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THE CITY AS AN OPEN-AIR MUSEUM
AN EDUCATIONAL MOBILE APPLICATION FOR THE HISTORIC CENTRE OF BARCELONA
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Η ΠΟΛΗ ΩΣ ΥΠΑΙΘΡΙΟ ΜΟΥΣΕΙΟ
ΜΙΑ ΕΚΠΑΙΔΕΥΤΙΚΗ ΚΙΝΗΤΗ ΕΦΑΡΜΟΓΗ ΓΙΑ ΤΟ ΙΣΤΟΡΙΚΟ ΚΕΝΤΡΟ ΤΗΣ ΒΑΡΚΕΛΩΝΗΣ

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ΠΕΡΙΛΗΨΗ

Σε αυτό το άρθρο, παρουσιάζονται ο σχεδιασμός και η αξιολόγηση της πειραματικής εκπαιδευτικής εφαρμογής *Open-Air Museum Barcelona,* «Βαρκελώνη Υπαίθριο Μουσείο», που σχεδιάσθηκε για κινητές ηλεκτρονικές συσκευές με ερευνητικό σκοπό. Αυτή η πρωτότυπη εφαρμογή ελέγχθηκε και αξιολογήθηκε σύμφωνα με διαφορετικά ερευνητικά εργαλεία, που οδήγησαν σε ορισμένα σημαντικά συμπεράσματα σχετικά με τον σχεδιασμό εφαρμογών για κινητές ηλεκτρονικές συσκευές. Η δράση αποτέλεσε μέρος της διδακτορικής διατριβής της συγγραφέως και αναπτύχθηκε στο πλαίσιο του 13ου International Congress of Educating Cities που πραγματοποιήθηκε στην Βαρκελώνη τον Νοέμβριο του 2014. Βασίσθηκε στην άποψη ότι, παρόλο ότι οι πόλεις περιλαμβάνουν πολλά πολιτισμικά στοιχεία –αστικά, μορφολογικά, δομικά, ακόμα και ιστορικά– η μεγάλη πλειονότητα των πιθανών αποδεκτών αντιμετωπίζουν δυσκολίες ως προς την κατανόηση των σύνθετων χρονικών και χωρικών χαρακτηριστικών των αντίστοιχων τοπογραφιών. Αυτή η δυσκολία οδηγεί την πλειονότητα των περιηγητών, είτε είναι

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μόνιμοι κάτοικοι είτε είναι τουρίστες, να αντιλαμβάνονται την πόλη ως ένα σύνολο ασύνδετων μεταξύ τους στοιχείων. Για αυτό, η εκπαιδευτική δυνατότητα μειώνεται σημαντικά και ορισμένες φορές παύει ακόμη και να υπάρχει. Η εκπαιδευτική αυτή εφαρμογή για κινητές ηλεκτρονικές συσκευές που παρουσιάζεται σε αυτό το άρθρο σχεδιάσθηκε με στόχο την αντιμετώπιση αυτού του ζητήματος.

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ABSTRACT

In this paper, the implementation and the evaluation of the experimental educational application *Open-Air Museum Barcelona* are presented, which was designed in the context of a relevant investigation. This prototype application was tested and evaluated by different research instruments and led to a number of conclusions about the design of mobile apps. The whole project was part of the author's doctoral PhD research and was developed in the framework of the 13th International Congress of Educating Cities held in Barcelona in November 2014. It is based on the assumption that although our cities are large heritage containers –urban, morphological, structural, and even historical– the vast majority of potential recipients have difficulties in understanding complex temporal and the spatial features. This difficulty leads the majority of the people, whether residents or tourists, to perceive the city as a set of unconnected single elements. Therefore, the educational potential is considerably reduced and sometimes it even ceases to exist. The educational mobile application presented in this paper was designed in order to face this problem.

ACKNOWLEDGEMENTS

The background

The area of mobile applications based on new mobile media capabilities has grown during the last years. This growth has been fostered by the development of the cultural tourism sector and the great penetration of smartphones in society. More and more, the use of applications is becoming a universal formula for travelling, understanding and interpreting the world around us.

Recent research studies demonstrate the importance of the use of new information technologies in Heritage Education (López 2014; Ibáñez-Etxeberria et.al. 2014; Santacana & Coma 2014). Especially in urban contexts, the use of mobile media for heritage education has many advantages; technology encourages the design of experiences for rethinking the city (Vicent 2013).

