



Modern Forms of Education and Public Warning in the Field of Civil Protection

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Abstract: This study examines current approaches to civil protection education, focusing on differences in communication behaviour and preparedness preferences across age groups. The theoretical section addresses experiential learning, serious games, simulations, virtual environments, mobile applications, social media, SMS, and mobile broadcasting, as well as self-protection and mutual aid. The core of the study consists of an anonymous online questionnaire completed by 187 respondents divided into three age groups. The results reveal clear differences in preferred communication and educational methods. Respondents under the age of 30 predominantly prefer social media, short videos, and interactive simulations. The 31–50 age group shows the greatest willingness to use a mobile application providing emergency alerts and guidance, whereas respondents aged 51 and older rely more on television, radio, SMS, official information sources, and practical training. These findings were used to develop a differentiated model combining the CIVIS mobile application, digital communication, and practical community-based training. The proposed approach acknowledges that different population groups utilize distinct communication channels and learning methods. Rather than relying on a single tool, civil protection communication should combine rapid warning systems with verified information, digital education, and practical preparedness activities.

Keywords: civil protection, disaster preparedness, public warning, self-protection, mobile application, digital education, community training

1 Introduction

Contemporary emergencies are becoming increasingly frequent and complex, placing growing demands on civil protection systems and public preparedness. Effective civil protection no longer relies solely on traditional warning methods such as sirens, printed materials, or occasional public lectures. Instead, digital technologies, mobile communication, interactive learning, and multi-channel warning systems are increasingly used to rapidly disseminate information and encourage appropriate protective behaviour. Education and public warning systems can therefore be viewed as complementary processes. Education builds knowledge and preparedness before various types of emergencies occur, whereas warning systems provide timely information that enables people to

apply that knowledge during actual events. Recent research highlights the growing importance of experiential learning in disaster education. Serious games, simulations, and virtual environments allow participants to practice decision-making, resource allocation, and emergency response actions, while simultaneously enhancing risk awareness, collaboration, and the delivery of assistance [1, 2, 3, 4, 5, 6]. Although these approaches have demonstrated positive educational outcomes, their effectiveness depends on realistic scenarios, clearly defined learning objectives, and their integration with other educational activities such as evacuation drills, first aid training, and lecture-based public preparedness programs [1, 4, 6]. Warning and notification systems have also evolved into multi-channel communication networks combining sirens, radio, television, SMS, mobile broadcasting, mobile applications, and social media. Their effectiveness depends not only on the rapid delivery of messages but also on credibility, information clarity, and the provision of specific instructions on how people should respond [7, 8]. Social media and mobile applications can also facilitate communication by enabling authorities to disseminate verified information while simultaneously receiving messages from areas affected by an emergency. These platforms require effective management of disinformation and clear institutional communication to maintain public trust in state institutions and prevent panic [9, 10, 11].

Consequently, modern civil protection increasingly combines technological innovation, practical education, and societal engagement in emergency response. Digital communication tools provide rapid access to information, while practical training strengthens self-protection skills, mutual aid capabilities, and societal resilience. Since communication habits and educational preferences vary across age groups, no single communication channel or educational method can fully meet the needs of the entire population. Research therefore highlights the value of an approach that combines digital technologies with conventional forms of education, complemented by information regarding warning and notification systems.

1.1 The Role of Self-Protection and Mutual Aid in Civil Protection

Civil protection is a coordinated system of measures designed to protect life, health, and property during emergencies [12]. Its effectiveness depends not only on public authorities and professional emergency services but also on the ability of individuals and communities to respond before help arrives. Self-protection and mutual assistance are vital elements of civil protection, as they link crisis management with preparedness and the citizenry.

