"My Soil Protection App" - A Mobile-Based Dedicated Environmental Information System - from a User Testing and Validation Perspective

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Abstract: *As part of the mobile application development and improvement process, evaluation and feedback along the way are essential elements for any software developer; they can provide him/her with information about both the value that the application has from the perspective of other users, as well as information that needs to be revised or removed from the interface and the functionalities that the application proposes. In this sense, for the mobile application "My Soil Protection App", created in our regime, we proposed to carry out an analysis of the design, interface, and functionalities; thus, through a form with permissive access, created in the open-source variant of the Survio® application we provided access through a link placed on the KnowledgeBase® platform to users both to the application itself and to a questionnaire.*
The questionnaire is composed of 15 questions, to which are added 3 prompts for the personalization of the respondents, to see to what extent the users can test and validate the elements contained in the application. The 15 questions are grouped into 4 classes of interest, numbered from A to D, each analyzing the design, interface, functionalities, and specialist contents included in the application. As a result of the analysis of the 39 responses received from the users (18-28 years), we concluded that the mobile application "My Soil Protection App" is bold and well-received by the users, who greatly appreciate the design elements and the friendly interface, the clearly explained functionalities and the contents that do not require further additions.

Keywords: *Comparative study, mobile applications, MIT App Inventor®, soil protection*

1. Introduction

Mobile applications dedicated to monitoring and protecting soil resources - as mature fruits of environmental scientific research and Environmental Informatics [1-3] - are increasingly common in the work of farmers, ecologists, pedologists, academics, and users all around the world [4,5]. What makes them popular among regular users is the possibility they offer in acquiring, saving storing, and processing environmental data from the field [6]. To see if such an application meets the requirements of ordinary (non-specialist) users, we set out to analyze the mobile application "My Soil Protection App" developed in-house regime using the MIT App Inventor® platform [7,8].
The quantification of the possibilities of acquiring, processing, saving, and storing data from the field, which the dedicated applications offer for mobile devices with the Android operating system, was carried out starting from the analysis of the design, interface, and functionalities proposed by the application in this regard taken into analysis.
As the tendency to Environmental Information Processing Systems [9-12], the application was subjected to a particularly important stage - through the lens of the feedback provided to the software developer, this stage is equivalent to the validation of the application by users; this involves accessing, analyzing, and auditing the application by users to provide constructive feedback to improve the quality of the application.

2. Material and methods - the perspective addressed by current research

In this endeavor (of the application evaluation) [13], we used the free working version of the Survio® platform [14], which from personal experience provides superior options to other similar platforms - Google Forms®, Microsoft Forms®, HubSpot Forms®, Cognito Forms®, etc. - to create an evaluation and feedback form about the self-developed mobile application "My Soil Protection App" (see Fig. 1, and also Fig. 2 and Fig. 3), which has real implications through MIT App Inventor® in the soil sciences e- and mLearning, and in the protection of soil resources [15,16].

