# “Playing with” museum exhibits: designing educational games mediated by mobile technology

**Nikoleta Yiannoutsou[a], Ioanna Papadimitriou[a], Vassilis Komis[a] and Nikolaos Avouris[b]**

[a]Department of ESECE, ICTE Group,
[b]Department of ECE, HCI Group
University of Patras Campus,
Rion, Achaia, 26504 GREECE
+30 2610969339,
nyiannoutsou@gmail.com, {iopapad, komis, avouris}@upatras.gr

**ABSTRACT**

In this paper, we describe two educational games mediated by mobile technology which were designed for use in the context of a traditional historical museum by young children. Our analysis focuses on the principles of the educational design, on the use of mobile technology and on the envisaged interaction between the exhibits and the children. The main argument of the paper is that mobile technology can support the play with the exhibits of a museum -instead of just viewing them in the more traditional way– and in this context the spectrum of children interaction with the exhibits can be broadened and enriched.

**Keywords**

Museums, educational games, mobile technologies.

**BACKGROUND**

Mobile technologies can find in museums an important area of implementation as they are a natural aid to support museum visits, which are structured around motion and in addition, they support visitors during and not just after or before the visit, as with more traditional desktop computer technologies [10 ,14].

A museum visit which is supported and mediated by mobile technologies can activate the visitors’ motivation by stimulating their imagination and engagement. It can also provide opportunities to reorganize and conceptualize historical, cultural and technological facts about the exhibits in a constructive and meaningful way. Design process should take into account the specific context of use, social and constructivist aspects of learning and pedagogical approaches.

Reviews of existing implications of mobile technologies for educational purposes in museums lead us in categorizing these implications in three main categories. The first category includes applications that mainly deliver information to the visitor. These applications are able to enhance the learning process by supplying multimedia and context-related content [12]. On the other hand, there are applications that provide specific tools that support richer interaction with the user. Such examples are the group of applications developed for the Exploratorium, a science museum in San Francisco. [3], the Sotto Voce System [4]. The third category of educational applications involve a specific educational scenario where the users, mostly children aged 5-15, are challenged to act a role and complete carefully designed pedagogical tasks. Examples of this latter category are: .the MUSEX application deployed in the National Museum of Emerging Science and Innovation in Japan [13], the Scavenger Hunt Game activity used in the Chicago Historical Society Museum [7], the project Myartspace [14], the archeological site game discussed by [1], etc.

One important characteristic of museum visits mediated by mobile technologies is that museum artifacts become tangible: distant museum exhibits that were out there for the visitors allowing them just to observe, now can be virtually touched, opened, turned and decomposed. Technology here provides the key to the user to open up the exhibit, explore it and construct an experience out of it. The exhibit-visitor interaction process in a traditional museum involves reading of information on a tag or the guide and observation of the exhibit. This is considered as one- dimensional “information flow” from the exhibit to the user. Mobile technology facilitates the transformation of the one dimensional relationship to a dialectic relationship between the visitor and the exhibit. Furthermore, this relationship can now include another important component of the museum environment: the other visitors. By providing a record of user–exhibit interaction for other visitors to see, reflect upon and transform, technology can support social activities of communication, co-construction etc., between the visitors. To sum up, mobile technology mediates three

types of interaction between the visitor and the environment of a museum: a) "exhibit – user" interaction b) "user – exhibit" interaction and c) "between the users" interaction about "a" and "b". The enrichment of interaction between the visitor and the museum might result in more or different learning opportunities [2]. In addition, the use of mobile devices provides a new and attractive way of interacting with the museum content especially for young children [5]. In particular when the visitors are young children, this approach of interaction with the exhibits of the museum is that their visit may be placed in the context of educational games. There are many studies on the role of play in learning (see for example [11]) and it has been revisited lately due to the expansion of electronic games. Our perspective in this study is to view educational game as a context where information about the museum exhibits becomes meaningful and can be used for a specific purpose [6]. Situating information in context, facilitates knowledge construction by offering the practices, the tools, and the relevant background along with the objectives towards which learning is directed and has a specific meaning or a special function, as knowledge is used for something [8].

