The Performance of Mobile Devices Running HTML5-designed Learning Objects

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Abstract— This paper presents a research study planned to verify the compatibility of Learning Objects, designed in HTML5, with the three major mobile operating systems: Android, iOS and Windows Phone. The research project has been structured in four steps: how to perform, chosen people, assign devices and run, analysis of results.

The beta testing activities involved a group of 20 users divided into two main categories and the devices were 35 (20 smartphones and 15 tablets) on all mobile operating systems currently on the market.

The Learning Object used on mobile devices is a Business Game based on Change Management contents.

In the end, the goal was to verify the "HTML5 vs device" adaptability and identify the device that returned the best results with regard to various parameters considered.

Index Terms — e-learning, mobile learning, e-learning usability, HTML5.

I. INTRODUCTION

This research paper describes a two faces project: an HTML5 Learning Object development project and a mobile learning verifying project.

As we all know, the HTML5 is a markup language for designing web pages, published as a W3C Recommendation of October 2014.

HTML5 development is started from the Web Hypertext Application Technology Working Group Working Group (WHATWG) (founded in 2004 by developers belonging to Apple, the Mozilla Foundation and Opera Software) that is both an objective to design specifications for the development of web applications, focusing of improvements and additions to HTML and related technologies.

The new features introduced by HTML5 compared to HTML4 are aimed mainly at improving the decoupling of structure, defined by the markup, yield characteristics (font, color, etc.), defined by the style guidelines, and content of a web page, as defined by real text. Besides the HTML5 provides support for local storage of large amounts of data downloaded from the web browser, to enable the use of web-based applications (such as Google mail boxes or other similar services) even in the absence of Internet connection [1].

“Mobile learning” (M-learning) is a blend derived from mobile and learning, means learning using mobile devices such as PDA, mobile phone, digital audio players, digital cameras, voice recorders, etc.

The rapid growth of communications technology and information technology makes it possible to develop new forms of education/training. The use of mobile devices by students today makes available e-learning contents more reachable.

In general, mobile learning can be considered a form of training or study that occurs when a student interacts through mobile devices [5].

In this research project, students used mobile learning devices to enjoy "just in time, just for me" business game, in HTML5 standard, wherever they need it.

The Business game was named “Savana e Bistecche” (Savana and steaks) based on “change management” contents. The Game was developed by Osel Srl (www.osel.it) an Italian e-learning company developing business games for training in medium and big firms.

II. THE PROJECT

The planning of the project has been structured in four steps:

a) first step, the group established how to perform the test on the mobile devices and, very important was the use the stock browser of the mobile operating systems, so as to obtain valid results on a large scale and cross platform. Besides, the group identified the versions of the various OS mobile to use: Jelly Bean, Kitkat and Lollipop for Android; 8.0 and 8.1 for Windows Phone; 7.0 and 8.0 for iOS;

b) second step, the group chose people to be involved in the activity of testing: twenty-five experts in the chosen field, within the staff of the main italian websites related to mobile devices; five non-experts in the filed, representing the prototype of common user can interface with learning objects in HTML 5. Subsequently, the group identified the mobile devices to be used during the test, that are fifteen smartphones and fifteen tablets;

c) third step, the group assigned a mobile device to each person, and everyone has performed a learning object through the browser of the mobile device attached. This part has had duration of sixty days, with weekly the report;

d) fourth step, the group combined the results from tests, which have certified the compatibility of learning objects in HTML 5 with browsers of Android, iOS and Windows Phone.

III. THE BUSINESS GAME

In virtual games, developed over several decision-making levels, the learner is fully absorbed in an environment created specifically to monitor and evaluate its decision-making performance.
The business game is the most effective method for transmitting content and at the same time monitor the results.

The design, developed by Osel, includes the use of elements borrowed from the games and game design techniques in contexts and environments inspired by real and immersive situations, where the user makes an enjoyable experience and an interactive game.

The “gamification approach” is the most effective method for transmitting content and at the same time entertain the users who will feel motivated in learning through these innovative training content. The monitoring of results is one of the key points of the training through interactive games [4].

The learning objects developed with this approach, inserted in an e-learning platform that supports gamification, allow to obtain excellent results in terms of employee engagement in training and to plot in minute detail the user experience [3].

