EVALUATING THE QUALITY OF EXPERIENCE OF A SYSTEM FOR ACCESSING EDUCATIONAL OBJECTS IN HEALTH

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ABSTRACT

In the area of primary health care, there is a high demand in Brazil of permanent education and qualification of professionals who work in this field. Besides, nowadays it is a consensus that education can be benefited by the use of mobile devices, especially due to the possibilities of browsing, use and of easy access to different resources. In this context, this article presents an evaluation experience of usability of a mobile system for the access to open educational resources in the area of health. The results point to the construction of a simple application and of to easy access to the objects available and are of utmost importance to their evolution in the aspect of user experience.

KEYWORDS

QoE; e-Health; Application, Education

1. INTRODUCTION

In Brazil, the health services are organized in assistance levels: primary (considered the users' preferential gateway in the health care services network), secondary (specialized services) and tertiary (hospital services). The primary health care is considered to be a set of actions, in the individual and collective spheres, which "comprises the promotion and protection of health, the prevention of dangers, the diagnosis, the treatment, the rehabilitation and the maintenance of health. And it is developed through the exercise of management and sanitary practices, democratic and participatory, in the form of team work, directed to populations from well delimited territories, for which they take sanitary responsibility. It must solve the most frequent and relevant problems in the territory" (Brazil, 2011).

When the technology to support health is applied nationally, it is an efficient way to universalize the access to health and education. The use of mobile applications, for instance, makes it possible promoting distance health actions and aims to: (i) expand the access to educational actions, both to workers and the assisted population, especially by using guidelines available in easy language, with elements of games (Marcos et al., 2006); (ii) increase the efficiency of the attendance in the health units; (iii) minimize the spontaneous demand in the hospitals; (iv) expand the service coverage; (v) enable the screening of medical consultations; (vi) reduce the waiting time between consultations; (vii) and make registrations of the services.

The use of mobile devices as learning tools in health tends to contribute to the reduction of social expenses, because it promotes the educational process in the field, during the professional practice, without the need of removing the professional from his work place for training and qualification (Rowe et al., 2007). This practice has been increasingly seen as a facilitator to the learning process in distance (Kneebone et al., 2008) (Marcos et al., 2006), especially in developing countries, due to the decentralization of the management of health services, which is common in those countries.

It can be noticed, therefore, that the use of mobile devices in health plays an important role in supporting health services, contributing, additionally, to the formation of human resources in the area, and enables the reach of services to countryside areas, by the application of telehealth, especially the tele-education.

Besides the educational aspects, the use of mobile technologies benefits and enhances, in the scope of professional qualification, the convergence of medias, exploring the diversity of resources in mobile devices. Thus, after this introductory section, Section 2 presents correlated works which reinforce the results achieved in the suggested solution. The application to support the offline teaching-learning, is presented in Section 3. Section 4 shows the process used to evaluate the system under criteria of quality and usability. Section 5 presents the results. Section 6 makes final considerations and presents ongoing activities.

2. RELATED WORKS

Some works deal with proposals of architecture and modeling of systems which meet the requirements related to connectivity and access to educational resources, whether via mobile applications or via web. The work of Marcos and other authors (Marcos et al., 2006), for instance, suggests architecture of access to repository of learning objects through mobile devices. Its motivation lies on the necessity of m-learning applications integrated to repositories. However, this architecture has not been fully implemented.

In the perspective of connectivity, Luz and Fonseca (Luz and Fonseca, 2013) presented a support tool to collaborative learning which enables the sending and storage of data between distinct devices even without internet. For this purpose, the concept of ad hoc networks is implanted, in which they depend only on the existence of devices with Wi-Fi boards which work as routers.

The work of Ferreira and Castro (Ferreira and Castro Jr., 2013), in turn, presents questions of synchronism, aiming to enable possible off-line access to educational resources in virtual learning environments. Even though the work does not focus on repositories, its relevance is justified by the architecture proposed, based on synchronization of files and database, designed for situations of instability in internet connection.

