AES BIOFLUX
Advances in Environmental Sciences - International Journal of the Bioflux Society

# Smartphone applications and their potential to enhance natural disaster risk communication and education in Romania

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**Abstract**. The increase of Smartphone users in Romania in recent years has enabled new ways of communication. Integrating them in disaster risk communication can complement the existing communication channels, targeting Smartphone users directly. The purpose is to enhance their situational awareness regarding natural disaster risk and promote appropriate behavior before, during and after a natural disaster. However, in order to develop an efficient and feasible Smartphone application and to create a positive user experience, the needs and requirements of future users have to be understood first. Therefore, in this paper, the authors conduct a specific needs analysis to identify the possibility of developing a Smartphone application designed to enhance natural disaster risk communication. The methodology is based on an online survey, completed by 384 persons of different ages and levels of education. The survey revealed significant information regarding the most relevant aspects to be included in such an application. The primary target group which would benefit from such an application has been identified, considering age and level of education.
**Key Words**: disaster risk reduction, Smartphone application, user requirements, primary target group.

**Introduction**. Due to mobile advanced technologies, the manner of communication and education is continuously changing, and adaptation of the messages to the current trends is necessary for an effective disaster risk communication process. Mobile applications have proven a diverse potential, both in the field of communication and in that of education (Li et al 2010; Palumbo et al 2012; Woodcock et al 2012) – and after recent disasters, such as Hurricane Sandy, mobile technology was considered a "game changer" in the field of disaster management as well (Culleton 2013). There are more arguments which favor Smartphones as a tool for disaster risk communication: small size favors portability and users have their phone most of the time on themselves; it is multifunctional and information can be delivered in various forms; and allows easy access to social media sites or other relevant sites regarding disasters (Sweta 2014).

How to implement this new channel of communication into existing disaster management structures is a question widely addressed on international, national and regional level. Mobile applications can answer specific requirements in the field of emergency management, considering the diversity of this medium (Sung 2011). The above mentioned author has classified Smartphone applications for disaster management in five major categories: alert notification; location sensing and hazard maps; disaster message boards; follow-up apps and educational apps. Each of these categories can coexist within one single application, according to the scope of each application. Some of the above mentioned categories come into handy in different phases of the disaster management (mitigation, preparedness, response and recovery). For example, alert notification, disaster management boards and hazard maps are most important in the response phase; follow-up apps in the recovery phase and educational apps can prove useful in each phase.

At the moment, various Smartphone applications for disaster risk communication are available online, that could be categorized by function as: news and alert apps (global disaster mapping, forum apps for preparedness issues, national/regional disaster news, specific disaster type tracking); guides and educational apps (disaster trivia, preparedness guide, first aid information, global emergency numbers); tool apps (for example: GPS tracking, shelter locator, panic button, torch, compass, donation) (Ridler-Ueno 2013). By analyzing existing applications, two major components can be observed: an on-line component (alert notifications, links to social media and important websites, photo-sharing options to raise situational awareness, message boards and so on); an offline component (pre-programmed messages, regarding appropriate behavior before, during and after a crisis event, interactive checklists and trivia and so on).

Besides setting a clear scope for developing the application, it is also important to design the informational content of the application in an attractive and easily understandable manner for future users. Information should be designed to deliver the maximum potential, allowing the user to take in easily the information (West & Norris 1997). According to above mentioned authors there are three major steps to be considered in order to achieve the full potential of a mobile application. Understanding the users is the first of those. The goal is to select and present information of interest in a manner that allows future users to make an informed and independent decision. To do so, it is important to understand the Smartphone usage pattern of present users, and their specific requirements regarding an application, in order to create a positive user experience. Creating maximum utility for the user is another important aspect. Mobile applications, especially design for disaster risk communication, need to be fast and reliable. The application should work flawlessly and meet user requirements. Last, but not least the design of the application is also important. A stunning design can capture the user's attention and can increase its satisfaction with the application. However, the design must be constructed in a simple way, so that the user can easily navigate in the application.