The historic value of cities and its potential for heritage education has been researched in numerous studies, some of which propose to conceive the city as an historic and cultural heritage container and archive (Prats & Santacana 2009; Coma & Santacana 2010; Coma 2011).

The analysis of mobile media designed for urban cultural tourism showed that the major portion of current mobile guides still propose themed itineraries targeted at groups or individuals. This kind of guide has a number of common features. It presents an established number of Points of Interest (POIs) and stops, like in a classic guided tour or itinerary offered by printed guidebooks. It is characterised by a closed-response digital format with very few interactive features, hardly adaptable for custom routes design.

The smartphone, as a portable tool, compared with its classic predecessors used in urban environments –stable informative panels and signs– presents a number of advantages. It communicates the significance of heritage sites without physical impact. It has additional features, like mobility and ubiquitous systems that enrich learning experiences, as well as, interactive tools for creating, modifying and sharing contents (Grevtsova 2012). Mobile media not only simplify a vast amount of information, but also improve the content thanks to interactive features and by offering a wide variety of interpretive proposals for cultural heritage.

Mobile learning (M-learning), as an extension of *E-learning*, represents a new approach to learning methodology with the use of mobile media. This kind of learning has been applied in various fields and projects, which have been carried out in schools, workplaces, museums, cities and rural areas throughout the world (Sharples 2007; Brazuelo & Gallego 2011).

In recent years, we have witnessed an explosion in the number of creative new games supported by mobile devices in such a way that the game activity evolves according to

the player's location (Avouris & Yiannoutsou 2012). The broad access to the network broke with the tradition of playing only in a physical location and enables the fusion of digital technology throughout the urban space (Sintoris et al. 2013). The combination of the educational potential of heritage urban sites and mobile location-based games enriches the visitor experience and provides new ways of learning. Some of the characteristics and interesting aspects of such games are mobility, collaboration, role-playing, engagement in making activities, location of museum objects and their further study.

Another feature of these games which use mobile technologies, specifically augmented reality, is that of potentially improving 21st century skills, such as interpretation, multimodal thinking, problem solving, information management, teamwork, flexibility, civic engagement, and the acceptance of diverse perspectives (Schrier 2006).

For some years, augmented reality –as an educational and outreach tool– has begun to be experimented by many cultural institutions. The Powerhouse Museum started displaying historic photographs of its collection in Sydney in 2010 and the same year the Museum of London released the *Streetmuseum* that provided access to hundreds of historic images of London as both 2D and 3D overlays. From that moment, augmented reality was spread widely in many cities all over the world.

The main use of augmented reality technologies in urban contexts consists of displaying urban heritage and historic scenarios by providing archive images and videos that are mapped in the urban streets where they were taken. The combination of virtual, location-specific and contextual information makes it possible to access cultural contents in a physical site, and improves the learning efficiency of mobile media.

The project's objectives

The objectives of this research project for the design of an educational mobile prototype were the following:

- The first objective was to define a new research methodology in the field of mobile applications in heritage education. The physical framework in which the prototype was experimented was the historic centre of Barcelona: the Gothic Quarter. For this reason, the research took on questions that are specific to this city, ranging from the history and the analysis of the urban structure, to the multiple formulas used to conserve but also to destroy its heritage. The methodological approach constitutes one of the main contributions of the research, given that few experiences of this type exist in the educational field.

- The second objective was to develop a new application based on the use of mobile technology and the veracity of information and gamification for

educational activities and dissemination of urban heritage in urban spaces of the historic centre of Barcelona.

- The third objective was to test and evaluate the new prototype, with quantitative and qualitative methods.

- The fourth objective was to design a flexible and adaptive model application – the Open-Air Museum (OAM)– that could be extrapolated and used in other historic cities (see Grevtsova 2016).

Methodology

The methodology had a mixed character and was based on four key disciplines: Heritage Education, Environmental Psychology, Urban Planning, and M-learning.

As far as the phases are concerned, we defined five principal stages. The first phase consisted of the documentation and analytic study of different types of the existing heritage resources of the historic quarter of Barcelona (signposting, guided tours, applications, cultural assets etc.). The second phase consisted of the description and analysis of the mental representations that visitors have about the city. The third phase focused on the design of a prototype application in compliance with the requirements of an inclusive educational application, which would be extrapolated to cultural tourism. During the fourth phase, the prototype was tested using various research techniques, from a user and usability test to an analysis of focus groups. The final phase consisted of the analysis of the tests' results.