Another relevant aspect is the matter of recommendation of materials, strongly approached by Reis and Barrére (Reis and Barrére, 2014). In this work, it is proposed an architecture which enables a professor to provide contents for specific groups, as well as automatic recommendations of content based on characteristics of the user and context information.

It is worth highlighting that the other works bring some interesting applications which emphasize the importance of repositories of educational resources as support instruments to professional qualification. The proposal of the International Database of Educational Objects (Rodrigues et al., 2012) is one of them and brings a repository of educational objects to web environments, whose intent is to cover a unified space of access to materials produced by teaching institutions around the world. We should also emphasize, as a differential, the importance of processes of validation of contents before they are made available.

Another work, strongly related to this article, is the Collection of Educational Resources in Health – ARES (Brazil, 2015), whose aim is to provide educational resources produced by higher education institutions for health professionals. In the context of this article, ARES is used as a subcomponent of the system presented in this paper, which will be presented with details in Section 3 of this article.

3. DESCRIPTION OF THE SYSTEM

It consists of a system, which aims to provide educational resources to the health professionals. Thus, just as in any other service and system of telehealth, there is the need of assuring the authenticity of the available content, because such information directly implies attention to the life and health of patients and population, besides the other legal, ethic, and professional requirements which are common in telehealth in general (Newton, 2014). In addition to these requirements, there is also a demand of monitoring and controlling the access of users' health professionals and allowing that the resources continue available for offline access.

The objectives mentioned and the other functionalities (detailed in this section) meet two main reasons: (i) the requirements of an efficient system to provide educational resources to health professionals and (ii) respect the governmental and institutional requirements of the public entities involved (Brazil, 2010) (Brazil, 2011).

3.1 Description of the Architecture

The architecture of the system is based on a client-server model, with the presence of an intermediate server (MServer), playing a role of processing information for content on lending (present in the Collection of Educational Resources in Health – ARES) as part of the service, in addition to a connection with a federate network of servers (National Registry of Health Professionals – CNPS) to carry out the authentication in different databases. It is important to remember that the servers CNPS and ARES are independent and they are already operating (Brazil, 2015).

For the user, the system presents itself as a mobile application, in which allows the access to a set of educational resources in different basic formats (audio, video, texts, and images) available for download and offline visualization (in mobile stage). Thus, the access and utilization of synchronized resources allows the user a more homogeneous interaction with the structure, where the content presented tends to be the same, with the access being done from different devices. The mobile application was built on Android platform.

3.2 Description of the Functionalities

After requirements elicitation process, validation with health professionals invited, evaluation of visibility and prototyping, the main requirements (essential) and more urgent were prioritized, composing the initial set of functionalities of the point of access and of the system:

User authentication: The user must access the resources of the system and the contents of the application after a federative authentication.

Provision of educational objects: The system provides the educational objects in formats compatible with the mobile devices. The educational objects were, initially, audio, video, text (in PDF), and images.

Offline access: The system must allow the access to the downloaded resources in sessions without internet connection, even though there must be a session time for authentication during the offline use.

Search for educational objects: It must be possible to search for educational objects, both among those which are present online and those already downloaded by the user (in offline sessions). The search may be done by themes, formats, institutions, and others, in addition to search keywords.

Data synchronization: The same user must have access to the downloaded educational objects, even if the access is done from different devices.

Monitoring of access and use: The system must monitor the users' actions, the operation of the device, and the conditions of connection, thus allowing the system of recommendations to be built and improved. Aside from making it possible the production of statistics of use, for the purpose of governmental management in the context of public education and health.

Security of transmitted data (non-functional requirement): The transmitted data related to users, health professionals, both at the moment of authentication and in other transfers of protocol data, must be properly covered and encrypted.

Authenticity of information (non-functional requirement): Any resource which is accessed through the system must be originated from a reliable repository. Thus, it is possible to guarantee that the content presented was properly evaluated and authorized by a competent content-producer team.