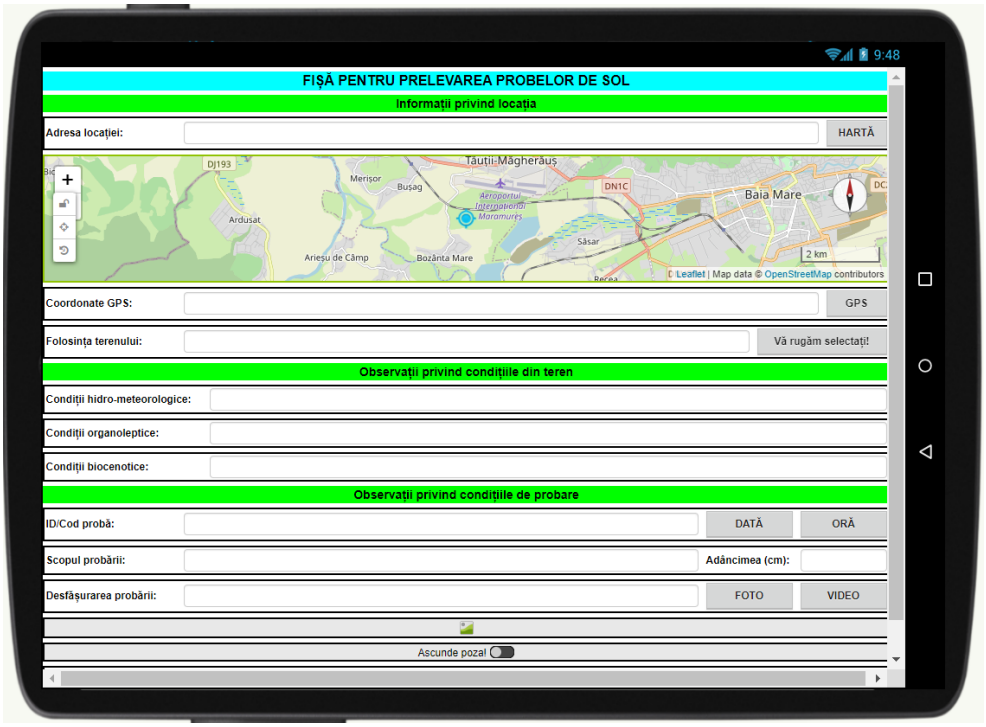


Fig. 1. The "Soil Sampling Sheet" interface where the user manually fills in the data acquisition forms

The questionnaire - associated with the account created through the institutional email address - was made available to the respondents through a permissive link, on the KnowledgeBase® platform [17], where the QR code for downloading and installing the application was also uploaded. The questionnaire in question includes:

- A welcome page that lets users know the purpose of the questionnaire;
  "Dear users,
  We invite you to fill in an evaluation and feedback form about the mobile application "My Soil Protection App", developed in-house. We note that your answers are necessary for me to improve the interface and functionalities of the application so that it is easily accessible and understandable to ordinary (non-specialist) users. Thank you for your time and answers!"
- A page that refers to «A. Evaluation of the general characteristics of the application (design elements and interface)», and contains 5 questions, for which only one answer variant can be chosen ("YES" or "NO");
  - "Does the application icon - represented by a magnifying glass and a soil profile - have an appropriate design about the name of the application (My Soil Protection App)?" [18];
  - "Is data about the version, structure, and purpose of the application presented and expressly provided in the «About the application» section?";
  - "The application contains a mini user guide in the «About the application» section?";
  - "Is data about the creator of the application and its ownership provided clearly?";
  - "Does the application allow identifying the creator and contacting him through social media platforms?" [19,20].

