Technology Enhanced Learning Environments for Social Literacy (TEL4SL)

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Methodological Guidelines for Pedagogical Exhibitions

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Erasmus+

1. Introduction

The TEL4SL project, submitted and approved by the ERASMUS+ Programme in 2014, has the overall goal to research, implement and test a technology enhanced learning environment at the Universal Values Museum (UVM), in Mafra Portugal, serving as a model for future reference and potential replication.

For the purpose of supporting knowledge sharing about this pilot experience at the UVM – where a significant number of digital and non-digital learning modules were built, tested and evaluated – the TEL4SL project has also included a set of training activities to build transferability capacity into other countries. These trainees – Entrepreneurs in Social Literacy – came to the UVM to an in-depth training on the foundations of this pedagogical and technological model, accessing knowledge, methodologies and tools to multiply Social Literacy efforts in their communities and regions. On that foundation, these social entrepreneurs are capacitated to act as mediators and consultants to future replications of the UVM in other social and cultural contexts.

2. Summary Report

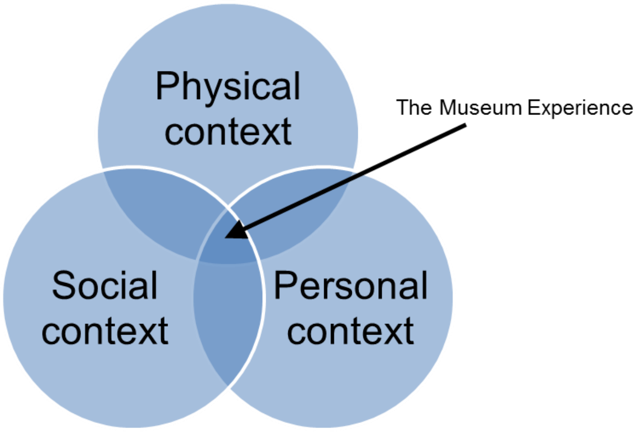
This chapter is a product of interpretation of the transnational team's report on best practices, aimed to facilitate the sharing of information among stakeholders who are interested in setting up interactive learning exhibitions, acting as a methodological guideline as used to the setting up of the Universal Values Museum (UVM).

2.1. Rationale for the Design of UVM – guidelines summary

UVM will combine a physic layout with a set of interactive activities/games. We intend, in this framework, to merge physical collaborative experience, technology and pedagogically relevant activities/games.

Ævarsson (2005) thesis introduces the "Interactive Experience Model", a method to prepare the experiences offered by museums to its visitors. This model combines three different contexts:

social, personal and physical. According to this model, the interactive experience stems from the intersection of these three contexts.



The utilization of video, audio and other multimedia activates the 'sensitive memory' and, when properly combined with the physical and social context, may lead to a richer experience, when compared to the experiences in museums without technological support (Raptis, Tselios & Avouris, 2005).

> "While new methods can only go so far as in offering new possibilities of interaction, it is the way those methods are used creatively to create new experiences in the museum." (Ævarsson, 2005: 2)

The mobilization of technological elements in UVM is supported by a relatively wide framework that integrates multidisciplinary contributes. It is argued that, in a general sense, using ICT allows to create rich learning environments and significant cultural experiences, improving the visitors' experience.

> "A digital context can augment the museum experience and offer the museum visitors a new possibility." (Ævarsson, 2005: 2)

The widespread familiarity with mobile devices makes them a technology with great potential from the pedagogical viewpoint, especially among the youth.

