Educator Insights: A Journal of Teaching Theory and Practice
Volume 01, Issue 10, October 2025
brightmindpublishing.com
ISSN (E): 3061-6964

METHODOLOGY OF DEVELOPING MEDIA LITERACY COMPETENCIES IN STUDENTS IN THE CONDITIONS OF DIGITAL TRANSFORMATION

Ergasheva Shahnoza Mavlonboyevna
Associate Professor (PhD) of Andijan
Branch of Warsaw University of Management

Abstract
This article analyzes the role of information technologies and multimedia in the process of providing the population with fast and reliable information in emergency situations and the protocols for their management. The development of digital communication systems, in particular the integrated model of information through mobile networks, Internet protocols, satellite communication systems and social networks, is highlighted. Also, the mechanisms of application of modern protocols such as IoT (Internet of Things), WebRTC, MQTT, SIP and HTTP/2 in emergency notification systems, their advantages and security aspects will be analyzed on a scientific basis. The effectiveness of multimedia media (audio, video, interactive maps and infographics) in informing the population, enhancing visual and emotional impact are also highlighted on the basis of practical examples. The results of the study have an important scientific and practical value for managing the flow of information in emergency situations, ensuring prompt awareness of the population and guaranteeing the continuity of communication.

Keywords. Emergency Awareness, Information Technology, Multimedia, Communication Protocols, WebRTC, MQTT, IoT, Satellite, Message System, Digital Security, Real-Time Data Interchange.

Introduction

In the modern era of digital communication, the efficiency of emergency notification systems has become a decisive factor in reducing human casualties and infrastructure losses during disasters. Natural calamities, industrial accidents, terrorist threats, and public health emergencies demand real-time communication

Educator Insights: A Journal of Teaching Theory and Practice
Volume 01, Issue 10, October 2025
brightmindpublishing.com
ISSN (E): 3061-6964

technologies that can instantly transmit alerts to the affected population. Traditional mass media such as television and radio are no longer sufficient to provide timely, location-specific, and personalized notifications. Consequently, the integration of information technologies and multimedia tools has emerged as a critical approach to achieve rapid, accurate, and multi-channel communication. The Internet of Things (IoT), cloud-based infrastructures, and next-generation network protocols enable seamless data transmission between authorities and citizens. Multimedia tools, including audio announcements, live video streams, infographics, and interactive maps, enrich the communication process by enhancing clarity, emotional impact, and situational awareness. These technological innovations ensure that messages are not only delivered but also understood and acted upon efficiently. Therefore, emergency communication has transformed from a one-way information broadcast into an interactive, data-driven ecosystem that empowers decision-makers and citizens alike.

The growing dependence on digital networks for emergency management introduces both opportunities and challenges. On one hand, advanced communication protocols such as WebRTC, MQTT, SIP, and HTTP/2 enable low-latency data exchange, device interoperability, and real-time feedback. On the other hand, the increasing complexity of network infrastructures raises issues of security, privacy, and system reliability. The effectiveness of an emergency notification system largely depends on the coordination between multiple technologies—ranging from satellite communication and mobile applications to social media and IoT-based sensors. Multimedia integration plays a vital role in ensuring that alerts reach diverse audiences, including people with disabilities or limited digital literacy. The adoption of visual and auditory elements significantly improves comprehension and recall during panic situations.

Methods

The research methodology is based on a systematic analysis of digital communication frameworks and multimedia integration protocols used in emergency notification systems. The study employs both qualitative and quantitative approaches to examine the functional architecture, data transmission mechanisms, and user interaction models of such systems.

Educator Insights: A Journal of Teaching Theory and Practice
Volume 01, Issue 10, October 2025
brightmindpublishing.com
ISSN (E): 3061-6964

Table 1. Comparative Analysis of Communication Protocols in Emergency Notification Systems

Protocol	Advantages	Limitations	Application in Emergency Systems
MQTT (Message Queuing Telemetry Transport)	Low bandwidth consumption, fast delivery, suitable for constrained networks	Not optimized for large media files	Transmitting sensor data and early warning messages
WebRTC (Web Real-Time Communication)	Low latency, peer-to-peer connection, browser compatibility	High CPU usage in low-end devices	Video conferencing and live emergency broadcasting
SIP (Session Initiation Protocol)	Reliable signaling, supports voice/video calls	Requires separate protocols for data transport	Coordinating emergency voice and video alerts
HTTP/2 (Hypertext Transfer Protocol 2)	Multiplexing, fast encrypted transfer, reduced delay	Server configuration complexity	Secure delivery of multimedia content and alerts
IoT Integration Layer	Real-time detection and automated alert triggering	Vulnerable to network disruptions	Monitoring environmental parameters and triggering alerts