## CONTEXT AND DESIGN PRINCIPLES

The educational games we are presenting in this paper and the technology supporting them are designed for the Museum of Solomos and Eminent Zakynthians, a historical and cultural museum in Zakynthos, Greece. The museum exhibits are mainly paintings, personal belongings, original works of historical persons of the region, mostly literary people, like poets, writers, composers etc. Both game activities are mediated by Personal Digital Assistants (PDA) and children are expected to use the PDAs in order to play the games.

The design of the game activities followed a set of principles which are briefly presented here:

- *Design in respect to the organization (museum)*. Technology was smoothly embedded in the museum ecology without demanding extreme changes of the physical layout of this traditional museum. Additionally, the new computing infrastructure built tried to support and enrich the accumulated knowledge about the exhibits that existed before the addition of technology (i.e. clustering of exhibits, predefined thematic routes etc.)
- *Design for unobtrusive presence*. Museum visit is by definition a social activity. Therefore the system was designed in such way in order to ensure that it will not isolate the users by blocking the interaction with other visitors. For example the visitors are asked to use PDA's speaker in order to listen to the exhibits description and not headphones. Also, visitors have full control over the system by being allowed to view exhibits outside the predefined routes and freely switch between exhibits at any time.
- *Design for engaging the users*, or viewing the exhibits vs "playing with them": The exhibits and the relevant information is not something distant for the visitors just to see. On the contrary, situating exhibits in the context of a game, offers to the young visitors the opportunity to use the exhibits and the information about them in a meaningful way. The difference between viewing and playing with the exhibits would be something like learning geometry for knowing it or learning geometry because you need it to construct something [9].
- *Design for enriching the spectrum of interaction between the museum end the user*: The games designed and the technology which supports them allows two dimensional interaction: interaction with the exhibits and interaction with the other visitors. The aim here is to see the museum visit also as a social activity.
- *Design for collaboration*: The activities are designed so that collaboration is an integral part of the game activity which means that the users need to collaborate in order to play the game and complete it. In the first game called *Donation* inter and intra group collaboration takes place. In the second game called *Museum scrabble*, users collaborate within their group but they need to take into account the actions of the opponent group.

## THE EDUCATIONAL GAME ACTIVITIES

In this section we describe two educational games that were developed according to the principles presented earlier.

### Donation

The "*Donation*" activity aims at the engagement of children in collection and manipulation of data about the museum exhibits through collaboration. It is based on a scenario, according to which the children are asked to locate a specific exhibit in order to facilitate an unknown art benefactor to donate certain artifacts to the Museum. Children read information about the exhibits by scanning RFID tags that are located near them, using their PDAs and try to locate in the collected information some hidden hints. These hints describe the sought exhibit. They can store these hints in a notepad in their mobile devices and use it in order to solve the given problem. Exchange of these hint phrases between the children is not only supported but also imposed by the application in order to encourage collaboration among participating teams. Collaboration is also encouraged through a set of rules that does not allow teams to collect all available hints. Each team can collect only three of the six hints. Teams need to exchange their pieces of information to have a more complete description of the exhibit they are looking for. Also agreement on the selection of the described exhibit is needed. Both teams need to indicate by using a specific button of the PDA an exhibit to check if it is the exhibit they are looking for. This activity is completed once the teams indicate the described by the collected hints exhibit. Two teams or at least two individuals can take part in this activity.

### Museum Scrabble

The *Museum Scrabble* game is based on the idea of linking exhibit properties with exhibits. The basic components of the game are the clues, the triggers and the exhibits. Clues are pieces of textual information associated to a specific exhibit, that contain triggers for linking to other exhibits. These links have varying strengths, and thus the challenge for the young players is to identify the stronger links, thus collecting more points. Clues might refer to those exhibits which are the focus of the visit (e.g. the works of an author or the paintings of the specific period) and the main information about the exhibit is stored in the game as items/triggers of the clue. Each trigger can be linked to more than one exhibits giving points to the player according to its relevance to the trigger. Thus, a more relevant to the trigger exhibit when linked to it, adds more points to the score than a less relevant one. Potentially all exhibits can be linked to a trigger but not all of them add points to the player.

