2015 International Conference on Virtual and Augmented Reality in Education

Framework to Heritage Education using Emerging Technologies

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Abstract

Heritage education is the process that allows people to learn about their heritage. This has been traditionally carried out in school settings in which teachers use conventional educational strategies as printed books to teach that kind of topics. However, the problem of heritage education is that more and more people that born in a particular place, lost the opportunity to know in deep their heritage due education could be neither effective nor contextualized to the need and preferences of the people. Currently, emerging technologies as mobile learning or augmented reality, have opened a really increasing set of opportunities to improve heritage education by offering alternatives to customize, locate and contextualize learning. It implies think about how to use adequately technology for learning. Our aim in this paper is to introduce the "Framework to Heritage Education", a framework for heritage education using emerging technologies as augmented reality. This proposed framework is based on the LTSA that proposes a conceptual architecture to facilitate the educational process mediated by information technologies. In this case, the changes on this architecture have been defined taking into account the processes and entities involved in heritage education. "Framework to Heritage Education" has been validated in Cartagena de Indias (Colombia), where tourism and citizens tested "Social Heritage App" which is inspired in the proposed framework to close individuals to their heritage. Results are promising and give us important inputs to improve the "Framework to Heritage Education" and the "Social Heritage App".

Keywords: Framework; Heritage Education, Emergin Technologies, Augmented Reality.

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1. Introduction

Heritage would be defined as all of those tangible and intangible assets with an elevated historic and cultural meaning and value to people inhabiting a determined geographical place or just visiting it [1].

Heritage can be categorized in two different groups: natural and cultural. Natural heritage is established by existing elements in nature and therefore, physical and biological formations as well [1]. Among this category natural parks, nature reserves, geologic formations, etc. can be found. Cultural heritage is referred as to "a focal point where building structures, monuments, artwork and intangible values are inferred, for citizens and their memory. Places and conducts as lifestyles, believes, languages and communication customs are converged in order to build group cultural identity" [2].

Heritage education might be considered as a pedagogical process in which people are able to learn about heritage assets. This learning process is focused not only on knowledge but recognition and importance given to social heritage [3]. Heritage education has been developed traditionally in learning scenarios where educators offer to scholars predetermined curricula using traditional teaching strategies [4, 5].

Regarding touristic heritage, technology has been used in order to facilitate the education process to intent closing the relation between people and their heritage, to do so, approaches as tourist guides, audio guides, interactive screens, mobile applications, web sites, etc. can be mentioned. However, these kinds of technology in many cases do not consider the needs and preference of the individuals, their context or their possibilities [6].

Nowadays citizens and visitors have multiple possibilities to learn in-situ by using mobile technology in context, and it should be exploited for heritage education in order to allow people to have a real conscious about humanity heritage values and their importance for the future. Furthermore, emerging technologies, as augmented reality has the capacity to involve people with the heritage, offering augmented information and experiences that become augmented reality in an opportunity for future generations to develop genuine and granting heritage processes.

This paper introduces the "Framework to Heritage Education" which was created to support heritage education mediated by information technologies facilitating people to access and really appropriate their heritage. The framework is based on the Learning Technology System Architecture (LTSA), a conceptual architecture that permits to understand and implement a learning process mediated by technology. The Learning Technology Standards Committee (LTSC) - IEEE, has developed this architecture. The "Framework to Heritage Education" considers specific processes, actors and their relations which differentiate educational heritage from others educational process while take advantage of the use of emerging technologies into the educational process motivating learning in real and contextualized scenarios for both formal and informal learning.

This article is organized as follows. The second section summarizes a literature review of heritage education and associated technologies. In the third section, the "Framework to Heritage Education" is introduced. The fourth section describes a conceptual and qualitative evaluation of the framework and finally in fifth section conclusions and future work are outline.

2. Heritage Education

2.1. Contextualization

Heritage education as a process is based on learning theories and specific didactic methodologies in order to achieve genuine appropriation and participation among citizens in order to conserve heritage and use it responsibly [3, 7, 8]. Specific models to this process have been defined [5]:

- Teacher-centered models are focused on traditional teaching methods and are characterized by the responsibility of the learning process which leads the teacher.

- Student-centered models are focused on the learners, specially considering their preferences and needs in the learning process. The teacher's role is to facilitate the learning process of the learner.

- Content-centered models are characterized due to the central axis being contents to support the learning process. Contents may vary or be adjusted according to the educational level of individuals and the environment in which these contents are displayed.