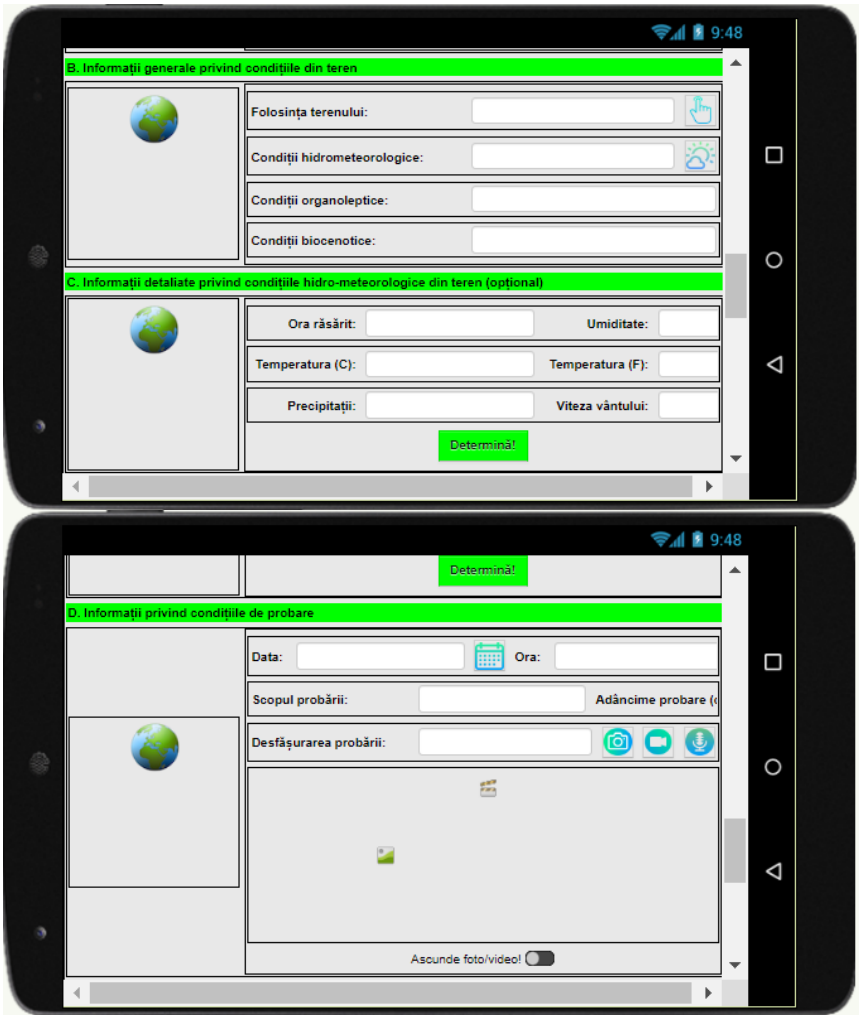


Fig. 2. The screens "B. General information on field conditions", "C. Detailed information on hydrometeorological conditions in the field (optional)" and "D. Information on testing conditions" with the acquisition of field data through the application interface

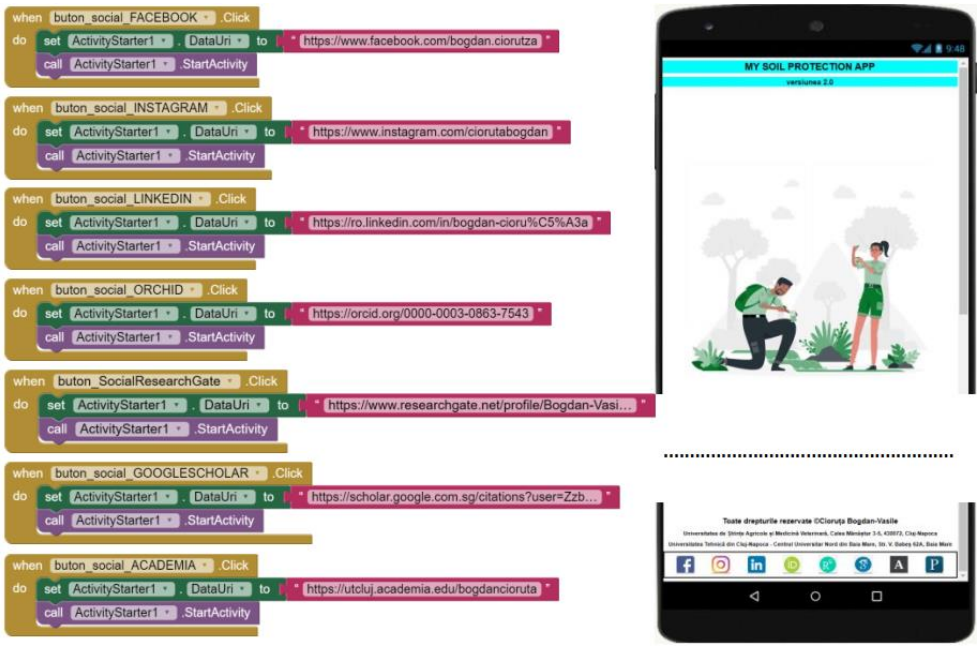


Fig. 3. Configuring and linking the application to various social media platforms (Facebook®, Instagram®, LinkedIn®, OrchID®, ResearchGate®, Google Scholar®, etc)