> "Mobile devices are an integral part of children's lives and they are here to stay. (…) Just as *Sesame Street* introduced generations of children and their families to the potential of television as an educational medium two generations ago, today's children will benefit if mobile becomes a force for learning and discovery in the next decade." (Shuler, 2009: 9)

An interactive exhibition should respect some basic principles regarding the balance between technology and physical context (Yiannoutsou, Papadimitrou, Konis & Avouris, 2008). First, it's important that technology is harmoniously integrated in the physical space, without the need to make radical changes in its the natural arrangements, assuring that the preservation of the knowledge previous to the technology. At the same time, technology shouldn't block the visitor's experience in any way: the system's complexity should not turn into an entanglement of barriers for the visitors, given that they should be able to use it in a simple and fluid way, not having to face technical complications. Applications should engage the users, leading them to make sense of the information they are provided with during the visit. The utilization of technologies should not take the place of social interaction; actually it can promote it and enrich it through collaborative experiences – the design of the applications should consider not only the user-device interaction, but also the collaborative interaction among users and the device.

Thus, it follows that the utilization of technological devices in museums should be properly framed in the *context* in which they will be integrated.

> "Museums are a representative example in which the context influences interaction. During a museum visit, the visitors interact with the exhibits through mobile devices. We argue that, effective interaction design needs to take into consideration multiple dimensions of the context." (Raptis, Tselios & Avouris, 2005: 1)

In a general sense, the concept of context refers to the physical, technical and social elements to be considerate during the development of the technological frame.

> "During a museum's visit, interaction between the visitor and the historical, social, or scientific realm defined by the exhibits should take place. In order for this interaction to be effective, both sides should be able to use implicit situational information. The mobile device as a part of a context aware application should be the means to provide this particular type of situational feedback augmenting the experience of the visitor." (Raptis, Tselios & Avouris, 2005: 7)

In this framework, a *system* is defined as a set of interconnected devices and applications. The system should be organized in such a manner that users can navigate it, discovering information as they experiment different interactive applications (Raptis, Tselios & Avouris, 2005: 3).

The *infrastructure* refers to the way the devices and applications that compose the system are connected (Raptis, Tselios & Avouris, 2005: 5). This is a very relevant aspect in the development of an interactive project, since the success of the communicative processes that operationalize the experiences demanded by users depend on it – if the infrastructure is fallible, the visit's interactivity is compromised. Thus it is important to assure that the connections among devices are conveniently established and work in a reliable way.

The *domain* has to do with the system's adaptability, i.e., its ability to adjust to differentiated user profiles, providing personalized interactive experiences. This feature largely depends on the existence of a server capable of hosting relevant data to anticipate users' expectations and interests (Raptis, Tselios & Avouris, 2005: 5). In an ideal set, the domain is capable of presenting the user with relevant suggestions while offering him different alternatives – hence flexibility should be regarded as a relevant element while designing this module.

In an interactive experience, it is essential to consider the *physical context*, or the natural environment where the devices will operate – these are still the objects with which the users establish their most immediate sensitive experience. The success of the interactive experience thus depends on the devices' ability to locate themselves in space, to move, to identify natural conditions (eg. noises) and to communicate with other objects (Raptis, Tselios & Avouris, 2005: 6). This is where innovation resides in the utilization of mobile devices: in the overlaying of physical and virtual spaces (Raptis, Tselios & Avouris, 2005: 2). It is from the interaction of these two spaces that stems a really innovative experience for the user, who comes to move simultaneously in two significant universes that compliment one another.

An adequate technological system should be plural, that is, it should offer distinct experiences to the users, depending on their profiles. In the one hand, the individuals' interaction with the physical space: how they move across the space and how they allocate their attention and time (Raptis, Tselios & Avouris, 2005). On the other hand, it should include diverse contents in terms of format (audio, video, games, etc.). Overall, the system should respond to the users' different personal contexts, which define their motivations, expectations and experiences.