As for the research techniques, different techniques were applied. First, in the pre-project phase, several studies were made, using both quantitative and qualitative techniques, in order to identify problematic issues that urban areas present for visitors, from different points of view, especially in the intervention area of the proposal. On the one hand, qualitative techniques such as direct observation of two guided tours organized by the Barcelona City History Museum were applied. At the same time, mental maps of visitors residing in the city were studied in order to identify what kind of cognitive difficulties the urban heritage of the old town generates. On the other hand, during the same phase, two quantitative studies were conducted: an analysis of the characteristics of the signalling systems of the historic centre of Barcelona and a study of the trends of the use of mobile technologies.

The analysis of the current applications in European cities, was carried out in two steps. The first was an empirical study that consisted of identifying the main types of applications created for teaching and dissemination of urban heritage. Then, a detailed study of the sample of 20 applications created in Barcelona was carried out. The four

studies of the first phase of the research were made in the old town of Barcelona, and their purpose was to get a deep multidisciplinary view of the target area before designing the proposal.

During the second phase of the project, which consisted of the design of the App, quantitative techniques were applied through the registration form of urban heritage, which allowed for the collection of information from direct observation.

The *Open-Air Museum of Barcelona* application

The prototype application, titled *Open-Air Museum of Barcelona*, was designed for the historic centre of the city of Barcelona.

The application provides tools that are formally and technically used from a game script, which, through a set of actions, allow for a unique interactive experience in discovering the history of Barcelona through its cultural and urban heritage.

One of the educational components of this application is to provide a mental map of this area, in which three categories of spatial elements –as defined by Lynch (1960)– are identified: roads, nodes and districts.
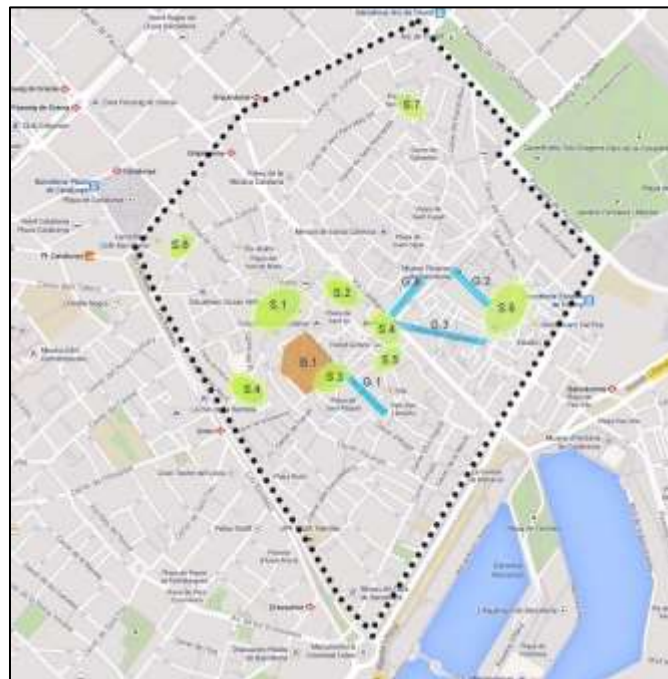
Picture 1. The action area of the city for the *Open-Air Museum of Barcelona*.

These spatial urban elements were included in a conceptual design of the application as exhibition spaces. Taking into account the spatial characteristics of every element, a *street* or path corresponds to a museum gallery in the application, a *node* to an *exhibition hall* and a *district* corresponds to a *museum area*.

The distribution of points of interest (POIs) of this mental map was performed according to the spatial features of urban sites. Thus, urban squares that present open and comfortable spaces for observing, as museum halls, have 5 - 7 POIs. In these spaces, the app users have to look for enigmas. In order to find them it is necessary to move and walk around the perimeter of the "museum halls" or to go across the streets.

Access and free route

The *Open-Air Museum of Barcelona* can be entered through five symbolic "doors" that are situated along a central street, *la Rambla* (Access through Santa Anna: Canuda, Portaferrissa, Portal de la Boqueria, Carrer de Ferrán, Carrer d' Escudellers). The "doors" were chosen on this site because *la Rambla* is undoubtedly the most popular street in Barcelona and, at the same time, the main entry points to the medieval town, which is situated along it.

The *Open-Air museum of Barcelona* has neither visible boundaries nor a roof, so it can be easily walked through. Inside it, users can choose their route and activities: to visit the museum spaces, to have a snack or to go shopping. It is open 24 hours and there are no entry tickets. The visitors can get out and come back whenever they wish. Nor are there any age limits or ethnic filters. In this sense, the "city open-air museum" is a human, inclusive and free museum, because it does not present any route or itinerary designed beforehand.