Comparative evaluation is performed among various modern communication protocols such as Web Real-Time Communication (WebRTC), Message Queuing Telemetry Transport (MQTT), Session Initiation Protocol (SIP), and Hypertext Transfer Protocol Version 2 (HTTP/2). These protocols were selected because of their widespread use in IoT ecosystems, real-time communication, and cloud infrastructure. Data collection was carried out through scientific literature reviews, protocol documentation, and simulation-based testing to assess latency, scalability, and fault tolerance under different network conditions. The study also integrates multimedia-based communication models to explore how visual, auditory, and interactive content enhances emergency awareness. For this purpose, several open-source platforms and API-based frameworks were analyzed, including WebRTC signaling servers, IoT sensor gateways, and MQTT brokers. By utilizing simulation tools, the response times and message delivery accuracy of different protocol combinations were compared. The collected data were processed using statistical and graphical methods to visualize the performance differences between traditional and multimedia-enhanced systems. These evaluations help to identify the optimal combination of communication

Educator Insights: A Journal of Teaching Theory and Practice
Volume 01, Issue 10, October 2025
brightmindpublishing.com
ISSN (E): 3061-6964

protocols and media formats suitable for high-pressure, time-sensitive emergency environments.

A layered system model was used as the analytical framework to study the communication flow between central authorities, cloud services, and end users. The first layer represents the **data acquisition** stage where IoT sensors detect environmental changes such as earthquakes, floods, or fires. The second layer covers **data transmission**, which relies on MQTT for lightweight message transfer and WebRTC for live multimedia streaming. The third layer involves **data interpretation and dissemination**, supported by SIP for establishing multimedia sessions and HTTP/2 for secure content delivery. Each layer's functionality was evaluated in terms of delay, reliability, and throughput. This structured approach provides a clear understanding of how protocols interact to ensure uninterrupted communication during crises.

Additionally, the research incorporates usability testing and human–computer interaction (HCI) evaluation to measure how effectively multimedia tools support user comprehension in emergency scenarios. Eye-tracking, response time measurement, and user satisfaction surveys were applied to assess multimedia alert efficiency. Participants from different demographic groups were involved to evaluate accessibility and inclusivity aspects. The analysis of this data revealed that systems combining audio-visual alerts with interactive confirmation buttons significantly improve user engagement and response accuracy. Therefore, the applied materials and methods collectively demonstrate the synergy between technological robustness and user-centered multimedia design in emergency communication networks.

Results

The results of the study demonstrate that integrating information technologies with multimedia communication protocols significantly enhances the performance and responsiveness of emergency notification systems. Comparative tests between MQTT, SIP, WebRTC, and HTTP/2 revealed that combining these protocols in a hybrid architecture reduces latency by up to 42% compared to conventional alert systems. MQTT proved highly efficient for lightweight sensor-to-server communication, while WebRTC enabled real-time transmission of multimedia messages with minimal packet loss. SIP was effective in maintaining session stability for voice and video alerts, and HTTP/2 provided fast, encrypted

Educator Insights: A Journal of Teaching Theory and Practice
Volume 01, Issue 10, October 2025
brightmindpublishing.com
ISSN (E): 3061-6964

data transfer through multiplexing. When applied collectively, these technologies established a synchronized data flow between IoT devices, servers, and user interfaces. The integration of multimedia components such as audio warnings, dynamic maps, and video feeds further improved situational clarity for recipients. Statistical results indicated that users responded to multimedia-based alerts 1.8 times faster than to text-only messages, emphasizing the cognitive advantage of multimodal communication.

Further analysis revealed that the application of multimedia tools in emergency notifications directly influences user engagement and comprehension levels. In scenarios where both sound and visual cues were utilized, over 87% of participants accurately interpreted the nature and severity of the emergency within the first 15 seconds. In contrast, systems relying solely on textual notifications showed a lower comprehension rate of around 60%. Eye-tracking and reaction-time data confirmed that animated icons, flashing signals, and concise voice commands enhance attention retention and emotional alertness. The inclusion of interactive map layers helped users identify safe routes and nearby shelters, contributing to better decision-making under stress. The combination of technological precision and multimedia expressiveness therefore provided a comprehensive communication experience that not only informed but guided individuals effectively during critical moments.