- a page that refers to «B. Evaluation of the specific characteristics of the application (interface and functionalities)», and contains 5 questions, for which only one answer variant can be chosen ("NO (0%)", "YES (1-25%)", "YES (26-50%)", "YES (51-75%) or "YES (76-100%)";
  - "Does the application propose a sufficient set of elements for characterizing the location of soil resources? (It is checked whether elements such as the name and address of the location, GPS coordinates, display of the location on the map, etc. are included and accessible)" [19];
  - "Does the application have a clearly defined structure (via menus), a friendly and easy-to-understand interface for the average user?" (It is checked whether elements such as labels and explanations, text boxes, checkboxes, and buttons, images, and gif animations, etc. are included and accessible)";
  - "Does the application propose a sufficient set of elements to characterize the soil profile in the field?" (It is checked if elements such as soil type, land use, data on texture, color, and temperature, data on organoleptic, biocenosis and meteo-climatological conditions, etc. are included and accessible, etc.)" [20];
  - "Does the application propose a sufficient set of elements for field data acquisition?" (It is checked whether elements such as text boxes, checkboxes and buttons for data acquisition are included and accessible)";
  - "Does the application propose a sufficient set of elements for saving field data? (Check if elements such as data save buttons, associated file types, and platforms - TinyDB®, File®, Firebase®, CloudDB®, DropBox®, Google Sheets/Drive®, etc) are included and accessible.
- a page that refers to «C. Evaluation of the structural elements of the application (specialized contents)», and contains 2 questions, for which only one answer option can be chosen: "NO (there is no repeated content)", "PARTIALLY YES (the content differs, but there are also common elements)" or "YES (contents different)";
  - "Does the application have specific content for each worksheet? (It is checked if the analyzed elements differ between worksheets)";
  - "Does the application contain explanations of the use of the elements for each worksheet? (It is checked if examples are included and accessible regarding how to operate the elements, especially text boxes and buttons)".
- A page that refers to «D. Proposals and recommendations for improving the application», and contains 6 requests for respondents, of which the first 3 are strictly related to the application:
  - "Choose a percentage where you think the worksheets fall developmentally" (Only one answer option will be selected for each worksheet (0-25%, 26-50%, 51-75%, or 76-100%);
  - "What elements do you think should be included in the application?", (where up to 1000 characters can be inserted), and
  - "Give the app several stars.", while the next 3 refer to "city of residence (county)", "occupation (age)" and "type and model of mobile device" used.

3. Results and discussions

Users of two specializations within the Faculty of Sciences (NUCBM-TUCN), namely Management (18 respondents) and Business Economics (21 respondents), aged between 19 and 28, participated in the questionnaire. Their distribution by age is faithfully reproduced in Fig. 4(a), while the distribution by place of residence and county is reproduced in Fig. 4(b). Also, regarding the type and model of mobile devices used in the analysis and evaluation of the application, the distribution of them is reproduced in Fig. 4(c).
According to the answers provided by the users to the first 5 questions (see Fig. 5), we noticed a reporting trend towards the answer variant "YES" (on average more than 35 favorable answers out of a total of 39), which certifies the fact that the application corresponds, the a little at the design level, the requirements of the average user:

- The application icon - represented by a magnifying glass and a soil profile - has a suitable design for the name of the application (My Soil Protection App);
- data regarding the version, structure, and purpose of the application are presented and expressly provided in the "About the application" section;
- the application contains a mini-guide for use in the "About the application" section;
- data relating to the creator of the application and its affiliation are provided clearly and expressly;
- the application allows identifying the creator and contacting him through social media platforms.