Navigation tools

The use of a Global Positioning System (GPS) helps the users to orientate in a historic quarter and to indicate areas of interest. Inside the museum area, when the users reach an area of interest (museum hall, gallery or area), the application points it out with a graphic notice and sound. Thus, while walking the visitors of the city can have a mobile or a tablet in their pockets and take it out when the alert sounds. The navigation starts through augmented reality with the use of a radar that locates all POIs of this area.

The localization of POIs can only be visualized by the augmented reality radar that shows consulted POIs and notifies which points still have to be discovered nearby, indicating the direction of their location. When the user focuses the camera in the direction of a POI, an overlaid graphic icon, an interactive tool is displayed on the screen (Picture 3).
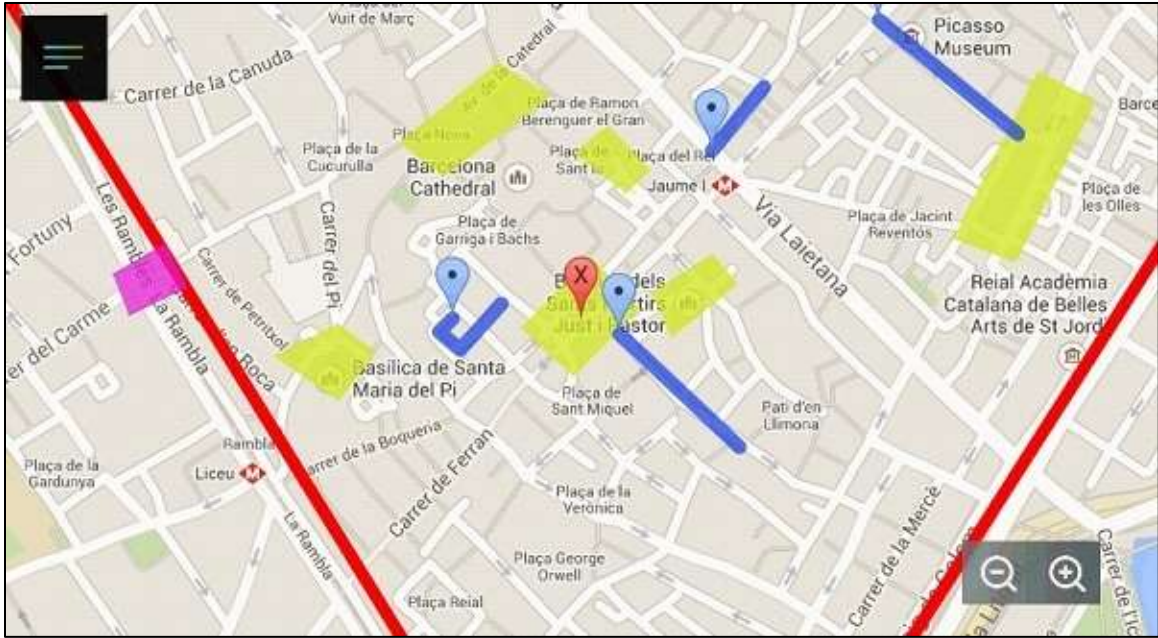
Picture 2. The GPS map.

Picture 3. Visualization and interpretation of the Roman walls.

Educational tools related to history and veracity

The application provides seven educational interactive tools that bring the users closer to the 2000 years of history and the architectural and urban heritage of Barcelona in a simple and comprehensive way. These tools can be conceptually divided into two big groups. The first group of tools is related to the history of buildings and urban places. A tool, the formal icon of which is a *building with legs*, is used to find out the origin of moved buildings. There are also other tools related to the historical exploration, which help the users to discover whether a historic building is original or has been rebuilt, restored or modified. Finally, a tool related to urban spaces shows the use of urban spaces in different historical periods and the changes in urban squares and streets.

The second group of educational tools indicates different tasks that players must carry out to get more information about some outstanding monuments and historic buildings (*an eye*), locate and associate museum objects with their original place (*a museum icon*) and search and discover hidden mysteries (*a magnifying-glass*). For these tasks, the players are required to interact with the content of the application: delete old photos by finger and observe current views (*eraser*), turn over the gallery of historical images (*time travel*), zoom an image (*an eye*), locate points with the use of a GPS map (*a magnifying-glass*), etc.

Pictures 4 & 5. Visualization of educational tools with the use of augmented reality radar.