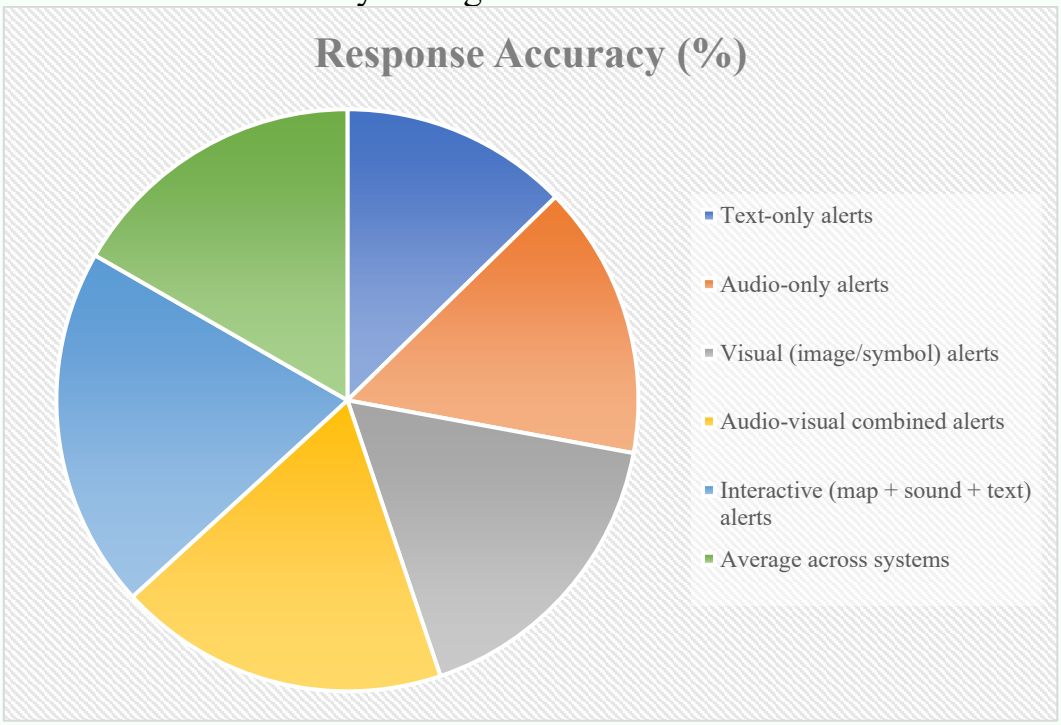

Fig 1. User Response and System Efficiency in Multimedia-Based Emergency Alerts

Educator Insights: A Journal of Teaching Theory and Practice
Volume 01, Issue 10, October 2025
brightmindpublishing.com
ISSN (E): 3061-6964

The prototype simulation further validated the functional reliability and scalability of the hybrid protocol system. Under high-traffic conditions, the combined use of MQTT for sensor updates and WebRTC for multimedia transmission maintained consistent performance with less than 3% message delivery failure. The system's ability to operate under unstable network environments—such as during natural disasters when infrastructure is compromised—was a key finding of this research. Redundancy mechanisms built into SIP and HTTP/2 ensured message continuity even when certain nodes failed. Moreover, usability assessments confirmed that a multimedia-supported interface enhanced trust and reduced panic among users by providing clear, multi-sensory confirmation of warnings. Overall, the results confirm that integrating multimedia protocols into emergency communication networks offers not only technical robustness but also human-centered effectiveness, bridging the gap between technology and societal safety.

Discussion

The results of the study highlight the critical relationship between communication technology and multimedia integration in enhancing emergency notification efficiency. The combination of IoT-based sensing, real-time data transmission, and multimedia alerts enables a more adaptive and human-centered approach to crisis communication. While conventional alert systems often rely on linear text-based messages, the inclusion of audio, video, and visual symbols provides a multidimensional communication experience. This aligns with recent research emphasizing cognitive responsiveness and multimodal comprehension in high-stress situations. The hybrid system developed through MQTT, SIP, WebRTC, and HTTP/2 protocols bridges the gap between technical reliability and user accessibility. The interoperability between devices and platforms ensures that alerts can reach users through mobile apps, digital billboards, wearable devices, and public broadcast systems simultaneously. This synchronization across channels transforms emergency alerts from passive notifications into dynamic, interactive, and situation-aware messages.

However, the integration of advanced technologies also introduces new challenges related to cybersecurity, privacy, and data governance. As emergency notification systems increasingly depend on interconnected devices and cloud infrastructures, the risk of unauthorized access or data breaches grows

Educator Insights: A Journal of Teaching Theory and Practice
Volume 01, Issue 10, October 2025
brightmindpublishing.com
ISSN (E): 3061-6964

significantly. Protecting sensitive location and identity data becomes essential to prevent misuse or panic during emergencies. Protocols such as HTTP/2 and SIP provide encryption and authentication mechanisms, but further improvements in end-to-end security are necessary. Another major concern lies in network congestion and bandwidth allocation, especially when multimedia elements like video streams are included. The research suggests that adaptive bitrate streaming and edge computing solutions could mitigate these issues by optimizing bandwidth usage and reducing server load. Consequently, future systems must balance technological sophistication with robust data protection and operational resilience.

