Uzbekistan Based on Long-Term Earthquake Forecasts. *Science, Protection, Safety*. **1**(8). 17–24.
**Kurbanov B.Yu., Kim S.G (2021).** Problems of Ensuring the Safety of Students in Educational Institutions upon Receiving Seismic Forecasts and Their Solutions in the Republic of Uzbekistan. *Science, Protection, Safety*. **2**(7). 138–143.
**Samandarov B.S. (2022).** Introduction of Digital Technologies into the Educational Process. *Educational and Methodical Complex. Nukus*: 86p.