To meet the above-mentioned needs, cooperation is required between scientists, practitioners and members of society in order to shape the technical and informational components according to the specific needs of future users. This is shown by a recent study in Queensland as well, where scientists initiate a dialog with young people living in areas affected by disasters to understand their perception and requirements for a Smartphone application design to enhance disaster risk communication (Riddell et al 2011). According to them, it is necessary to include both off-line components (checklists, preprogrammed information on appropriate behavior and on first aid, etc.) and the on-line components (using multimedia and social networking features, using the "crowd sourced" information type, connection to key websites, etc.). They also considered important the interactivity and useful usage (the app has to be user-friendly and has to provide the possibility for two-way, interactive communication, etc.).

Considering the above-discussed aspects, it is clear that knowing future users is very important in order to develop an efficient and feasible app for disaster risk communication. A recent study revealed that Romanian citizens showed interest for information on risks (Kozma et al 2013) and one tool to disseminate this information on various types of natural disaster risk could be a Smartphone app, taking into consideration that in the past years the number of Smartphone users in Romania has continuously increased (Moldovan 2012; Fuciu & Gorski 2013).

**Material and Method**. The paper uses the methodology of social investigation, namely the questionnaire, in order to identify the special needs of Romanian citizens regarding a Smartphone application for disaster risk communication (Annex 1). The questionnaire was applied online, to a convenience sampling, consisting in respondents of an on-line survey conducted between April 15$^{th}$ and May 30$^{th}$, 2014. The resulting sample (N = 384) included persons of different age groups and educational levels (Figure 1). The sample was also divided by Smartphone users: 74.7% of the respondents had Smartphones.

Three non-parametric tests (the Chi-Square Test, the Kruskal-Wallis test and the Man-Whitney test) were applied (Field 2007) and a pc-value of 0.05, a confidence level of 95% and a margin of error of ±5% were considered during the data processing.

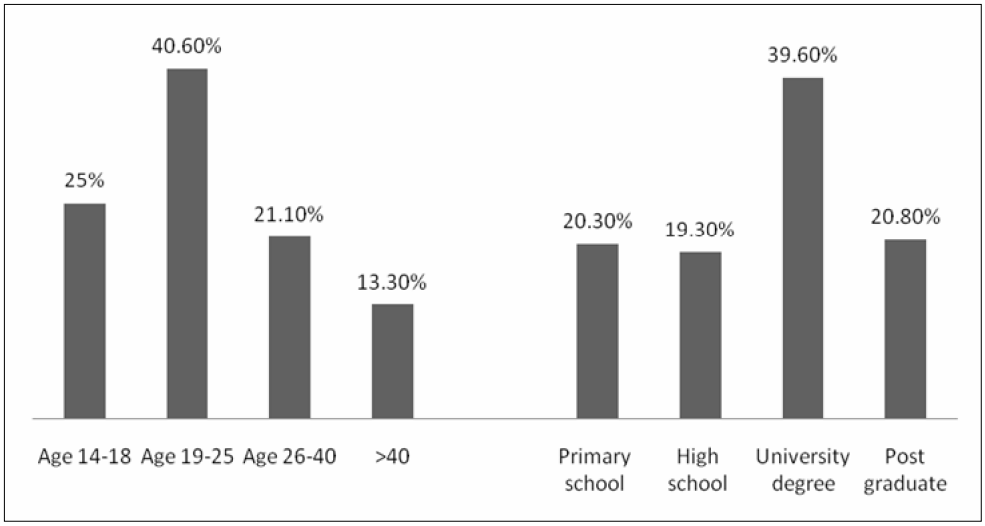


Figure 1. Sample description by age group and educational level.

The survey has been divided into three major parts. In the first part, answered only by Smartphone users, the authors gathered information regarding the behavior of mobile users and their willingness to download and use various mobile applications. The second part of the survey, answered by all respondents, included indicators for assessing aspects like: perception and knowledge about natural risk on individual level; perception of vulnerability; risk awareness; knowledge about appropriate behavior in case of a natural disaster. Based on these indicators, the authors tried to determine the most vulnerable persons to natural disasters based on the lack of knowledge on risks and adequate behavior and the most relevant beneficiaries of a mobile application to enhance disaster risk communication. In the last part of the survey, the authors collected data about how each respondent thought a Smartphone application for disaster risk communication and education should look like. This part included indicators regarding the informational content for such a Smartphone application, elements and tools considered necessary, and the optimal developer for the application.