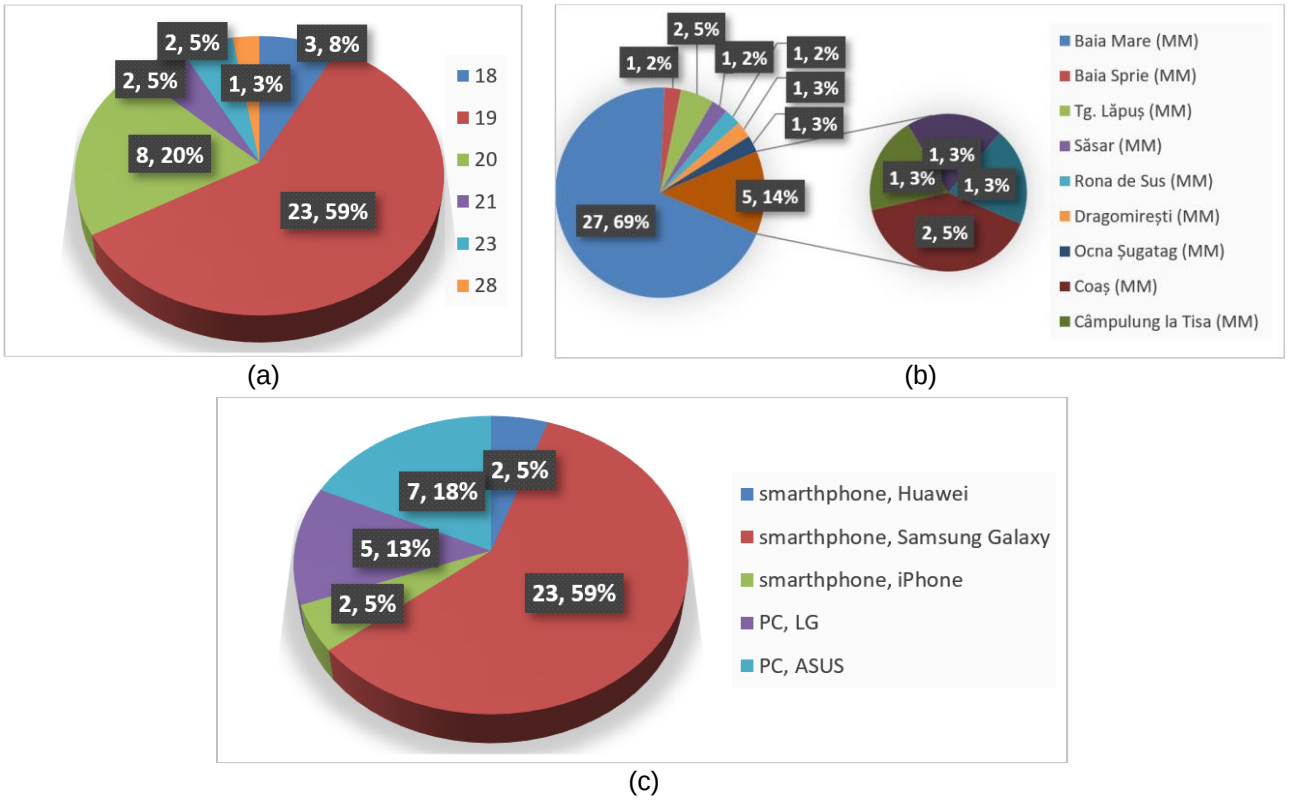


Fig. 4. Distribution of respondents by age (a), by the place of residence and the county (b), and by the type/model of mobile device used (c)