- Context-centered models are focused on the context, consider aspects such as features of the real scenarios where the learning take place, access device, and other aspects, in order to define learning strategies.
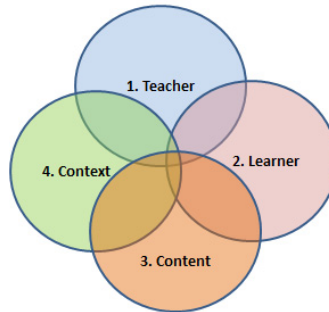

Fig. 1. Heritage Teaching Model - Fontal

The models described above are characterized by being designed according to school contexts, where learners carry out a training process guided by a predefined curriculum structure.

In addition to the described models, there are hybrid models that integrate the basic principles of the models presented before:

- Models combining content and context promote learning "in situ".

- Models combining teacher expectative and learner needs permit to implement learning scenarios considering available contents and learners' interests.

- Models combining Learner-centered and content-centered models promote the definition of contents based in learners' background, knowledge, and other relevant features. Contents will change as the learning process evolves.

- Meanwhile, in learner-centered, content-centered and context-centered models, contents are organized according to individual learning needs; also context is taken into account to personalize the learning process.

This work is based on hybrid models combining learner-centered, content-centered and context-centered models to enrich both formal and informal heritage education, articulating a learning process that takes place in real scenarios where individual needs are personalized.

2.2. Informal leaning for heritage education

Several authors [2] have classified teaching/learning process into two categories: formal learning and informal learning.

Formal learning refers to teaching/learning processes which take place in legally formalized institutions. In this case, students carry out their learning process based on curricula determined by the educational institutions.

The Informal learning, differently to the formal context, learning is not the only and main goal of the process. The learning process also includes entertainment, enjoyment, culture or just tourism which significantly alters the meaning and rhythm of the learning [9]. Informal learning has some advantages for heritage education. Since it is

not directly linked to a curriculum, it allows learners to undertake learning processes in a flexible way focusing on personal interests [10] and on the other hand, permit take advantage of emerging technologies contextualizing and situating the learning.

The above mentioned advantages allow us to conclude that informal learning is a promising alternative to the difficult task to close the relationship between citizens and their heritage through and adequate heritage education.

2.3. Technologies for heritage education in informal contexts

In the economic sectors of heritage and tourism, Information and Communication Technologies (ICT) have been used to bring people closer to heritage assets. The following paragraphs explain some of these technologies.

Tour Guide is defined as "the person who provides assistance information to visitors in a chosen language and interprets the cultural and natural heritage of an area" [11]. Tour guides are trained to offer visitors information related with culture and heritage. A disadvantage to this technology is that most guides have not the level of knowledge, nor teaching experience that it is necessary for an effective heritage education process.

Audio guides are electronic systems that deliver information to people through audio recordings, used in places like museums, parks, art halls, historic sites and more places of interest [12]. These audio guides are usually available in multiple languages. Technically, audio guides list places of interest, each of them associated in their own audio guide. This technology is internationally well known. Most museums have audio guide mechanisms used to transmit information to people. The main disadvantage of audio guides technology is that contents are delivered in predefined formats and do not take into consideration individual needs or preferences.

Interactive screens are touch screens connected to computers available for people to interact with and find further information [13]. This technology helps citizens understanding the routes and content on places such as museums and art galleries. They make it easier to deepen heritage information. The main disadvantage of these screens is mobility as they are fixed in specific places, it is necessary for people to stand in front of them in order to interact and get needed information.

Mobile Applications become a great opportunity for heritage education due to "the connectivity and portability which facilitates access to resources and activities/actions to learn out of formal learning environments" [14]. There are currently several mobile applications for heritage education, regardless of lack of essential personalization aspects and content recommendations, for example: the application as Ayuntamiento de Arjona that ims to encourage tourism in Arjona, an spanish town located in the province of Jaén [15], Guimarães which is an application that offers information on the heritage and the history of the city of Guimarãe [16], "Valladolid tu Corazon" it is a technological solution that extends the current cultural and tourist services for citizens and visitors who come to Valladolid [17] and Artá Travel that provides information with augmented reality on heritage, tradition, modernity, nature and tourism [18]. One of the risks in the use of mobile applications in heritage education process is not being an appropriate model for informal learning process.

2.4. Main problems in heritage educations

Although education on heritage is frequently an opened process at formal institutions, new generations have less interest or knowledge on heritage values regarding the places they inhabit due to globalization and cultural influences from other countries.