**Results and Discussion**. As discussed above, in order to develop an efficient and feasible Smartphone application for disaster risk communication, the needs and requirements of the target group have to be known. Therefore, defining the primary target group is very important.

***Primary target group***. First of all, we analyzed who has the technology to use an application designed to enhance disaster risk communication. The majority of the respondents, 74.7%, have Smartphones. The percentage of Smartphone users of age between 19 and 25 is significantly higher than the percentage of Smartphone users of age between 14 and 18 and above 40. Therefore, the primary target group from the perspective of available technology would include the persons of the age between 19 and 25 (Figure 2).

The majority of the respondents agreed that they used their mobile phones on daily basis besides making calls and messaging. More than a half also agreed on some level that they used to download applications for their mobile phones (Figure 3). Persons of the age between 14 and 25 seem more likely to download applications than persons above the age of 40. The majority of the persons from the latter group somewhat agree to download applications. There is a similar situation which takes into consideration the level of education – significantly more persons with a high school degree are downloading applications, than post graduates.

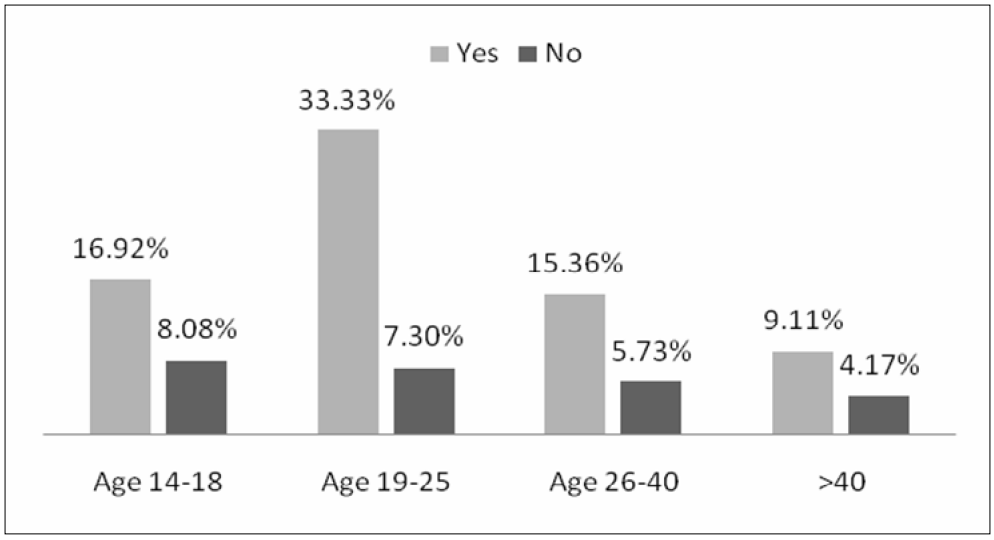


Figure 2. The percent of Smartphone users reported to age groups.