3.3 Application's Interface and Use Cases

The application was developed and tested, aside from the main functionalities of the intermediate server, thus putting the system in a functional stage ready for evaluation. The server for tests of authentication with data was left in operation for security reasons. On the "Authentication" screen the user's authentication is done, with the professional's register data. If there is not a register, the user is directed to a registration page.

Figure 1. "My Archive" Screen

After the authentication, the user starts a session on "My Archive" screen, where he can view the objects already accessed which are present in the device. It is possible to filter the objects by format, run a search among the downloaded materials, filter by themes, see the details of an educational object (such as description, author, date, institution, and file size) and open the resources.

Figure 2. "UNA-SUS Archive" Screen

It is possible to browse to the tab "UNA-SUS Archive" (if there is an internet connection). The browsing can be done among the objects available for download in the repository. It is likewise possible to filter by themes and formats and run a search among the objects in the archive. The details of the objects are presented in this screen.

4. SYSTEM'S EVALUATION PROCESS

The proposal of this research, which has been developed and evolved, is divided into three big stages: conception, development, and evaluation. In order to guarantee the correct execution of the methodology proposed, the management is based on the practices of the PMBOK Guide (Project Management Body of Knowledge) (PMI, 2013) while the process of development of the solution is based on the agile framework Scrum: planning, dynamic and adaptive control based on the execution of the activities proposed.

The conception stage comprised bibliographic review, understanding of the problem to be tackled, gaps identified, and delimitation of the scope. A study of mobile applications applied to health, aiming at defining the proper architecture to the solution was carried out. The requirements were evaluated with the support of health professionals acting in primary healthcare. At the end of this stage, a concept proof was idealized and a prototype of the system was built for the initial and real analysis of the solution proposed.

The development stage comprised the selection of the technologies, platforms, and devices for the modeling of the requirements raised/defined. The intention was to adopt free platforms and technologies, because they favor the dissemination of the use in public services of health, and also facilitate the integration with other systems.

And finally the evaluation stage, which consists of (i) the capture of impression and experience of the users; (ii) the elaboration of simulations and empirical studies. The first part will be described in this article. The second experimental stage, in progress, is where the system proposed will be evaluated integrated to the module of decision, aiming at finding points of improvement and evaluate the impact of the practical application to the remote health and community services in real situations.

With the purpose of capturing the impression and experience of users, a test of usability was planned. Usability is a component of the acceptability of a system. Authors like Nielsen and Sommerville (Sommerville, 2010) (Nielsen, 1993) affirm that the acceptability is a characteristic of the system, which refers, basically, to informing if the system is good enough and meets the specifications of the users. Nielsen (Nielsen, 1993) presents the usability as composed of five components: Easiness of Learning, Easiness of Memorization, Efficiency in use, Few Errors, and Subjective Satisfaction.

The tests of usability for mobile applications are done in laboratories or in field. The tests in laboratory normally use simulators or the device itself. It is important to register that they are less expensive, but in contrast they come up short of the expected, because they do not use the applications in a real environment with access via mobile operator, for instance. In order to verify if the components of usability were met, measurements were defined, such as: time users take to complete the tasks and number of errors in the execution of tasks.

4.1 Capture of Impression and Users Experience

For the evaluation of the application and of the continuous actions, the following indicators were defined: (1) **Learning**: evaluation of the participants profile (players involved) in the use of the technological platform, based on structured surveys and interviews; (2) **Quality of the learning objects**: continuous evaluation of the insertions of technology from the point of view of the population directly favored; (3) **Quality of the system**: evaluation of the system, in such a way to define points of improvement, especially in aspects related to the usability, in other words, if the learning object in the mobile system is easy to be used.

In the evaluation of the application, we considered: a) Performance: aspects related to the minimum requirements of hardware, because of the product lightness; b) Connectivity: it will access repository of scenarios and data of the user for the synchronization and also in offline mode; c) Usability: the scenarios will be for the use in a self-instructional way; d) Portability: capacity of usage in different mobile devices, whether in smartphones or tablets.