As mentioned earlier, the clues are stored in the PDA when the game starts. However, the children have to search in the museum for the exhibits and store them in their PDA in order to link the exhibit to the trigger of the clue. Thus the trigger provides a point of view, or a criterion in searching in the museum for the relevant exhibit.

The game is designed so that a group plays against another group. Hence when an exhibit is linked to a trigger, then this exhibit becomes no longer available for links to the other group. The group that made a link between a trigger and an exhibit can break this link and make the exhibit – and the trigger- available again. Each group is aware of the score of the rival group and is also aware of which triggers the opponents have already linked. The game ends when all clues are linked to exhibits and the winner is the group who has the highest score. The game can be either played by two individuals – playing one against the other- or by two groups of children.

## THE MEDIATION OF MOBILE TECHNOLOGIES

Why do we need mobile technologies to support the above games? Our answer to this question is the mediation of mobile technologies in engaging in educational games in the museum contributes in enriching children interaction with the museum in the following ways:

- Store, manipulate, exchange information
- Transform the one dimensional relationship between the exhibit and the user (flow of information from the exhibit to the user) to dialectic relationship (the user can interact back with the exhibit, by asking for info, clues or hints, by linking it with other exhibits)
- Support the process of making museum visit a social activity rather than an individual matter (status awareness of the co-players, awareness of the other players interaction with the exhibits, exchange of information etc).

## EXPECTED INTERACTION – CHARACTERISTICS

The dialectic relationship between the user and the museum artifacts, mediated by mobile devices, might offer chances for analysis of the exhibit, experimentation with it, hypothesis formulation and testing, construction of interpretation, information processing and organization, reflection and many more, according to the educational activity designed around the proposed games. Collaboration and communication about the exhibits and information processing about them makes possible socio-constructive learning activities. If we compare these elements of the learning process to the reading of information or listening to information about the exhibits (which is a the starting point for a traditional museum visit) we might realize that mobile technology has the potential to offer an active role to the visitor: she can choose the information she wants to see, open up and de-construct an exhibit if she is interested in it, see how other visitors have interacted with a certain exhibit, discuss about it with them, exchange information, store information for further processing and use etc.

## PRELIMINARY FINDINGS

The games we presented here have been used in two pilot studies in order to test the functionalities and to observe how visitors respond to the games designed. The outcome of our observation was used as input for fine tuning and refining the details of the educational games.

The *Donation* was implemented inside the museum when two groups of children participated in this study. The first group consisted of seventeen 11 year olds elementary pupils. The second group consisted of twenty 14 year olds junior high school children. Children played in pairs. Each pair could use one PDA. Data were collected by video cameras, mp3 recorders, questionnaires and interviews. Dialogues, observation notes and log files were used for the evaluation of the activities.

Children appear to be highly engaged and motivated by the game. All teams managed to complete the donation activity and collaboration occurred not only among children in a group but also among pairs.

The *Scrabble* game was tested so far just with grown-ups. The results of the relevant pilot study were similar to those of the *Donation* with respect to user engagement. Additionally, the study offered valuable feedback with respect to the design of the activity because we realized that some exhibits were more appropriate for being used as clues in comparison to others and we focused on pinpointing their characteristics, thus re-designing the content of the game.

## CONCLUDING REMARKS

The use of mobile technologies in the context of educational game activities provides the tools and the conditions for an enriched interaction with the museum exhibits in the following ways: Children can interact with the exhibits, use their information to play the designed

games and search for other exhibits. The technology used and the design of the games adds a social dimension in the museum visit because it supports and includes interaction between the visitors of the museum. Finally, the educational game-like activities have been designed so as to offer a context where the exhibit information becomes meaningful and useful, i.e: children are expected to use this information in order to play the games and achieve their goals. Thus the exhibits and their information are not treated as something for the users just to see and know but as something that can play with, think with and have fun with in a purposeful manner.


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