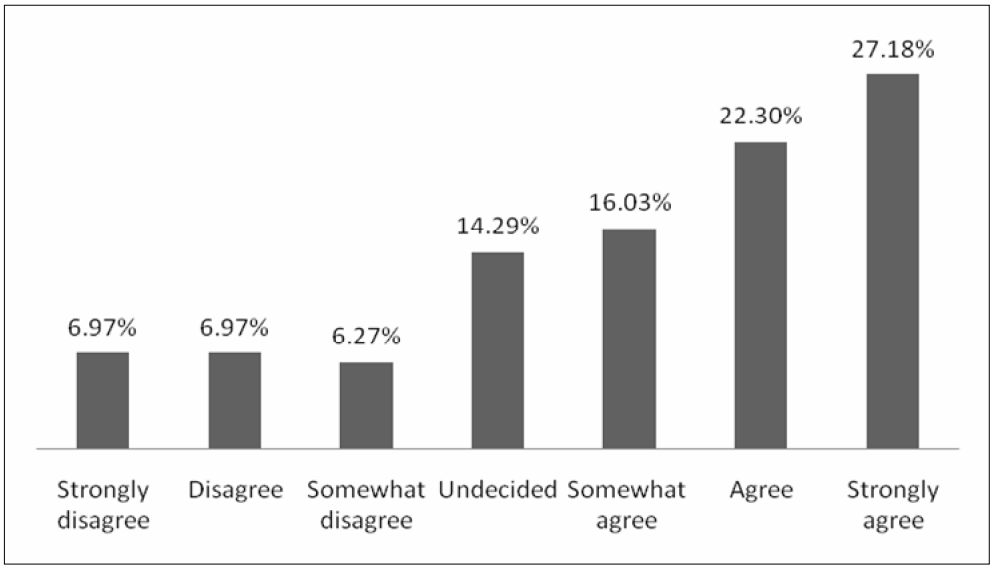


Figure 3. Ranking scale for the affirmation "I download applications for my mobile phone".

The second step to determine the primary target group is to determine the most vulnerable persons to natural disasters based on the lack of knowledge on risks and adequate behavior. Respondents were asked to rank on a scale from 1 to 7 how strongly they agree or disagree with the statements presented in Table 1. The results revealed that the older the respondent, the more knowledge he or she possessed on the below-mentioned topics, except the first aid knowledge, where p-value ($p = 0.029$) indicated that there was no association between age of the respondent and the level of knowledge (Table 1).

It is interesting that besides the fact that persons of age between 14 and 18 posses the least knowledge about the mentioned topics, many of them consider that they need no future information about natural disasters and appropriate behaviors in order to feel safe. That means that about 6% of the persons of the age of 14-18 are not even aware of their lack of knowledge, a percent much smaller in the case of older persons. Therefore they are considered to be the most vulnerable group to natural disasters.

The second most vulnerable group to natural disasters includes persons of the age between 19 and 25. They are aware of the lack of knowledge that they have, but the problem here is that they showed the least interest to inform themselves on these topics

out of personal motivation – only 39.7% of them agreed with the statement "in the last 3 years I informed myself voluntarily about natural disasters and appropriate behavior during such situations", while 46.8% of the 14-18 age group, 55.5% of the 26-40 age group and 45.1% above 40 years acknowledged this fact.

Table 1

Test statistics and ranking of knowledge depending on the age

| *Questions related to risk perception at individual level* | *Chi-Square* | *Asymp. Sig./ p-value* | *Age groups* | *N* | *Mean Rank* |
|---|---|---|---|---|---|
| I think I have good knowledge about the natural hazards that may occur in the environment where I live. | 23.353 | 0.000 | 14-18 | 96 | 157.60 |
| | | | 19-25 | 156 | 186.18 |
| | | | 26-40 | 81 | 219.96 |
| | | | > 40 | 51 | 233.90 |
| | | | Total | 384 | |
| I think I have a good knowledge of appropriate behavior in the event of natural disasters. | 16.808 | 0.001 | 14-18 | 96 | 168.51 |
| | | | 19-25 | 156 | 181.48 |
| | | | 26-40 | 81 | 221.14 |
| | | | > 40 | 51 | 225.89 |
| | | | Total | 384 | |
| I think I have a good knowledge of first aid. | 8.993 | 0.029 | 14-18 | 96 | 167.79 |
| | | | 19-25 | 156 | 191.88 |
| | | | 26-40 | 81 | 214.75 |
| | | | > 40 | 51 | 205.59 |
| | | | Total | 384 | |
| I believe that I know what to include in an emergency kit. | 19.666 | 0.000 | 14-18 | 96 | 154.20 |
| | | | 19-25 | 156 | 197.80 |
| | | | 26-40 | 81 | 225.49 |
| | | | > 40 | 51 | 195.99 |
| | | | Total | 384 | |

If p-value < 0.05, this marks a statistically significant association. Kruskal-Wallis test was used.

In conclusion, according to the questionnaire data, the primary target group is composed of persons between the ages of 14 and 25. This represents a group more vulnerable to natural disasters than older persons because of the lack of knowledge on risks and adequate behavior. At the same time, this group is likely to benefit the most from such an app as they download more frequently all kinds of apps on their personal phone. Given the fact that some of them are not aware of the lack of knowledge and others showed little interest in self-education in the field of natural disasters, it is very important that the information within the application is projected in an interactive manner, to capture the interest of this particular age group. The promotion of the app has to be well established as well. For example, promoting the app in high schools and universities can reach out directly to the proposed target group.