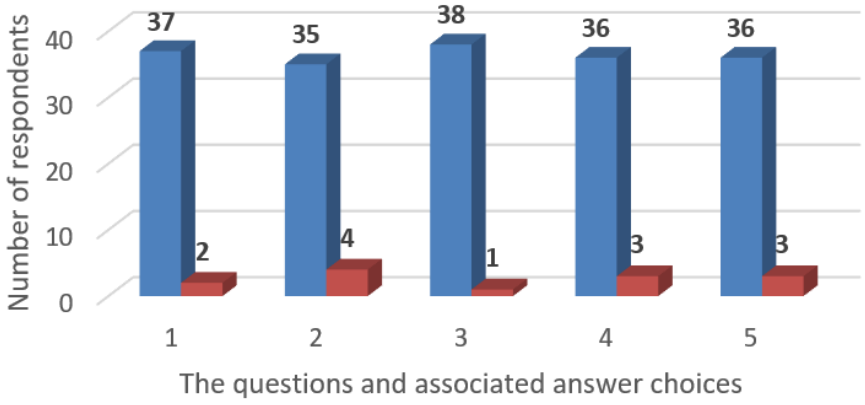


Fig. 5. Users' responses to section/category questions «A. Evaluation of the general features of the application (design and interface)»

Also, according to the answers obtained from the users (see Fig. 6), there is an upward trend towards the answer options "YES (51-75%)" - on average more than 10 answers for each question, respectively "YES (76-100%)" - on average more than 20 answers for each question.

Under these conditions, we can state that more than 50% of the respondents confirmed that the application: has a clearly defined structure (through menus), a friendly and easy-to-understand interface for the average user, proposes a sufficient set of elements to characterize the location of soil resources and their profile and characteristics, and proposes a sufficient set of elements for the acquisition, saving/storage, processing, and distribution of field data.

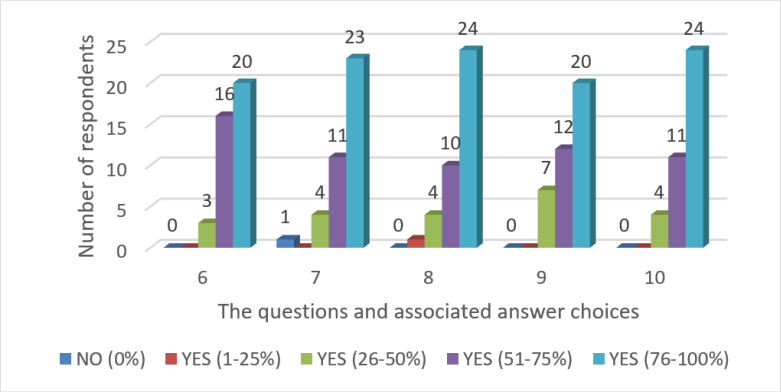


Fig. 6. Users' responses to section/category questions «B. Evaluation of the specific features of the application (interface and functionalities)»

Regarding the level of development of the worksheets proposed through the application menu, the users' answers show us (in Fig. 7, up) that the worksheets have content that differs, although some common elements are also found, which are repeated from sheet to sheet (on average over 15 answers for the option "PARTIALLY YES"/sheet, and over 19 answers for "YES"/sheet).
At the same time, regarding the explanations and indications of how to use the application elements, it can be seen from the users' answers (see Fig. 7, down) that there are on average more than 32 confirmations ("YES") for each worksheet; this aspect shows us that the application developer has made sure that the user has easy access to the documentation for using the text boxes and associated buttons.