Self-protection encompasses both preventive and reactive activities through which individuals utilize available knowledge, skills, and resources to protect themselves. Key factors include awareness of local hazards, recognition of warning signals, adherence to official instructions, knowledge of evacuation and sheltering procedures, preparation of emergency supplies, and the ability to administer basic first aid to oneself and others. Its importance is particularly evident during the initial phase of an emergency, when professional assistance may not yet be available. In the Slovak Republic, the role of citizens in civil protection is defined primarily by Act No. 42/1994 Coll. on Civil Protection of the Population [12]. Preparation for self-protection and mutual assistance is

further regulated by Decree No. 303/1996 Coll. [13], which defines it as a continuous process combining preventive education, theoretical instruction, and practical training. Preparation is one of the initial steps taken prior to the occurrence of an emergency. Citizens should be aware of local hazards, maintain basic emergency supplies, and know how to identify reliable sources of information. Attention should also be paid to children, the elderly, persons with disabilities, and those dependent on medication (vulnerable groups), as this segment of the population is most at risk during an emergency. Such preparation can help households remain functional during temporary disruptions to electricity, water, transport, or communication services. Adequate knowledge and preparedness can reduce reliance on emergency services and allow professional responders to prioritise areas most critically affected by the emergency [14]. However, knowledge and skills alone are not enough. Established procedures and actions must also be practiced under real-world conditions, as studies from Slovakia indicate that public preparedness is relatively low [15].

Mutual aid complements self-protection through activities such as administering first aid, assisting with evacuations, sharing verified information, and supporting vulnerable population groups. Such assistance can be spontaneous or organized through volunteer fire departments, neighbourhood networks, or local civil protection units. In either form, mutual aid can strengthen local capabilities, improve coordination, and bolster community resilience against the consequences of an emergency [16]. At the same time, the assistance should complement rather than replace the obligations of public authorities, and it should not expose citizens to unnecessary risk.

2 Methodology

The research was designed as a quantitative survey examining how residents obtain information about emergency events, which forms of self-protection and mutual aid they prefer, and whether these preferences differ across age groups. The methodological approach combined a review of academic literature, legislation, and strategic documents with primary data collected via an anonymous questionnaire. The main objective was to identify communication and educational tools that could contribute to public preparedness for self-protection and mutual aid. Four research questions were formulated regarding the issue:

Question 1: Which communication tools do residents most frequently use to obtain information?

Question 2: What forms of preparation for self-protection and mutual aid do residents prefer?

Question 3: Are there differences between age groups regarding their preferences for communication tools and forms of preparation?

Question 4: Which modern technologies and communication tools do residents consider most suitable for improving emergency preparedness?

Data were collected via an anonymous questionnaire created by the authors and distributed using Google Forms. The questionnaire comprised 24 items (16 closed-ended,

seven semi-closed, and one open-ended question) focusing on demographic data, sources of information, preferred educational methods, attitudes toward modern technologies, and perceived gaps in emergency preparedness. The research sample consisted of 187 respondents, comprising 103 women (55.1%) and 84 men (44.9%). The majority of respondents (120; 64.2%) reported living in an urban environment, while 67 (35.8%) lived in rural areas.

Sturges' rule was used to divide the data into age intervals; this rule is used to determine the optimal number of intervals (k) based on the total number of observations (n) in the dataset. It is ideal for normally distributed data. Formula for the number of intervals: $k=1+3.322*\log(n)$. Interval width (h) is calculated as the difference between the maximum and minimum ages divided by the number of intervals: $h=(x_{max}-x_{min})/k$. It follows from the above that: $k=1+3.322*\log(187)=8.55\approx 9$ age intervals and interval width is $h=(73-15)/9=6,79\approx 7$ years in an interval. We have combined the age categories into approximate groups by generation, to make the data easier to interpret, as shown in Table 1.

Tab. 1. Distribution of respondents by age intervals and generation groups

Age intervals of respondents	Number of respondents	Percentage distribution	Generation
<15;22>	13	6,95%	Z
(22;29>	22	11,76%	
(29;36>	36	19,25%	
(36;43>	39	20,86%	Y
(43;50>	29	15,51%	
(50;57>	21	11,23%	X
(57;64>	19	10,16%	
64;71>	6	3,21%	Baby Boomers
(71+>	2	1,07%	
Total	187	100%	

Age served as the primary comparative variable, with respondents divided into four groups: age 15-29 (35; 18.72%) represents Generation Z, age 30–50 years (104; 55.61%) represents Generation Y, age 51–64 years (40; 21.39%) represents Generation X and age 65 and older (8; 4.28%) represents Baby Boomers. Respondents aged 30 to 50 constituted the largest age group, whereas those 65 and over formed the smallest group.