The process of capturing of the user's impression and experience happened according to the following flow of activities:

1. Survey Application – Intending to identify the profile of the participant, under aspects related to the use of technologies and social media, the survey, composed of four questions subdivided in up to five items each, was applied.

2. Orientation to the User – The second step was represented by orientation to the user, in order to contextualize the applicability of the system.

3. Execution of The Task List – After the orientation, the user received a list of eight tasks which should be accomplished and in any time questions may be reported.

4. Evaluation of the Test – In this activity, after the accomplishment of the task list, the user was invited to evaluate the way the tests were carried out. Questions related to the easiness of use, disposition and organization of information, layout of the screens presented, nomenclature, messages of the system, and assimilation of the information tackled were numbered. At the end, the user presented a general impression of the test, if it was Interesting or Dull.

5. Suggestion of Improvement and New Requirements – The last activity had the support of the participants, in the sense of suggesting new requirements and improvements to the application.

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4.2 Elaboration of Simulation and Empirical Studies

The set of activities related to the evaluation of the application, in real situation, is in the final stage of planning. The evaluation will be a systemic and a continuous process which will involve: (i) Continuous evaluation of the learning objects produced and of the professionals involved in the execution of the usage scenarios; (ii) Self evaluation of by the students and professionals involved; (iii) Evaluation of the mobile technology used, emphasis on the impact of its use within the educational and assistance contexts.

The team of execution will be responsible for the evaluation of the application, encompassing the analysis of the technologies, as well as the educational resources available and accessed. The evaluation of the system will be done during and after the provision of learning objects, aiming at making adjustments and improvements.

5. RESULTS OF THE EVALUATION

In this section, the results related to the execution of the activities of capture of impression and experience of users will be presented, according to what was presented in the subsection 4.1., items 3 and 4, Execution of the Task List and Evaluation of the Test, respectively.

A set of 7 (seven) professionals, being 2 physicians of family health, 2 professionals in information science, and 3 professionals of information technology participated in the test. The professionals were guided to execute the following tasks:

- Task 01 – Initiate the application;
- Task 02 – Run authentication;
- Task 03 – Identify if there is any video in "My Archive";
- Task 04 – Download from UNA-SUS an audio object;
- Task 05 – Access additional information of a text object in "My Archive";
- Task 06 – Play the downloaded audio object;
- Task 07 – Find the theme "Children's Health" in "UNA-SUS Archive";
- Task 08 – Filter the theme "Children's Health" by audio format.

During the execution the time of execution of each task, the errors made in the execution were observed through filming and filling of forms. The average of time spent in the execution of each task is presented in Figure 03. Worst time: 204 seconds (task 4), best time: 54 seconds.

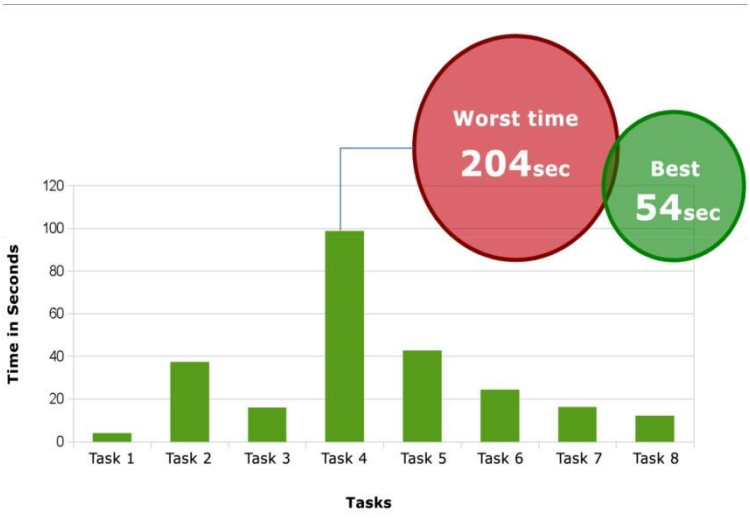

Figure. 3. Average of time spent in the execution of task

Table 1 brings a view of the quantity of errors made by each of the 7 participants in the execution of the tasks.