> "Each person grows in a cultural environment that will compose a part of her personality. Personal context encompasses all of the user's motivations, knowledge and beliefs, as well as his choices regarding the route, his attitudes during the visit and the afterwards reinforcement events and experiences outside the museum. Each person's life experience and the cultural environment in which she's embedded surely make a difference. These personal context elements only make sense here when related to the museum's interactive experience."
>
> (Almeida & Lopes, 2003: 143)

Mobile applications should be conceived as mediating tools in the learning process, and never as ends themselves (Winters, 2007). It is important to keep in mind that the user's purpose is to learn and not simply to use a certain technology. Thus it is more appropriate to talk about mediated learning, and not about mobile learning (idem). This conception broadens the thought frame regarding learning processes, since it implicitly established that these depend upon a set of factors. Actually, the apprehension of knowledge depends on the stimulation of various “sensitivities”, that can’t always feed on only one device (Winters, 2007). Thus, mobile devices should be framed in a more complex system, interacting with other learning tools.

Considering Winters’ reference frame, we assume that mobile devices can be integrated in an interactive learning system. It is thus important to clarify the roles played by these technologies in the learning process (Yiannoutsou, Papadimitriou, Komis & Avouris, 2008: 1):

1. Amplification of the learning process by providing multimedia content;
2. Enrichment of the interaction between user and physical objects;
3. Performance of pedagogical tasks through applications designed for this end.

The utilization of mobile technologies shouldn’t neglect social interaction in favor of interaction with non-humans; it can even be used to stimulate it and enrich it. The user should thus be able to interact with 1) the mobile device, 2) the exhibition and 3) other users (Yiannoutsou, Papadimitriou, Komis & Avouris, 2008). In game applications, the development of social skills and values can be stimulated, namely in terms of collaborative action, which can be integrated in group games. Collaboration is “a process throughout which individuals negotiate and share relevant understandings regarding the solution of a given problem” (Roschelle & Teasley, 1995, cit. Stahl, 2006: 3). It is important to differentiate cooperative learning, in which work is distributed and tasks are performed individually, from collaborative learning, in which partners perform the tasks together (Dillenbourg, 1999, cit. Stahl, 2006: 3).

Regarding the interaction among users and physical objects, mobile devices contribute to transform a unidimensional relation into a dialectic relation (Yiannoutsou, Papadimitriou, Komis & Avouris, 2008: 3).

2.2. Best Practices – model cases summary

There are already many interactive applications that conciliate the concepts of social and technological spaces and pedagogy. Games and other interactive applications with pedagogical purposes have been conceived and tested in the context of museums or exhibitions. The knowledge gathered from the development of such applications should be analyzed in a progress perspective, identifying strengths and weaknesses to reinforce or mitigate in the development of new applications.

Using interactive applications is mainly aimed at deepening the users' relation with the museum, but it also involves the promotion of social interaction among the visitors. On the other hand, applications are learning tools conceived not only to facilitate but also to improve the users' acquisition of knowledge and skills.

- **Scavenger Hunt Game**

One of the basic objectives of using interactive resources is to capture the visitors' attention, encouraging them to look at the museum's exhibitions with more detail. Projects such as "Scavenger Hunt Game", developed by Su Young Kwak (2004), are conceived to stimulate younger users' sensitive memory, combining interactive media with artifacts and encouraging them to search for historical facts by providing them with graspable meanings. The game's scoring system was conceived to promote a greater interaction with the space, thus avoiding that the users choose to explore the device instead of the space.

These applications are, by definition, interactive. Therefore, they offer various possibilities in terms of their practical operability, that is, they can be used from different strategic frames oriented to different purposes.

- **MyArtSpace**

"MyArtSpace" was tested in three museums in the United Kingdom over a year, comprehending over 300 students. This is a model project regarding the utilization of technology to promote a greater interactivity between schools and museums, not only because of the design of the application itself, but because of its contextualization: before the visit, in the classroom, students work on a question to explore in the museum and work on research and evidence collecting skills. In the museum, they are given smartphones with the "MyArtSpace" software – the application allows to watch multimedia presentations of the exhibition, to take pictures, to record audio, to take notes and to see who attended the exhibition. The contents produced by students are hosted in a website that keeps a record for each visitor.When they return to school, students can review their visit and all the records they made, share contents and build presentations.