Agencies responsible for the management and dissemination of heritage information have such strategies as printed brochures and websites to disclosure the information. However, this information is not guaranteed to perform an effective and accurate heritage educational process. There is frequently a misunderstanding of the meaning of heritage assets. For instance, "misinterpreting artwork and message decoding from art pieces due to lack of understanding capacity" is common for people in heritage contexts [19], which makes it difficult to be close to its heritage.

In spite of modern technologies being developed to support heritage education, they are usually used in enclosed and specific places as museums or art galleries scenarios. The contents are delivered from web and mobile applications which in general are standardized and do not take into account people preferences or needs. Therefore, it is

necessary to propose new alternatives that allow users to come closer to their heritage taking advantage of new models, methodologies and frameworks to improve heritage education.

3. The "Framework to Heritage Education"

3.1. The Learning Technology System Architecture

The word framework is referred to a set of concepts, criteria and methods focusing particularly on solving problem. These concepts, criteria and practices become a reference for solving problems similar to the ones specified by the framework [20].

The "Framework to Heritage Education" is based on the Learning Technology System Architecture (LTSA) [21]. LTSA define a conceptual architecture about how the learning processes supported by information technology take place. It is considered a neutral architecture in technical, cultural and educational aspects, and it is also a reference for educational system developers. Figure 2 shows LTSA structure.
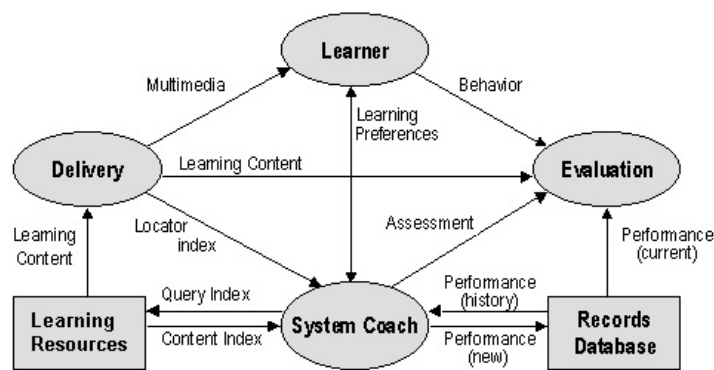

Fig. 2. The Learning Technology System Architecture (LTSA)

LTSA suggests that in a learning system mediated by technology it is possible identify processes as *Learner*, *Evaluation*, *System Coach*, and *Delivery* which are entities that perform educational processes. It also important to highlights the existence of historical data storage system of student's performance in teaching/learning process (*Records Database*) as well as *Learning Resources Repositories* to store the *Learning Resources* that support the learning process.

The *Learner* is an entity that represents abstraction of the person carrying out a learning process. It may also represent a group of people working collaboratively.

Meanwhile, the *Evaluation* refers to the assessment processes that allow learners' observation regarding their performance and behavior. The records of the observation must be stored in a *Records Database* to save students historical information of the teaching/learning process.

The *System Coach* is the entity responsible for making recommendations regarding *Learning Resources* for learners based on aspects such as learning style, preferences, performance or other learners' features. It is also responsible for negotiating to each individual the most appropriated teaching/learning strategies. In a traditional teaching process, the *Coach* is the *Teacher*.

The *Delivery* is the entity that manages the process of displaying *Learning Resources* to *Learners*, considering recommendations made by the *Coach*, the *Evaluation*, the learners' information (stored in the *Records Database*) as well as the available *Learning Resources (stored in the Learning Resources Repository* that represents the database which stores any kind of education resources (videos, audios, tutorials, slides, assessments files) to support the learning processes).

3.2. Description of the Framework to heritage education

Figure 3 shows the Framework to heritage education which was defined based on the LTSA structure. LTSA has been extended by defining additional and necessary elements to be considered in heritage education.
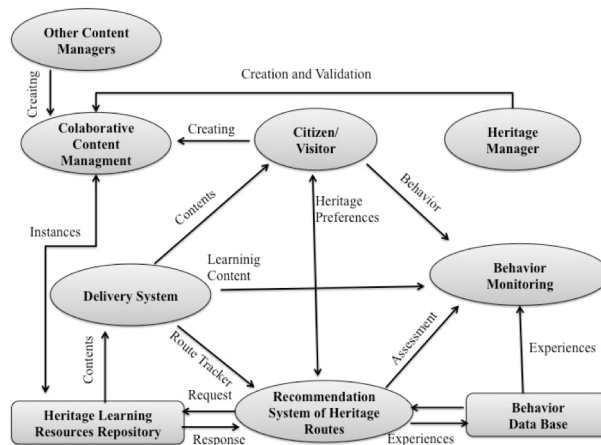

Fig.3. Framework to Heritage Education

In heritage education process, the learner is referred as to the *Citizens/Visitor* who is interested in learning about his/her heritage. The *citizen* is known as a person who was born or inhabits a specific place. *Visitors* are referred to people who are temporarily in a particular place.