***Expectations regarding a Smartphone application designed to enhance disaster risk communication***. In this section more aspects were considered, such as who would be the optimal developer for such an app, what kind of natural disasters should be addressed within the app and what aspects of an app are considered important by the respondents.

*Optimal developer.* Trust is a very important aspect in disaster risk communication and a recent study showed that Romanian citizens considered the General Inspectorate for Emergency Situations to be the most trustworthy in terms of information source on disasters (Kozma et al 2013). But in this case the majority of the respondents thought that as long as the application is functional it did not matter who developed and designed it. Other opinions were that the optimal developer would be research centers from the field of disaster management or the competent authorities. Few considered ONGs from the field of disaster management as an optimal developer (Figure 4). Others suggested good possible developers would be the IT companies.

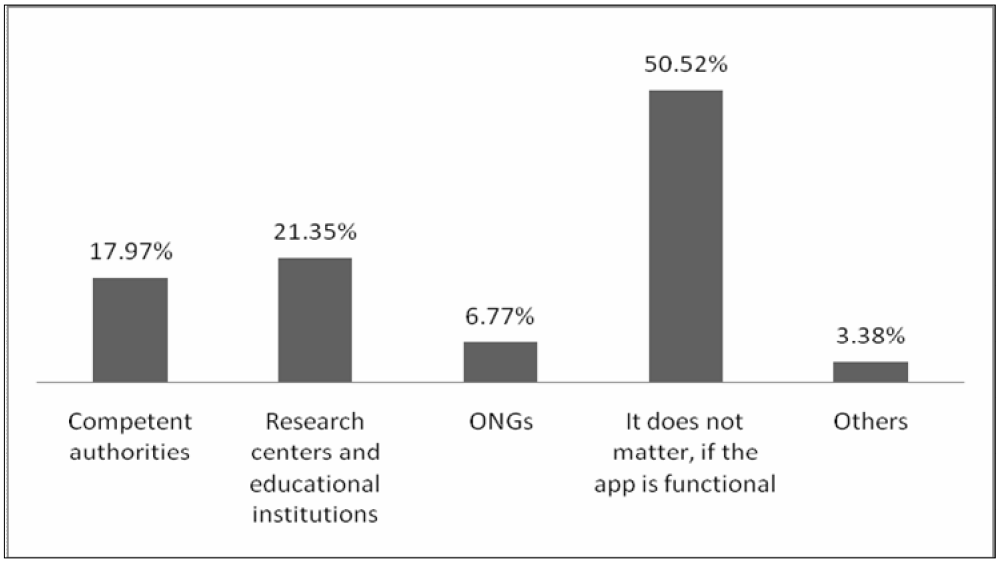


Figure 4. Optimal developer of the app in disaster risk communication.

*Important aspects.* Regarding the informational content, the majority of the respondents strongly agreed that such an application should address all kinds of natural disasters not just those specific to Romania (Figure 5).