Only questionnaire items directly related to the established research questions were included in the analysis. For several questions, respondents could select more than one answer; this applied particularly to questions regarding information sources, communication channels, preferred warning methods, educational formats, and modern preparedness tools. The percentage values presented for these items therefore represent the

proportion of respondents who selected a given option, and their sum does not necessarily total 100%. For single-choice questions, respondents were required to select only one answer. To address the research questions, the analysis focused on preferred communication channels, educational formats, and attitudes toward modern preparedness tools. The variables examined included commonly used information sources, preferred warning methods, willingness to use a mobile application, acceptance of social media for communication during emergencies, preferred educational formats, and the use of modern tools.

The collected data were analysed using descriptive statistics. Absolute frequencies were converted into percentages and presented for the entire sample and separately for each age group. Differences between age categories were interpreted through percentage-point comparisons. As the study was exploratory, inferential statistical tests were not applied; therefore, the findings describe the research sample rather than the entire Slovak population. Responses to the open-ended question were analysed using qualitative categorisation. Recurring themes included a lack of public awareness, limited practical training, unclear instructions, the absence of a centralized digital platform, concerns regarding the credibility of information, and low public motivation. These responses were used to complement the quantitative findings and to formulate practical recommendations.

As the study aimed to identify communication and educational preferences rather than test predefined causal relationships, the analysis was structured around research questions rather than formal hypotheses. This approach was deemed appropriate given the exploratory nature of the study and the goal of identifying patterns for further investigation in future research. The study has several limitations. The questionnaire was distributed online, which may have favoured respondents with higher digital literacy. Additionally, the sample was non-probability-based and unevenly distributed across age groups, with respondents aged 30–50 accounting for more than half of the sample. Finally, the research examined stated preferences rather than actual behaviour during emergencies. Consequently, the results should be interpreted as descriptive evidence of respondents' reported preferences rather than as evidence of causal relationships or effects across the general population. An artificial intelligence tool (ChatGPT-4) was used to generate the image, with requirements regarding the proposed application's appearance being entered incrementally. The resulting design was subsequently refined and adjusted iteratively based on the established requirements.

3 Results

The survey identified three distinct, although partially overlapping, population profiles. Respondents aged up to 29 years predominantly used visually oriented digital platforms. Instagram (71.43%), Facebook (68.57%) and YouTube (48.57%) were the most frequently used communication channels, while 51.43% identified social media as their primary source of information during emergencies. Short instructional videos

(80.00%), simulations (57.14%) and infographics (48.57%) were the preferred educational formats, indicating that younger residents are the primary target group for digital communication campaigns. Respondents aged 30–50 years combined digital and conventional communication channels. Facebook (63.46%), television (52.88%) and news websites (51.92%) were the most frequently used sources. This group expressed the highest willingness to use a mobile application for emergency alerts and guidance, with 73.08% definitely willing and 92.31% either definitely or probably willing to use such a tool. Mobile applications with emergency instructions (69.23%), short videos (67.31%) and practical demonstrations (62.50%) were the preferred preparedness methods. Respondents aged 51–64 years and over relied more strongly on conventional communication channels. Television and radio were each used by 67.50%, while official state and municipal institutions were considered the most trustworthy information source by 82.50%. SMS was the preferred warning method (70%), and practical demonstrations (65%) were regarded as the most effective way of learning emergency procedures. Nevertheless, 87.50% of respondents in this group expressed definite or probable willingness to use a civil protection application, indicating that digital tools should complement rather than replace conventional communication. These results support a differentiated, multichannel approach rather than an exclusively digital or conventional communication strategy [8,17].

3.1 Proposed CIVIS civil protection application

Survey results indicate that respondents value a combination of rapid alerts, accessible information about emergency events, and practical instructions. A mobile application was identified as a preferred tool for enhancing preparedness, particularly among respondents under the age of 50. At the same time, the results show that a mobile application should complement rather than replace established warning channels such as SMS, sirens, television, and radio. Based on these findings, the authors propose the CIVIS concept—a civil protection application designed to integrate alerts, verified information, education, and crisis support into a single official platform.