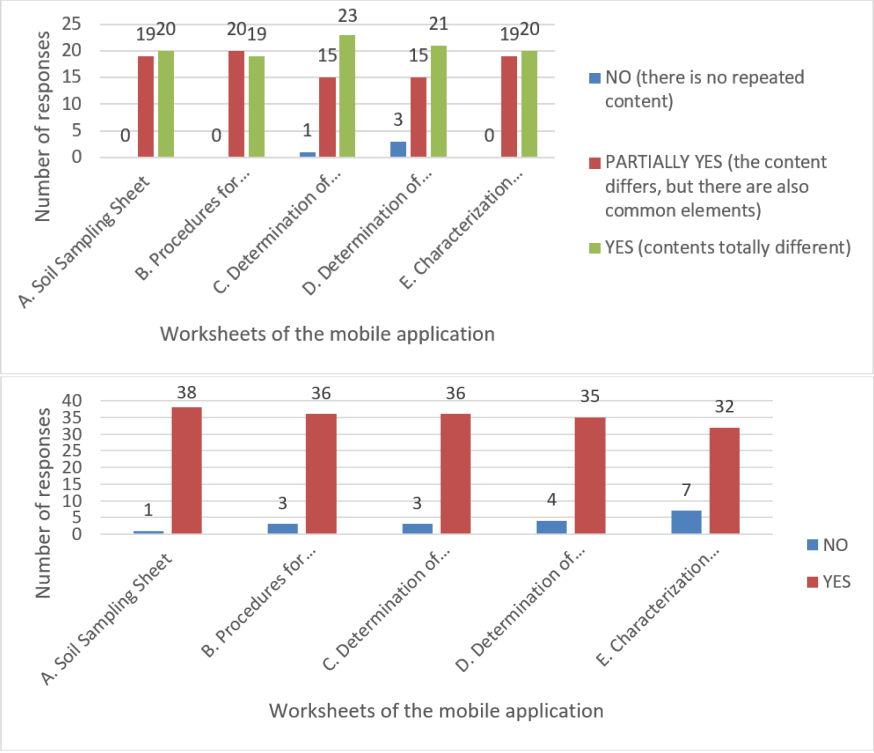
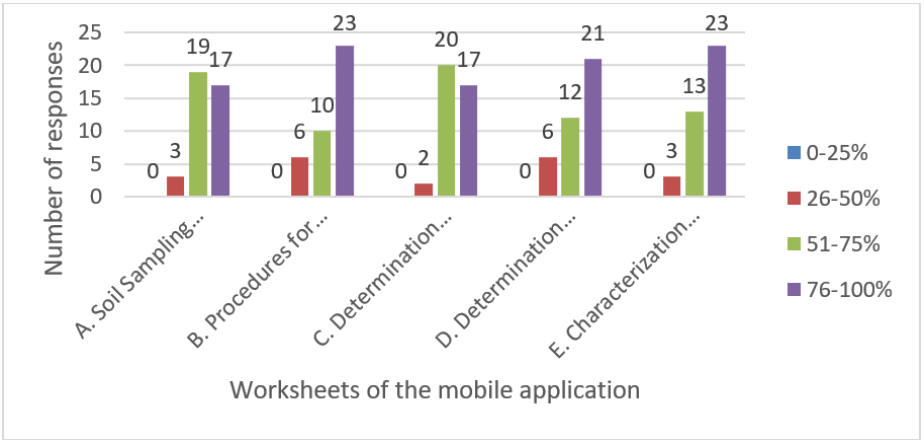
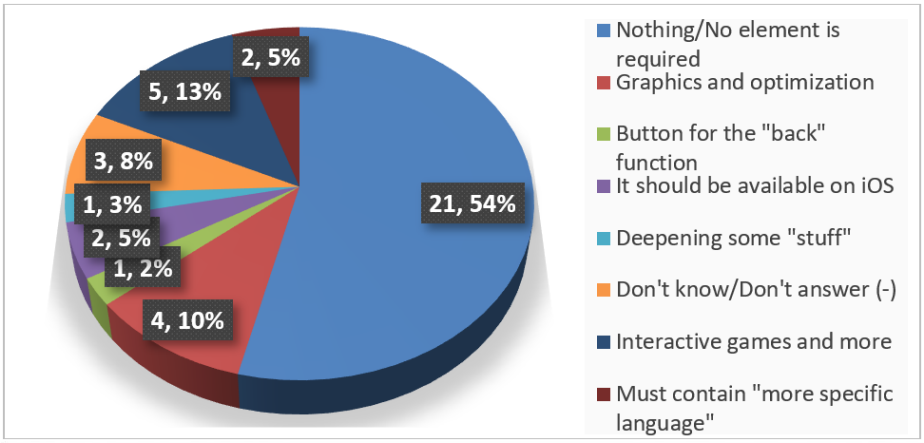