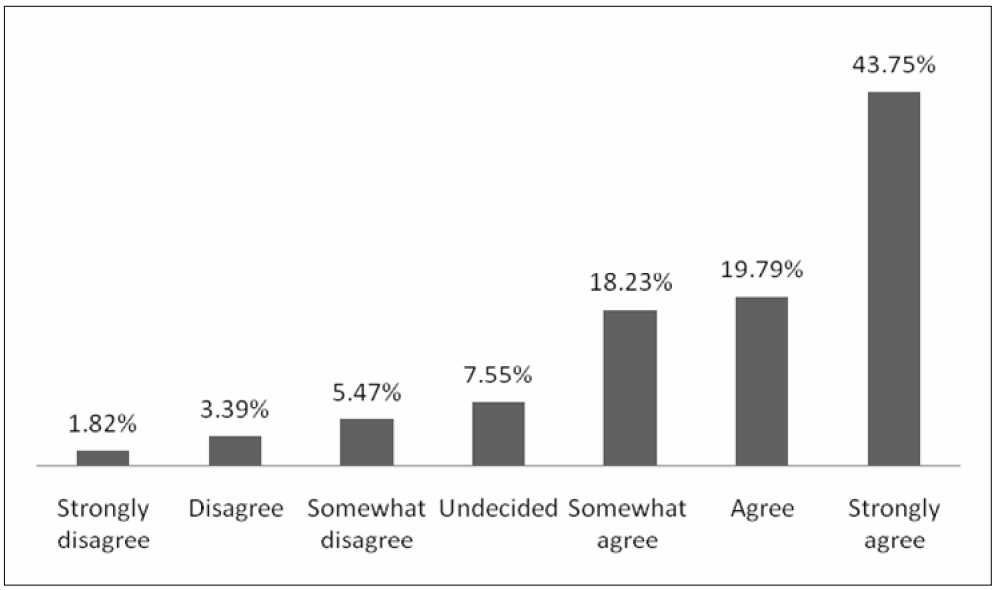


Figure 5. Ranking of the statement "Such an application must include all existing natural disasters".

In order to find out which aspects are considered by the respondents important to include, they were asked to choose from a list of aspects, presented in Table 2. The most important elements were considered those encouraging specific behaviors in case of an emergency situation: 77.1% of the respondent opted for information on proper behavior in case of a natural disaster and 83.3% opted for Information about first aid. Elements which provide the user the feeling of safety during a disaster were second in the ranking: 82% of the respondents considered important to add GPS tracking functions to the app and 75% would like to be able to send S.O.S. signals. Another aspect considered important included the visual representations of risk and hazard in form of maps. Less interest was shown for interactive elements (quizzes, checklists) or direct links to social media sites.

Table 2

Absolute frequency of positive responses and their percentage for each aspect considered important

| *Aspects* | *Affirmative responses* | *%* |
|---|---|---|
| Information on proper behavior in case of a natural disaster | 296 | 77.1% |
| Information about first aid | 320 | 83.3% |
| Interactive quizzes to check knowledge | 130 | 33.9% |
| Ability to send S.O.S. signals | 288 | 75% |
| Checklists | 141 | 36.7% |
| Direct links to useful web sites | 154 | 40.1% |
| Direct links to useful social web sites | 88 | 22.9% |
| Integration of hardware elements | 141 | 36.7% |
| Integration of interactive maps | 212 | 55.2% |
| Incident reporting | 181 | 47.1% |
| GPS tracking | 315 | 82% |
| Volunteering platform | 179 | 46.6% |

Taking into consideration that, as discussed earlier, the primary focus group for such an app is composed of the persons of the age between 14-25, it has to be noted that in some cases there is a significant difference between the age of the respondent and the elements they considered important. Younger respondents opted more frequently for interactive elements, such as quizzes and checklists and for the integration of direct links to social web sites, as opposed to older respondents who preferred the elements that encouraged specific behaviors in case of an emergency situation and provided the user the feeling of safety during a disaster (Table 3). Therefore, including these elements, even if at first they do not seem important, should be a smart thing to do, in order to directly address the primary target group and answer their specific needs.

Regarding the cost of such an application, the majority of the respondents (24.22%) were undecided whether they would be ready to pay for such an application or they thought that such an application should be free. An additional remark was that such an application should not contain any publicity.