The proposed CIVIS concept (figure 1) is intended to complement existing warning systems—including sirens, SMS, cell broadcasting, and broadcast services—by providing detailed, location-specific information following the initial alert. Previous research highlights the potential of mobile technologies for disseminating alerts, geolocation, supporting preparedness, and coordination, while emphasizing usability, reliability, and the importance of clear information [8, 18, 19]. Furthermore, the survey results demonstrate the importance of clear behavioural instructions; warning messages should not only inform users of a hazard but also provide guidance on appropriate protective measures [17].



Fig. 1. Conceptual design of the proposed CIVIS civil protection application [20]

The proposed application consists of four interconnected functions. **The emergency warning and notification function** would provide priority alerts issued by authorized crisis management agencies, based on the user's location and where technically feasible. Each alert would identify the responsible authority, the type of hazard, the affected area, the severity, the time of issuance, and recommended protective measures. Providing instructions is particularly important, as a notification lacking clear guidance might require users to seek additional information [17].

The verified information function would provide continuously updated information from relevant public institutions. Its purpose would be to consolidate various pieces of information into a unified resource. Institutional credibility plays a crucial role in this function, as respondents identified official state and municipal institutions as their most trusted sources of information. Previous research also indicates that trust in app-based warning systems depends not only on technical performance but also on transparency, credibility, and the perceived accuracy and relevance of the information [21].

The educational function would provide accessible guidance for specific emergency situations, including first aid, evacuation procedures, various types of accidents, and potential terrorist attacks. This function would also include an evacuation kit checklist and educational materials in the form of short videos, infographics, and practical guidelines. These formats align with the learning preferences identified in the survey, as well

as findings from research on education and the use of interactive and experiential learning approaches [1,22]. Where possible, selected guidelines could also be made available offline so that essential information remains accessible even in cases of limited internet connectivity.

The crisis support function would provide quick access to emergency numbers (112, 150, 155, and 158), along with information on nearby shelters and other relevant civil protection facilities. The design aims to minimize the steps required to contact emergency services or obtain location-specific information. This is particularly important during emergencies, as stress and time pressure can impair a user's ability to navigate complex interfaces.

Overall, CIVIS is proposed as a complementary digital component of the civil protection system rather than a replacement for existing warning and communication channels. Its primary purpose is to integrate rapid alerts with verified information, practical preparedness instructions, and access to assistance within a single platform. The concept thus reflects the diverse communication preferences identified in the survey while respecting the established roles of existing communication channels and public institutions.

3.2 Digital and community preparedness

The second part of the proposed approach combines digital communication with practical training within the community. Digital communication should primarily target residents who frequently use social media and prefer short, visually oriented educational content. Instagram, Facebook, and YouTube can be used to distribute short videos, infographics, quizzes, and interactive scenarios focusing on specific protective measures, such as responding to warning signals, preparing an evacuation kit, or verifying information from official sources. More detailed information can then be provided via the proposed CIVIS app and official agency websites. Social media should complement rather than replace official warning systems and should rely on verified institutional accounts and clear procedures for correcting misinformation [23,24].

Practical training should complement digital education by providing opportunities to practice first aid, evacuation procedures, the preparation of evacuation kits, the interpretation of warning signals, and assistance to vulnerable individuals [24]. Such activities could be organized by municipalities in cooperation with fire and rescue services, the Red Cross, volunteer fire departments, and schools. This approach aligns with respondents' preference for practical demonstrations and hands-on learning, and it can also strengthen local cooperation and mutual aid [25,26]. Combining digital communication with hands-on training enables diverse population groups to access preparedness information through channels that better align with their stated preferences. Digital content can provide accessible and repeatable educational materials, while hands-on training can foster skills that cannot be acquired through information alone. Evidence from previous research suggests that educational interventions combined with behavioural support can improve household preparedness, although their effectiveness depends on

program design and participant characteristics [26,27]. Older adults should not, therefore, be viewed as a group excluded from digital technologies; rather, digital tools and conventional hands-on training can be offered concurrently [28].

4 Discussion

The results support the use of a differentiated, multi-channel approach to civil protection communication and education. However, the observed differences between age groups should not be interpreted as being caused solely by age. They may also reflect differences in digital media usage, familiarity with communication technologies, trust in information sources, educational backgrounds, and other characteristics not examined in this study.