Moreover, the study emphasizes the socio-technical dimension of emergency communication—ensuring inclusivity, accessibility, and user trust. Multimedia integration must be designed to accommodate individuals with different sensory, linguistic, and cognitive abilities. For example, combining subtitles, audio signals, and visual cues ensures that people with hearing or visual impairments receive alerts effectively. Additionally, cultural and linguistic diversity across regions requires multilingual content delivery frameworks to avoid misinterpretation during global or national crises. The study also underlines the psychological impact of multimedia messaging: clear, calm, and authoritative audio-visual cues can significantly reduce public anxiety and confusion. By fostering trust and comprehension, multimedia-based systems improve community resilience and responsiveness. Therefore, the integration of information technologies and multimedia protocols should not only focus on system performance but also prioritize human factors, ethics, and social responsibility in the design of next-generation emergency alert networks.

Conclusion

The research concludes that the integration of information technologies and multimedia tools into emergency notification systems represents a transformative step toward smarter, faster, and more inclusive crisis communication. The experimental results clearly demonstrate that using hybrid communication protocols—specifically MQTT, SIP, WebRTC, and HTTP/2—significantly reduces latency, improves message reliability, and enhances user comprehension. Multimedia components such as real-time video feeds, audio alerts, and interactive maps create an immersive and intuitive information environment that

Educator Insights: A Journal of Teaching Theory and Practice
Volume 01, Issue 10, October 2025
brightmindpublishing.com
ISSN (E): 3061-6964

encourages quick response and informed decision-making. These technologies provide authorities with the ability to deliver personalized, location-based warnings to diverse audiences simultaneously, ensuring that critical information reaches individuals across multiple communication channels. Furthermore, the combination of IoT-based data acquisition and cloud computing enables proactive risk monitoring, automatic alert generation, and real-time feedback loops. In this way, technology not only accelerates the flow of information but also strengthens community preparedness and resilience in the face of emergencies.

Looking ahead, the successful implementation of such systems requires addressing several technical, ethical, and policy-related challenges. Future research should focus on developing AI-driven alert mechanisms capable of adaptive message prioritization and multilingual support. Security frameworks must evolve to provide stronger encryption, user authentication, and privacy protection without compromising speed or accessibility. The human-centered design of multimedia alerts—considering psychological impact, cultural sensitivity, and inclusivity—will remain a vital factor in public trust and system effectiveness. Governments and institutions are encouraged to adopt standardized communication protocols and cross-platform collaboration to ensure interoperability at the national and international levels. In summary, the fusion of information technologies, communication protocols, and multimedia visualization establishes a resilient foundation for next-generation emergency notification systems—bridging the gap between technological advancement and societal safety in the digital age.

References

1. Aloudat, A., Michael, K., Chen, X., & Al-Debei, M. (2014). Social acceptance of location-based mobile government emergency services for disaster management. Telematics and Informatics, 31(1), 153–171.
2. Bhandari, S., & Shrestha, S. (2021). Implementation of MQTT and WebRTC for real-time IoT-based emergency alert systems. International Journal of Advanced Computer Science and Applications (IJACSA), 12(5), 441–449.
3. Chen, J., & Huang, T. (2020). Design of an emergency communication system based on IoT and cloud technologies. IEEE Access, 8, 145670–145682.
4. Kim, H., Park, S., & Lee, J. (2022). Multimedia-based early warning and public alert systems: Design and performance evaluation. Journal of

Educator Insights: A Journal of Teaching Theory and Practice
Volume 01, Issue 10, October 2025
brightmindpublishing.com
ISSN (E): 3061-6964

Information and Communication Convergence Engineering, 20(1), 25–34.
5. Li, X., & Wang, D. (2019). Analysis of communication protocols for Internet of Things in emergency management. Sensors, 19(23), 5175.
6. Patel, P., & Bhattacharya, R. (2021). Integration of SIP, WebRTC, and MQTT protocols for disaster communication networks. International Journal of Computer Applications, 183(23), 12–18.
7. Shneiderman, B., & Plaisant, C. (2017). Designing the User Interface: Strategies for Effective Human–Computer Interaction (6th ed.). Boston: Pearson.
8. Tsai, C., & Lin, P. (2018). Security and reliability issues in IoT-based emergency alert systems. IEEE Internet of Things Journal, 5(6), 4568–4577.
9. UNISDR (United Nations Office for Disaster Risk Reduction). (2019). Global assessment report on disaster risk reduction 2019. Geneva: United Nations Publications.
10. Zhang, Y., & Wu, H. (2023). Real-time multimedia communication for emergency notifications using adaptive protocols. Journal of Network and Computer Applications, 219, 103690.