“Savana e bistecce” (Savana and steaks) game is based on a novel by Spencer Johnson entitled “Who moved my cheese”, published on September 8, 1998, is a motivational tale written in the style of a parable or business fable. The text describes change in one's work and life, and four typical reactions to those changes by two mice and two “little people,” during their hunt for cheese. A New York Times business bestseller upon release, Who Moved My Cheese? remained on the list for almost five years and spent over 200 weeks on Publishers Weekly’s hardcover nonfiction list.[1] It has sold more than 26 million copies worldwide in 37 languages and remains one of the best-selling business books [2].

Osel team changed the subject and actors of the tale and introduced lions (Leopoldo and Leonardo) instead of “little people” and steaks instead of cheese, to let students understand better the content, that was about change management tips for professionals working in a company.

The game has been built considering the story as a red string connecting the learning path, the students were playing at the game considering the prologue featured at the start of the learning object. Along the story, students must solve some logical-mathematical tests. The path has a length, expressed in km, which goes from a minimum of 7km to a maximum of 27km.

The wrong answer increases the path and the students have to answer further questions to complete the course.

At the end, students will have their final score, measured in km.

IV. BETA TEST ACTIVITY

The beta testing activities involved a group of 20 members divided into two main categories: 15 users specialized in the use of mobile operating systems and 5 newcomers, which are the ideal prototypes of people who may use the e-learning platform.

35 devices involved (20 smartphones and 15 tablets), with all mobile operating systems currently on the market.

Each user, depending on the device used, filled out an evaluation module by assigning a rating scale of 10 for each of the four parameters considered: touch screen speed, speed and fluidity scroll, pinch usability and overall user experience.

Leaving aside the results of each device, which are accessible through the tabs in the next section, it’s important to underline that the test has shown one thing in common, that is independent from mobile operating systems considered: the small displays are struggling to benefit satisfactory user experience, as it will always be necessary to "pan" in order to center the playing area. Therefore, the tablets are the most suitable devices to use the application via browser, even if the user experience is also excellent on so-called "phablet", i.e. those smartphones that have a display diagonal between 5.5 and 6.5 inches.

However, it seems appropriate to point out some facts in relation to hardware issues: displays with higher than Full-HD resolution present a "flicker" during animations of the game; devices with stereo speakers have some difficulty in managing the sound of the same game, even if it is not important for the user experience.

As for the software side, the operating system that manages the game in a better way, is, undoubtedly, IOS, followed by Windows Phone. In fact, the hardware/software optimization of these two platforms means that even the less efficient devices (e.g. IPhone 4 or Lumia 625) are able, in a good way, to run the application. Remember that the test has been successfully performed even on iOs8 and Windows Phone 8.1, both not yet officially placed on the market. More complex is the situation of the Android environment, where top range devices offer performance even better than iOS and Windows Phone, but the mid-range and the base devices (such as the Sony Xperia M1) turns out to be below the sufficiency. In Android environment we can say that 2 GB RAM is a minimum requirement in order to play the game correctly, with no lag or catching.

Separate discussion is related to BlackBerry OS10, operating system developed by Canada’s RIM. It should be remembered that this OS was launched on the market for just one year, then it is obvious that has not yet been fully developed. Given this, we must say that the game runs the sufficiency through Blackberry browser. The situation is acceptable on the BlackBerry Z30, whose 5-inch display is able to provide a user experience at least sufficient, while it is somewhat compromised on the BlackBerry Z10, Terminal that is not recommended for the use of this game.

We can conclude, therefore, that the e-learning service measured and proposed by Osel is fully compatible with iOS, Windows Phone and Android, and can run on about 85% of mobile devices on the market.

Alongside the 15 advanced users, the test was performed also by 5 "average user" (or person who knows interface for a basic use) and thus represents the user who most frequently may have to do with the e-learning contents and business games.

Again, the test can be considered a cross-platform test, because the 5 users have used different devices: the Xperia Z, the Samsung Galaxy S4, iPhone 5s, the Lumia 925 and the iPad Air involving Android, iOS and Windows Phone (given the problems we had with Blackberry OS 10, the research group decided not to include it in the user test "not experts", they would have found difficult to overcome the difficulties for them). The users were specifically chosen because owners of top-range terminal, which objectively makes it much more enjoyable user experience relative to this game. There were no particular difficulties for them to complete the “Gaming” session, but all of them have been agreed concerning three main points:
The evaluation started with Android OS (Table 1) and was conducted for: Samsung Galaxy Note 3, Samsung Galaxy S5, Sony Xperia M2, Sony Xperia Z Ultra, LG G2, HTC One M8.