The strong preference for SMS as a method of immediate warning confirms the importance of rapid, simple, and reliable communication during emergencies [29]. At the same time, respondents expressed interest in detailed guidance, location-specific information, and continuously updated instructions. These findings support the proposed CIVIS concept as a complementary tool capable of integrating warnings, verified information, educational materials, and crisis support functions. Similarly, previous studies highlight the potential of mobile technologies for warning dissemination, preparedness, and coordination, emphasizing usability, reliability, and cross-device compatibility [8, 30]. Therefore, prior to any widespread implementation, such a system would require testing across different age groups and varying levels of digital competence.

The results also suggest that digital communication and practical education should be viewed as complementary rather than competing approaches. Younger respondents showed a stronger preference for social media, short videos, and simulations, whereas older respondents placed greater emphasis on television, radio, SMS, and practical demonstrations. Social media can facilitate rapid communication and public interaction when linked to verified institutional sources [23,32], while practical exercises remain important for skill development during emergencies and for supporting individuals with lower digital literacy [33]. Similarly, serious games and scenario-based exercises can enhance disaster-related knowledge, decision-making capabilities, and self-confidence, although their long-term impact on behaviour requires further investigation [34].

Alternative explanations should also be considered. The stronger preference among younger respondents for social media, short videos, and simulations may reflect their general digital media usage patterns rather than a specific preference for these formats within civil protection education. Likewise, a willingness to use a civil protection app does not necessarily imply that respondents would actually install, regularly use, or rely on it during a real emergency. Stress, limited connectivity, battery availability, and information overload can influence behaviour in real-world situations. Similarly, the preference of older respondents for conventional communication channels may reflect established habits and familiarity with these sources rather than age alone. The observed differences should therefore be understood as associations within the studied sample rather than as evidence that age independently determines communication or educational preferences.

The relatively high level of trust in state and municipal institutions should be interpreted with caution. Respondents may have identified these institutions as the most trustworthy sources because they are perceived as formally responsible for emergency management. However, this does not necessarily mean that all information provided via a new digital platform would automatically be trusted or acted upon. Public trust would depend on the accuracy, timeliness, and relevance of the information, as well as on transparency regarding the issuing authority and recommended measures [21, 31]. Cybersecurity and protection against unauthorized access would also be crucial for maintaining the institution's credibility.

Several methodological limitations should be acknowledged. The study used a non-probability online sample that was unevenly distributed across age groups and examined stated preferences rather than actual behaviour during emergencies. Consequently, the findings cannot be generalized to the overall population. Furthermore, no inferential statistical tests were employed, as the study was designed as an exploratory survey. Future research should utilize representative samples, apply appropriate inferential methods, and test the proposed communication and educational measures under realistic or simulated conditions.

5 Conclusion

The study examined differences in communication behaviour and preparedness preferences across three age groups and identified several implications for civil protection education and public warning systems. The results indicate that respondents do not rely on a single communication or educational method. Younger respondents showed a stronger preference for social media, short videos, and interactive formats, whereas respondents aged 31–50 expressed a willingness to use a mobile application. Respondents aged 51 and older rely on television, radio, SMS, and practical training, although a significant proportion also expressed a willingness to use a civil protection app.

Based on these findings, the study proposes a differentiated approach combining established warning channels, digital communication, the CIVIS mobile application, and practical community-based training. CIVIS is intended as a complementary digital to integrating public warnings, verified information, educational materials, and crisis support functions rather than a replacement for existing warning systems. Digital communication can extend the reach of preparedness education, while practical training remains crucial for skill development and fostering mutual aid within communities.

The findings should be interpreted in light of the study's nature and limitations. The use of a non-probability online sample and self-reported preferences means that the results cannot be generalized to the entire population nor interpreted as evidence of actual behaviour during emergencies. Therefore, further research should utilize representative samples and examine the practical application and effectiveness of the proposed communication and educational measures under real-world or simulated conditions.

Overall, effective civil protection preparedness requires more than a single technology or communication channel. A combination of rapid, reliable alerts accompanied by verified information, accessible digital education, and practical community training can offer a more flexible approach to fostering self-protection and mutual aid among diverse population groups.

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