The *Behavior Monitoring* (Evaluation in LTSA) is referred to the learner behavior observation while she/he is learning about the heritage.

Individual behavior is stored in terms of interests, consulted heritage, selected routes, viewed and aggregated content, etc. All these information is stored into the *Behavior Data Base*.

The main purposes of *Recommendation System of Heritage Routes* (System Coach in LTSA) is proposing a route of heritage that *Citizens/Visitor* can visits but considering stored information in the *Behavior Data Base* (Record Database in LTSA). Information in the *Behavior Data Base* permits the system to infer *Citizens/Visitor* profile or user models that can be used to support the recommendations. This system will initially implement a recommendation scheme based on contents, comparing available information about the heritage content and the *Citizens/Visitor* profiles to identify according with predefined rules the most relevant pointes of interest to each particular *Citizens/Visitor*. When the *Behavior Data Base* counts with a considerable amount of data, recommendations will be implemented based on collaborative filtering.

Delivery System (Delivery in LTSA) is in charge to present the content to learners in different formats: audio, video, text, animations, etc. These contents should be accessible from different types of mobile devices such as phones, eyeglasses and tablets, as well as desktop.

On the other hand, the heritage content is stored as *Heritage Learning Resources* establishing a large repository of resources to support heritage education which increase while the *Citizens/Visitor* creates new content. From the starting point of usage a set of initial *Heritage Learning Resources* is created mapping the identify heritage interest point and the most promising kind of content to each of they. *Heritage Learning Resources* feed the augmented reality perspective of the heritage, for instance, "… adding virtual graphics in real time, a person's line of vision" [22]. It permits contextualize heritage education in real scenarios.

Two factors considered by the "Framework to Heritage Education" but not by LTSA are *Collaborative Content Management* for heritage content development and the entity called *Heritage Manager*.

The *Collaborative Content Management* process for heritage content development is refered to the process of creating *Heritage Learning Resources* to be considered in the heritage learning process. These resources could be

created by different entities: *Citizens/Visitors*, *Heritage Managers* and *Other Content Managers* who should be experts in content creating: designers, graphic producers, artists, programmers and any other person who might be interested as well.

Moreover, *Heritage Manager* entity represents individuals and institutions responsible for heritage education or heritage management in a particular place. This entity is responsible of validating not only the framework but also how the educational process is conceived. *Manager* are also in charge of producing *Heritage Learning Resources* but also of validating the resources produced by the other actors to ensure high quality in the process.

4. Framework Evaluation

The evaluation of the framework was done through three strategies. The first one is a qualitative evaluation carried out by experts. The second one is referred to the instantiation of a prototype mapping the framework. And finally the third one is referred to final users (visitors and citizen) evaluation. The process and the results of the evaluation are described below.

4.1. Qualitative Evaluation carried out by experts

In order to perform a conceptual and qualitative evaluation of the framework, 4 experts on heritage and tourism from the Institut Català de Recerca en Patrimoni Cultural (ICRPC) and Institut Superior d'Estudis Turístics (INSETUR) of Girona University were interviewed.

The methodology used for this qualitative study is as follows:

- The Framework to Heritage Education was presented, indicating its fundamental aspects and its main purpose.

- Once the framework presentation was finished, a discussion considering the following questions was proposed: 1) According with your opinion, what are the main problems that face heritage education nowadays? , 2) Do you consider The "Framework to Heritage Education" maps the processes of heritage education?; and 3) What are your recommendations for improving the framework?.

The results achieved from this qualitative study are the following:

- Experts agreed that new generation citizens are moving away from their heritage values.

- There is a general agreement on not having an organized strategy in heritage education planning by cultural institutions.

- There is agreement that emerging technologies such as augmented reality are a good alternative in order to develop heritage education.

- They recommend that heritage content description could be organize by layers in order to allow people to observe different historical moments and be able to clearly visualize heritage evolution.

- Experts recommend that public entities and heritage experts must validate heritage content.

- User characteristics and preferences should be clearly defined as well as their impact in the heritage education.