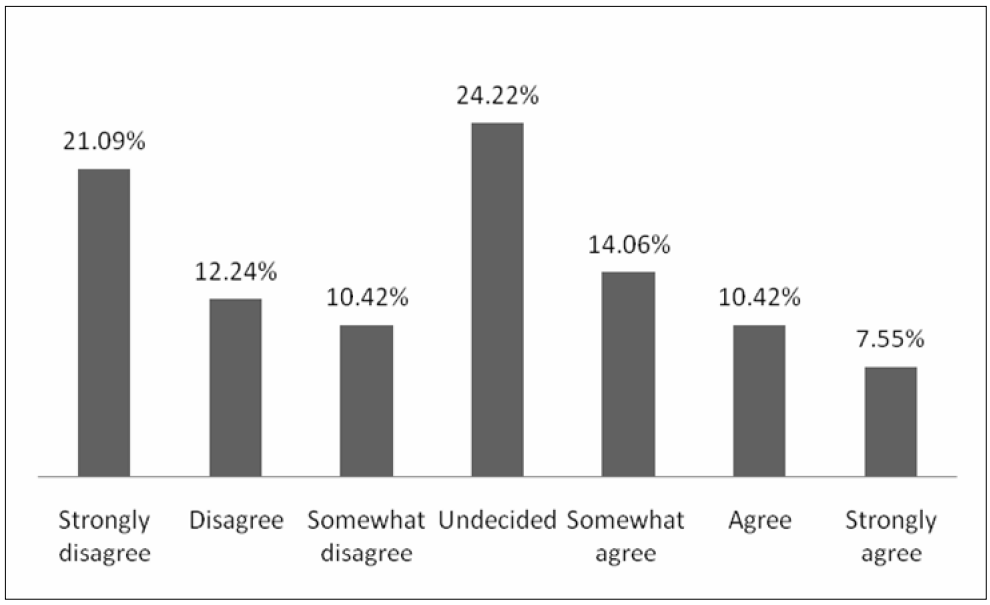


Figure 6. Ranking of the statement “I would pay to download such an application”.

Table 3

Relation between respondents' age and preferences for the aspects considered useful

| *Aspects* | *All (384 pers.)* | *Age 14-18 (96 pers.)* | *Age 19-25 (156 pers.)* | *Age 26-40 (81 pers.)* | *>40 (51 pers.)* | *Asymp. Sig./ p-value* |
|---|---|---|---|---|---|---|
| Information on proper behavior in case of a natural disaster* | 12.1% | 11.9% | 11.7% | 12.4% | 13% | 0.008 |
| Information about first aid * | 13.1% | 12.9% | 13.8% | 12.4% | 12.4% | 0.0001 |
| Interactive quizzes to check knowledge* | 5.3% | 7.2% | 6.2% | 3.4% | 2.8% | 0.002 |
| Ability to send S.O.S. signals* | 11.8% | 11% | 12.1% | 11.5% | 12.4% | 0.002 |
| Checklists | 5.8% | 6.2% | 5.8% | 5.3% | 5.6% | 0.924 |
| Direct links to useful web sites | 6.3% | 6.4% | 5.4% | 6.9% | 7.7% | 0.118 |
| Direct links to useful social web sites * | 3.6% | 6.1% | 2.6% | 3.5% | 2.8% | 0.022 |
| Integration of hardware elements | 5.8% | 5.3% | 5.7% | 6.4% | 5.6% | 0.208 |
| Integration of interactive maps | 8.7% | 8.9% | 8.4% | 8.9% | 8.7% | 0.404 |
| Incident reporting* | 7.4% | 6.4% | 7.7% | 8.2% | 6.8% | 0.024 |
| GPS tracking* | 12.9% | 11.2% | 13.3% | 13.3% | 13.6% | 0.0001 |
| Volunteering platform* | 7.3% | 6.4% | 7.1% | 7.8% | 8.7% | 0.043 |
| Total | 100% | 100% | 100% | 100% | 100% | |

* indicates the existence of a statistically significant association between respondents' age and preferences for the aspects considered useful; p-value (p) < 0.05, marks a statistically significant association; Kruskal-Wallis test was used.

**Conclusions**. For a successful disaster communication, the public should be addressed in their own language. Therefore, developing a Smartphone application for disaster risk communication which targets the Romanian public could enhance disaster risk communication at national level. Study respondents acknowledged that a mobile application developed for disaster risk communication can be useful in different phases of the disaster management. According to the outcomes of the study, they considered that such an application could fulfill disaster risk communication functions, such as: raising awareness regarding existing risks; encouraging protective behavior; informing vulnerable actors in order to promote the acceptance of risks and their management measures; informing users on the appropriate behavior during a natural disaster; warning and alarming before and during an emergency situation; and providing support after a natural disaster to the affected community.

In order to meet the needs of potential users, the authors identified several design elements and informational content considered important by the study respondents. First of all, information within the application has to be structured in short sentences that are easy to understand. The app should approach all types of disasters, not just those specific to Romania. It should include specific elements to encourage protective behaviors, as well as components which give the users a feeling of safety during a disaster. Other elements to be included in the app aim to help the facile visualization of information, to make the application interactive, user-friendly and easy to use. Application has to be free and should contain no publicity.