- **GeoHistorian Project & Yellow Arrow**

"GeoHistorian Project" was developed to mitigate the barriers between schools and community resources. Using smartphones, students can build digital resources (pictures, video, audio) that are available to the local community through QR codes placed in historical spots. This project uses mobile devices as learning tools inside and outside the classroom, while promoting a greater integration of the local community. "Yellow Arrow" is very similar to "GeoHistorian Project", but it's open to all the community and uses SMS instead of QR codes. QR codes are used in many applications in museums or exhibitions, basically to provide additional information. At the Derby Museum, QR codes give access to a "QRPedia", a virtual database that complements the physical exhibition. QR codes can also give access to blogs about certain parts of the museum or exhibition, thus promoting dialogue and social interaction among users/visitors (Fenimore Art Museum).

> "(…) students' interactions will be enriched when possibilities of social software are integrated in the learning situations, and thus, building virtual communities will be more fluent than in more traditional virtual learning environments." (Järvelä, Näykki, Laru & Luokkanen, 2007: 75)

Sharing and discussing contents in virtual platforms such as blogs, forums or social networks is a way to stimulate social interactions based on experiences in museums, while giving continuity to the learning process.

- **Mystery at the Museum**

"Mystery at the Museum" was developed by MIT and uses augmented reality to create an interactive experience in which Science Museum visitors are invited to solve a mystery in a collaborative activity. Real and virtual worlds merge, creating an unique interaction context and a challenge that requires exploring the physical space, using the technological tools and interacting with other visitors. The project was designed for a specific target audience: families with teenage children. This target audience led to another purpose: promoting a greater interaction and collaboration among parents and children during the visit. It's a pedagogical game of approximately 2-3 hours in which users (teams of parents and children) play the role of researchers (a technician, a biologist and a detective) to solve the robbery of one of the museum's artifacts. The interdependence among the roles of each specialist promotes greater collaboration among players. During the game, participants get to interview virtual characters and to examine virtual objects using virtual equipment. The game ends when the team collects enough evidence to obtain a virtual mandate to arrest the robbers.

The game was tested in two weekend afternoons with a group of 20 parents and children per day. All the participants were invited to answer inquiries about the process and some of them were interviewed by the research team, in order to evaluate the success of the application. Results have shown that the visitors felt a greater engagement with the museum and the exhibitions, admitting to have searched for information that they would otherwise have ignored. On the other hand, the application's success in promoting interaction and collaboration among participants was also demonstrated.

We highlight two relevant notes from this experiment: first, the importance of preparing the visit in the classroom; second, the importance of testing and providing different difficulty levels in such applications, since too much difficulty will make the participants lose interest. Adjusting themes and contents and correspondent difficulty levels to the users' profiles is indeed a key aspect of application design. In "Scavenger Hunt Game", the questions are organized in categories that the users chose according to their personal taste, and the themes were selected according to the expectable knowledge for the defined age range.

> "The educational value of many of these games is not always clear, but what is clear is that kids are becoming more familiar with works of art, they are learning to look and think critically about art, and they are associating museums and art with fun." (from a review in futuresoflearning.org)[1]

- **Mobilearn & M-Learning**

"MOBILearn" and "M-Learning" are success cases in the utilization of mobile devices in learning processes.

> "The proliferation of mobile phones and other handheld devices has transformed mobile learning from a researcher-led, specialist endeavour, to an everyday activity where mobile devices are personal tools helping people learn wherever they go, through formal training or informal support and conversation (Kukulska-Hulme et al., 2007)." (Kukulska-Hulme et al., 2009: 13)

"MOBILearn" comprehends three learning domains: 1) mixed learning – as parto f formal courses; 2) accidental learning, dependent on location – in visits to museums; 3) information sources and advisement learning – acquiring medical information for daily life. The project is supported by 24 European partners, Israel, Switzerland, USA and Australia. "MOBILearn" has successfully shown that mobile devices can be used to provide users with information and

[1] http://futuresoflearning.org/index.php/Firda_08/tag/games+in+museums

guidance given their location and route. "M-Learning" targets young adults who abandoned school and uses SMS quizzes, mobile games and forums, and has proven itself efficient.