The evaluation study

In the third experimental and evaluative phase of the project, we used two principal qualitative techniques: a usability test of the application and a discussion group. The use of these techniques allowed us to make a valuable and reliable assessment. The

first technique is widely used in the field of web design, in order to identify problems of information architecture, web design or functions, while the second, is more used in the field of social sciences and enables one to acquire additional information about problems, experiences and user desires. A qualitative questionnaire was designed in order to measure user satisfaction in both the above mentioned cases.

Pictures 6 & 7. Usability test of the application in the historic quarter of Barcelona.

The operation test of the app with users was held in the historic quarter of Barcelona. The test started in the main square *Plaça de la Catedral*. The duration of the game was about 50 minutes. Participants were divided into groups and each group had 2-3 mobile phones with an Android operative system. The data collected included observation notes, photos and short videos of participant behaviour. A relevant video is available at https://www.youtube.com/watch?v=urBUEdiG6HI&t=3s

The second evaluation phase was realised in a teaching-room of the faculty of Geography and History at the University of Barcelona. During this phase, two research instruments were used: a questionnaire evaluated the participants' opinions about the experience of the use of the application. This questionnaire was also used as a guide to formulate more detailed questions for further discussion in groups about technical issues and learning experiences.

The questionnaire consisted of four thematic blocks: usability assessment, evaluation of educational model, assessment of satisfaction and the SWOT table. In particular, the first six questions focused on technical aspects of the application in order to evaluate the usability level. The aim of the next block of questions was to have users' feedback about the app's educational characteristics. The questionnaire ended with a SWOT analysis in order to ask the participants to summarize all their observations using their own words.

Results and discussion

Results based on the analysis of the data collected during the evaluation phase are summarized in the following SWOT table.

Table 1. The SWOT analysis of the questionnaire

STRENGTHS	WEAKNESSES
• Product innovation • Expansion of knowledge • Portability • Team activity • Innovative, practical, different, intuitive, entertaining • Simple, interesting, creative • Attractive design • Useful for knowledge of the city • Intelligent use of new technologies • Interactive and didactic way to know the city	• Battery consumption by GPS • WiFi connectivity • Low interactivity • Slow, energy dependence of the device • Slow process of downloading data • A lack of audio resources • Problems in downloading and installation • GPS dependence
OPPORTUNITIES	THREATS
• Newly emerging mobile market • Possibility to expand and apply to the market by introducing new languages • Offer different game experiences • Possibility of expansion for different types of audience • Application of the model in other cities or urban areas	• Market competition • Over-exploitation, trivialization of heritage • External effects that make its use impossible (during city celebrations) • Reduction of human tour guides • Not accessible to all audiences • Easy to remain outdated

The SWOT analysis highlighted the principal technological problems that the users detected during their experience walking through the streets of the historic quarter of Barcelona. It also demonstrated the principal potentials that distinguish this model from other tour guides. The data collected by the questionnaire was used for further discussion during a group session. Thus, all participants had time to mature their opinions and sharpen their critical reflection about their experience.

The completed evaluation led us to define the following seven principle conclusions about the design of mobile applications for educational purposes, and gave us ideas for its future improvement:

1. For mobile application design, it is necessary the use and application of various research techniques.

2. For mobile application design, it is important to consider the current imprecision of GPS in urban historic contexts.

3. Because of the limits of small mobile screens, textual contents are not suitable for mobile devices.

4. An educational application that is not interactive loses its utility and interest for city visitors.

5. A wide variety of educational tools is required to make comprehensive a complex urban historic context.

6. An educational application for an urban environment should offer tools to customize routes and allow users to save and share them.

7. An educational application should have playful elements and apply gamification techniques.

CONCLUSIONS

To summarize the results of the presented research, it is important to highlight several main points. Firstly, the methodology for designing and testing educational mobile applications carried out in this research, seems to be one of the main contributions of the investigation. At the same time, the applied research techniques have helped us to detect the principal weak points of the application and define future lines for improvement.

Secondly, the use of the Lynch mental maps theory and of seven educational interactive tools designed to enhance understanding of the authenticity of heritage urban elements significantly improved the initial complex cognitive user perception of the historic quarter of Barcelona. Grouping isolated heritage assets in museum interactive spaces allow the visitors to find the keys to develop their own critical opinion about the past. Finally, the users and their behaviour should play a central role in the designing process of mobile educational applications. This approach potentially may allow us to design custom mobile resources adapted to the needs, demands and interests of different types of audience, moving away from standard solutions nowadays existing on the tourism market.

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