Table 1: Evaluation of Android OS Smartphones

<table>
<thead>
<tr>
<th></th>
<th>Touch screen speed</th>
<th>Speed and fluidity scroll</th>
<th>Pinch usability</th>
<th>Overall user experience</th>
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<tbody>
<tr>
<td>Samsung Galaxy Note 3</td>
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<td>Samsung Galaxy S5</td>
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<td>Sony Xperia M2</td>
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<tr>
<td>Sony Xperia Z Ultra</td>
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<td>LG G2</td>
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<td>HTC One M8</td>
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Versus iOS (Table 2): iPhone 4, iPhone 4S, iPhone 5, iPhone 5S.

Table 2: Evaluation of iOS Smartphones

<table>
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<tr>
<th></th>
<th>Touch screen speed</th>
<th>Speed and fluidity scroll</th>
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<th>Overall user experience</th>
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<tr>
<td>iPhone 4</td>
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<td>iPhone 4S</td>
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<td>iPhone 5</td>
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<td>iPhone 5S</td>
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Versus BlackBerry OS (Table 3): BlackBerry Z10, BlackBerry Z30.

Table 3: Evaluation of BlackBerry OS Smartphones

<table>
<thead>
<tr>
<th></th>
<th>Touch screen speed</th>
<th>Speed and fluidity scroll</th>
<th>Pinch usability</th>
<th>Overall user experience</th>
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<tr>
<td>BlackBerry Z10</td>
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<td>BlackBerry Z30</td>
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Versus Windows Phone (Table 4): Nokia Lumia 625, Nokia Lumia 925, Nokia Lumia 1020, Nokia Lumia 1520.

Table 4: Evaluation of Windows OS Smartphones

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<tr>
<th></th>
<th>Touch screen speed</th>
<th>Speed and fluidity scroll</th>
<th>Pinch usability</th>
<th>Overall user experience</th>
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<tbody>
<tr>
<td>Nokia Lumia 625</td>
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<td>Nokia Lumia 925</td>
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<td>Nokia Lumia 1020</td>
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<td>Nokia Lumia 1520</td>
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VI. Tablets Evaluation Tests

The evaluation started with Android OS (Table 5) and was conducted for: Asus Phonepad 7, Asus Nexus 7, LG Gpad 8.3, Samsung Nexus 10, Samsung Galaxy Note Pro 12.2, Sony Tablet S, Sony Xperia Tablet Z.

Table 5: Evaluation of Android OS Tablets

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<tr>
<th></th>
<th>Touch screen speed</th>
<th>Speed and fluidity scroll</th>
<th>Pinch usability</th>
<th>Overall user experience</th>
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</thead>
<tbody>
<tr>
<td>Asus Phonepad 7</td>
<td>8</td>
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<tr>
<td>Asus Nexus 7</td>
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<tr>
<td>LG Gpad</td>
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The evaluation report focuses that the game has been tested on 13 tablet and 3 operating systems, Android, iOS and Windows (in Pro and RT version).

In Android environment, the balance is represented by the resolution and the dimension (the diagonal) of the display: the devices with less than 9-inch screen, have no particular problems to play the game regardless of their resolution; the devices with screen diagonal of more than 9.5 inches (and full HD resolution or 2K) are better reaching the play area, but they have difficulties in scrol and pinch. In any case, the average evaluation of users experiences with Android tablet is 7.28. In iOS environment, the situation is fairly constant. The group tested four devices running the game in an excellent way, just the first-generation iPad Mini is trudging in some situations due to the hardware not particularly powerful. The game can also run on iOS8 Beta 1 supporting the innovative “Multi Windows” function. The total average rating of user experiences with iOS tablet is 8.25. In the Windows environment, as expected, the game runs in the good way. The Windows OS is a kind of derivation of the desktop, so the only problems are given by the screen diagonals and by their resolution (of scrol and pinch problems that do not compromise in any case the end-user experience). The average rating of user experiences with Windows tablet is 8. The average total vote (which therefore includes the Android tablet, iOS and Windows) is 7.69, which then highlights the fact that the game runs in an excellent way, cross-platform, on tablets.

REFERENCES


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Manuscript received April 11, 2016.
This work was supported in part by the U.S. Department of Commerce under Grant BS123456 (sponsor and financial support acknowledgment goes here).

Published as submitted by the author(s).