Fig. 7. Users' responses to questions in section/category «C. Evaluation of structural elements of the application (specialized contents)»

In the same context, the users' answers show us that the degree of development of the application is over 51-75% - on average over 10 answers/each worksheet of the application, respectively 76-100% - on average over 17 answers/each application worksheet (see Fig. 8); moreover, in terms of completing the application with other elements or adapting to the general audience, 54% of users' answers show us that "nothing/no element" is needed anymore, while 10% of users say that minor adjustments are needed.





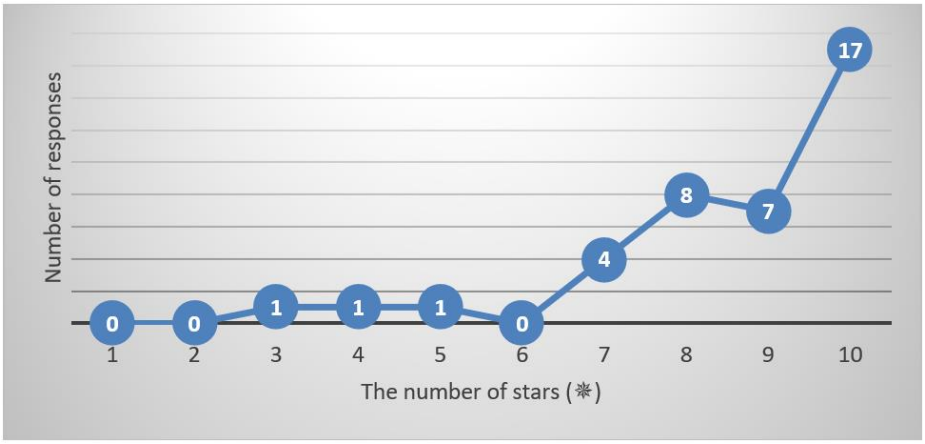


Fig. 8. Users' responses to questions in section/category «D. Proposals and recommendations for improving the application»

As a result of the users' answers, it can be noted that the application has specific content and contains pertinent explanations regarding the use of the elements for each worksheet, the worksheets being developed in the vast majority above 51-75%. In addition, referring to the whole application, in general, it can be noted that only one student each gave 3, 4, and 5 stars, 4 users gave 7 stars, 8 users gave 8 stars, 7 users gave 9 stars and 17 users gave 10 stars, which reveals a weighted average of 8.64 stars.

4. Conclusions, perspectives, and proposals

Third-party access to a mobile app (such as "My Soil Protection App") before the app "goes to market" is a vital process that can add value to the app itself (by changes and removals of design elements, interface, and functionality), but also new elements that can cover new requests from users. At the same time, we are glad that the self-made mobile application "My Soil Protection App" was analyzed and evaluated positively by the users, whose openness to such applications is as significant as possible.

Equally, through the lens of the feedback obtained, we are much more confident in our own decisions about the development scenarios of applications of this kind, testing the application making it possible to understand specific aspects that target not only the average user but also the implications of the application in relative to market requirements. In addition, we consider such an initiative (to analyze and evaluate the application) as opportune and urge all those who develop such dedicated mobile applications (not only for soil resource tracking) to take the time to test and validate the application and through non-specialist users; we believe that any constructive feedback is more than welcome, as the app ultimately manages to establish itself much more easily among the public.

Acknowledgments

We would like to thank all the users from the two specializations (Management and Business Economics) who, in the informatics class, under the auspices of anonymity, actively got involved and responded positively to the request to analyze and evaluate the mobile application entitled "My Soil Protection App", and to record the feedback through the questionnaire.

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