- They also recommended that heritage content could be represented as a "magnifying glass" which depending on user interests can increasingly extend the contents for more detail.

- About the heritage routes, experts recommend to analyze the intensity of the flow of people when they visit heritage point of interest. It could permit to identify aspects as the low- visit flow after the first trips made by people, or the number of entrances to an specific heritage route which is crucial for the quality of the tour. This kind of information could support the decision about the best route to recommend for specific visitors or citizens.

4.2. Evaluation of the framework capacity to support the implementation of educational system to support heritage education

In order to evaluate whether the "Framework to Heritage Education" facilitates the implementation of applications to support heritage education, a mobile application called "Social Heritage App" was designed and implemented under the conceptual model provide by the framework [23].

The main purpose of Social Heritage App it is to facilitate the processes of heritage education in the city of Cartagena de Indias (Colombia). Cartagena de Indias is considered by UNESCO as Historical and Cultural Heritage of Humanity and has a great historical and cultural value.

Certains places in Cartagena's historic center were identified and selected for being heritage points of interest: "Torre del Reloj", "Statue of Rafael Núñez", "Rafael Núñez Square", "Portal de Los Dulces", "Plaza de la Proclamación", the Cathedral, "Parque Bolívar", "Statue of Simón Bolívar", among others. Each of these points is geographically referenced.

The information model of Social Heritage App considered completely the model proposed by the framework.

Social Heritage App was developed for two user categories. The first one, Citizens/Visitors who would use the platform to carried out informal heritage education and also collaborative content management. The second category refers to Heritage Managers as previously mentioned referred as the experts users who support several activities in the framework as the validation of contents and heritage points of interest verifying they cover the requirements to support heritage education.

Citizens/Visitors are able to access all augmented information for each geolocalised point of interest. A log on and/or registration mechanism allows user data and preferences access. Once user logs on, they have different options showing the main menu they can interact with: points of interest display through GIS, personalized search through organized lists, content uploading, and content rating and heritage data visualization points with augmented reality.

The complete information about the users interaction with the system was tracked and recorded. This information could be used in the future by the Route Recommender System to make recommendations to users about the most promising routes for they, according with their interest, preferences and also considering other users features and interactions.

JAVA programming language was used to create the application. Eclipse was the environment development (IDE) used because it supports Android SDK. For GIS development, Google Play Service was selected, it is able to generate a map, marking the heritage points of interest and drawing signs showing the heritage routes. Finally, Vision SDK, augmented reality SDK libraries permit us to create overlapping radar screens which can be viewed through augmented reality.

In conclusion, The Framework to Heritage Education facilitated the implementation of "Social Heritage App".

4.3. Final users evaluation

The evaluation of the "Social Heritage App" and therefore of the "Framework to Heritage Education" considered a mixed approach: quantitative and the qualitative. The first one with the intention to identify the level of acceptance of "Social Heritage App" and second one with the intention to observe the interests and behaviors of the users when they use the technology.

4.3.1. Sample

The sample of the study was 42 individuals (visitors and citizens) randomly selected in the historical center of Cartagena during July and August, 2015. These persons were identify at the moment of the validation study by the team doing the evaluation and invited to participate.

4.3.2. Procedure

The study was carried out by a team of ten beginning researchers from Fundación Universitaria Tecnológico Comfenalco in Cartagena. Team was divided in pairs, a person from the computing area who was responsible for making the explanation of the app to the user and another person from the psychology area who was in charge to observer the behavior and interest of the user.

Each pairs selected randomly the potential user which were just persons in the downtown of Cartagena at the moment of the evaluation. They invited the users to participate in the evaluation, and explained the basic functionality of the system. Then the users were free to explore and use "Social Heritage App" during several minutes. During the time the user was using the application the team observed the attitudes and behaviors of the users.

4.3.3. Instruments

Two instruments were used, one for the quantitative analysis and another for the qualitative. Regarding the quantitative study a survey was applied to users. Survey consisted on 4 questions which could be responded using a Likert scale of 5 possible values: "Totally agree", "Partially agree", "Indifferent", "Partially disagree", and "Totally disagree". Questions were oriented to identify if the users considered the application support they in learning about the heritage and also about the usability of the system.

The instrument for the qualitative analysis was used by the persons from the psychology area which were observing the behavior of the users while they interacted with the application. The instrument provides the observer with a set of categories of analysis, and for each of then the observer was elaborating conclusions of the observation.

4.3.4. Results of evaluation

Figure 4 shows some pictures of the evaluation process carried out in the city of Cartagena de Indias, Colombia.