The current research is the first step in developing a Smartphone application to enhance natural disaster risk communication and education in Romania. The outcomes of this questionnaire analysis include the identification of the primary target group for the application and some aspects considered useful by the respondents. Further studies intend to pursue the following most important aspects such as initiating a dialogue with representatives of the primary focus group, identifying possible stakeholders, and developing key messages.

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Received: 29 July 2014. Accepted: 30 August 2014. Published online: 15 September 2014.


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How to cite this article:
Meltzer M., Bican-Brişan N., Ştefănescu L., 2014 Smartphone applications and their potential to enhance natural disaster risk communication and education in Romania. AES Bioflux 6(3):223-234.

Annex 1

**Online questionnaire: DO IT SMART - risk communication plan for natural disasters through Smartphones**

**General questions**:

1. What is your gender?

□ Male □ Female

2. What is your age?

3. What are the latest studies completed?

□ Primary school
□ High school
□ University degree
□ Post graduate

4. Are you a Smartphone user? (If you check no, skip the following questions)

□ Yes □ No

**Questions about Smartphone users' behavior**:

Indicate to what extent you agree or disagree with the following statements on a scale of 1-7: 1 - Strongly disagree; 2 – Disagree; 3 - Somewhat disagree; 4 – Undecided; 5 – Somewhat agree; 6 – Agree; 7 - Strongly agree.

5. I use my Smartphone every day besides conversations and messages.

6. I download applications for my mobile phone.

7. When I download a mobile application, I take into account its rating.

8. When I download a mobile application I take account of its developer.

9. I usually download mobile applications recommended by friends or other acquaintances.

10. I look on the internet for mobile applications which meet my specific requirements.

**Questions about perception and knowledge of natural hazards at individual level**:

Indicate to what extent you agree or disagree with the following statements on a scale of 1-7: 1 - Strongly disagree; 2 – Disagree; 3 - Somewhat disagree; 4 – Undecided; 5 – Somewhat agree; 6 – Agree; 7 - Strongly agree.

11. I think I have a good knowledge of the natural hazards that may occur in the environment where I live.

12. I think I have a good knowledge of appropriate behavior in the event of natural disasters.

13. I think I have a good knowledge of first aid.

14. I believe that I know what an emergency kit should include.

15. I believe that I know the warning signals in case of disaster.

16. In the last three years I have participated to trainings/courses on appropriate behavior in case of natural disasters.

□ Yes □ No

17. In the last three years I have received informative materials on appropriate behavior in case of natural disasters.

□ Yes □ No

18. In the last three years I have informed the personal motivation of natural disasters and the appropriate behavior.

□ Yes □ No

19. I think I need more summarized information in the field, so that I feel prepared for any natural disaster.

□ Yes □ No

**Question on a smartphone application developed for risk communication and education**:

20. I think the following aspects would be important to include in a smartphone application developed to enhance natural disaster risk communication and education:

□ Information on proper behavior in case of a natural disaster
□ Information on first aid
□ Interactive quizzes to check knowledge
□ Ability to send S.O.S. signals
□ Checklists
□ Direct links to useful web sites
□ Direct links to useful social web sites
□ Integration of hardware elements
□ Integration of interactive maps
□ Incident reporting
□ GPS tracking
□ Volunteering platform

21. Who do you think would be the best developer of such an application?

□ Competent authorities
□ Research centers and educational institutions
□ ONGs
□ It does not matter, if the app is functional.
□ Others

Indicate to what extent you agree or disagree with the following statements on a scale of 1-7: 1 - Strongly disagree; 2 – Disagree; 3 - Somewhat disagree; 4 – Undecided; 5 – Somewhat agree; 6 – Agree; 7 - Strongly agree.

22. Such an application should include all types of existing natural disasters.
23. It is enough that the application addresses only natural disasters specific to Romania.

24. Risks should be indicated on an interactive map of Romania, divided on counties.

25. Information on disasters should be gathered in a package with other types of information, such as tourism.

26. Information on disasters and appropriate behavior disaster in the form of a game would be more effective in the learning process.

27. I would pay for such an application.