Table 1. Quantity of errors per execution of tasks by professional

	Tasks							
Users	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
User 1	0	-	0	1	1	0	0	1
User 2	0	-	0	2	1	0	0	0
User 3	0	-	0	1	0	0	0	0
User 4	0	0	0	0	0	0	0	1
User 5	0	1	8	-	5	1	-	-
User 6	0	0	0	3	1	0	0	0
User 7	0	0	0	4	0	0	0	0

Task 4 appears to be the most complex, because it presented the largest number of errors made per participant. In Figure 3 we can observe that task 4 had the longest time of execution, and it may be a consequence of the errors made during the execution. At the end of the accomplishment of the task list, the participants were invited to evaluate the system. The results are presented in Figure 4. Best score: 5, Worst score: 0.

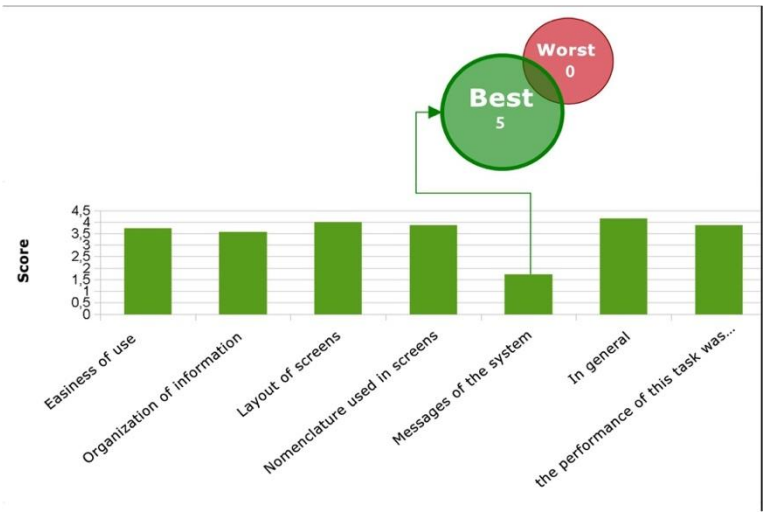

Figure 4. Evaluation of the System by the Participants

In general, the participants emphasized, as positive aspects, (i) the simplicity of the application; (ii) clear and simple layout; (iii) the alternation between "UNA-SUS Archive" and "My Archive"; and (iv) quick view of the themes. Difficulties were observed and reported during the execution of the task list. The most recurring were (i) the functionality "return" did not work; (ii) canceling of download of educational objects/resources; and (iii) exclusion of files initially downloaded to the device.

Based on these results, actions of improvement to the application were defined and are were executed. Especially questions related to (i) the standardization of the search area of educational objects/resources – using Google standard and material design; (iii) the cancelling of the functionality of download; and (iii) the sending of messages of loading objects in the application.

6. FINAL CONSIDERATIONS AND ONGOING ACTIVITIES

This paper presented an application developed initially for Android system, whose object is providing educational resources and objects, in offline mode, to health professionals. The article brings an account of an experience acquired during the execution of tests of usability of the application in laboratory.

The results obtained were very interesting and contributed greatly to the evaluation of the functionalities and usability of the system. Indeed, new ideas were captured for the improvement of the graphic interface. The simplicity of the application was considered one of the most relevant aspects, reinforcing the idea that browsing must be as simple and intuitive as possible.

The application was evolved according to the results taken from the evaluation presented in this work. Thus, improvements in the interface with the user are were implemented. Besides, the application is going through functional adjustments, the most important one being the possibility of taking courses in offline mode.

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