Fig. 4 Evaluation in Cartagena de Indias

Regarding the survey results we can conclude that the majority of the users consider a good solution the developed technology indicating that it allowed them in the learning process about the heritage in Cartagena. They also have indicated they would recommend the application to other persons.

Regarding the interest and behavior using the application, the majority was very interested and it will be demonstrated by the desire to continue working with the application to deep in its understanding and usage.

76% of respondents reported being "Totally agree" regarding the idea of the prototype support they in the learning process about the heritage in Cartagena as shown in Figure 5. While, 24% of respondents report being " Partially agree". These values indicate the great acceptance that had the app.
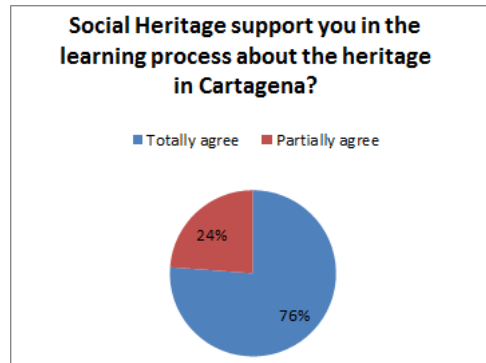
Fig.5. Social Heritage support in heritage education in Cartagena

88% of respondents were "Totally agree" that the prototype developed would help others in the process of heritage education according with Figure 6. 100% of the responders indicated they would recommend to other people to use the application.

Regarding usability, as shown in Figure 7, the 81% of people indicated they considered the application as easy to use and user friendly while the 19% were partially agree.
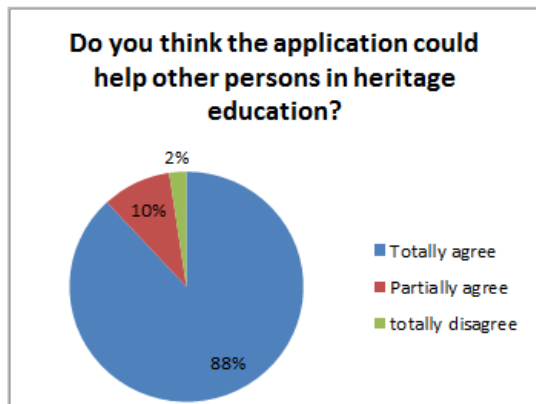

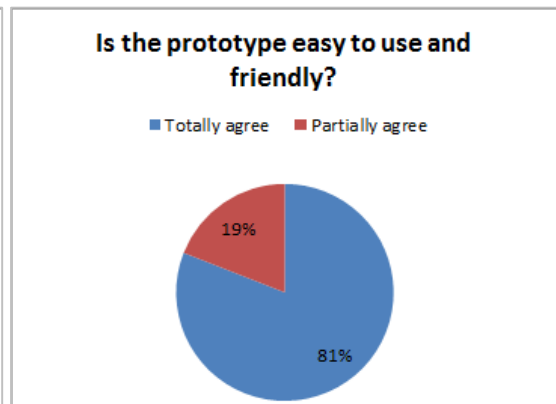Fig.6. Support other people in heritage education   Fig.7. Usability

As mentioned before, the qualitative study was focused on the evaluation of user behavior while using the application. We can confirm that the majority of users showed a high level of interest which was demonstrated by a positive attitude they had when they used the application and the attention they shown while they were interacting with the technology.

It is also important to highlight the recommendations made about the application. For instance, include more points of heritage interest in the city of Cartagena, or that users can define their own content in an easy way because this functionality is not ready yet.

Conclusion

Heritage education might be considered as a pedagogical process in which people are able to learn about heritage assets. This process can be conducted in a formal or informal learning context. In this paper, the "Framework to Heritage Education" was introduced as a conceptual base to support the best understanding about the actors and process involved in heritage education but also to support the creations of applications that using information and communication technologies becoming an opportunity to close the relation between the citizens and visitors and

their heritage. The framework has been evaluated by experts in heritage education, creating an application based on its fundamentals and additionally through a validation carried out with real users.

Results of the evaluation are promising and give important information that must be used to improve the framework and the application.

The use of emerging technologies such as augmented reality in heritage education is promising in both formal and informal contexts, observing that heritage and natural environments are suitable for contextualized learning development processes.

As future work, the framework and the application will be enhance and will be validate them in other cities. Additionally the "Social Heritage App" will be launched and will be published in the market place.

Acknowledgements

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