> "Reports from the project concluded that mobile learning can work, reaching places that other learning cannot, it is best provided as part of a blend of learning activities, it offers a collection of pieces to be fitted to a learning need rather than a single solution, it is not simply a tool for delivering teaching material but can be used for learning through creativity, collaboration and communication, and that the best way to get started with developing mobile learning is to try it in practice through trial and experiment with simple tools." (Kukulska-Hulme et al., 2009: 18)

2.3. Summary – An innovative vision for the Museum

The analysis of model cases in light of the framework presented above allows us to identify some good practices to follow, to analyze and, eventually, to adopt in the context of the Museum, toward a potential pilot implementation.

Without being exhaustive, the table below provides a summary and a stimuli to our creativity:

	Physical space	Social Space	IT
SHC	Stimulation of the sensitive memory Requires detailed observation of the exhibition's elements	Articulation of contents with school curriculum/ users age range	Scoring system implies physical exploration Questions organized by theme and chosen by the user
MyArtSpace	Implica preparação da visita ao espaço	Background work in classroom Comparing multimedia records in classroom, after the visit	Mobile devices capture vídeo, pictures and personal notes Upload of a personal area with multimedia archive
GeoH & YArrow	Multimedia contents are additional information about the objects in the physical/local space	Community integration Valuing local context Stimulates online interaction and sharing	Picture, video, audio and ~~text records~~ Building informative videos about physical objects

QRPedia	Create interest about existing objects. Additional information about the physical objects Enriquecimento da visita ao museu	contents and opinions among users Blogs and forums promote discussion among groups	Access to contents through QR codes QR codes give access to information hosted in a database
M@M	Promove a exploração do espaço do museu Promotes search for aditional information	Collaborative parents-children interaction Role playing with interdependente roles promotes collaboration	Virtual scenario complements real scenario: virtual characters, tools and objects.

3. Methodological Guidelines and Learning Scenarios

3.1. Mobile Learning – Key Features

Key characteristics of mobile learning that emerged in the workshop are as follows (Winters, 2007):

- Enables knowledge building by learners in different contexts.
- Enables learners to construct understandings.
- Mobile technology often changes the pattern of learning/work activity.
- The context of mobile learning is about more than time and space.

Mobile learning applications to be innovative should not focus on information transmission and must move away from a model of 'anytime, anywhere' access.

The implications of the role of mobile devices in the socialization process (Winters, 2007):

1. Mobile learning applications are best viewed as mediating tools in the learning process. They are not ends in themselves and should be related to other learning tools that students and teachers are already using, and/or tools that having arisen as a result of technical developments (e.g. social software).
2. Designing a mobile learning activity can be supported by addressing the following factors:
    a. The learner and their personal relationships (peer groups, teachers, etc.)
    b. What is the leaner learning (topic, relationship to prior experience, etc.)?
    c. Where and when are learners learning?
3. By answering these questions, the application will be designed from the ground up to form the basis for a distributed learning network. This construct sees mobile learning as part of a greater whole in which learning tools, activities, contexts and people are distributed over time and space.

The workshop group presented a concept map of key characteristics (Figure 1). The most revealing aspect of this map is that it is centered upon mediated rather than mobile learning. This reflects the participants' view that learning is mediated by a number of factors, which when viewed from a particular perspective, help in characterizing the unique dimensions of mobile learning. By beginning to delineate these factors, participants felt there was a strong rationale for using the concept map as a collaborative tool for all stakeholders to identify design sensitivities that need to be accounted for when developing mobile learning applications. A partial list of these factors include (Winters, 2007):

- Contexts
- Curricula
- Cultures
- Ethics
- Tools
- Learning activity
- Access to information and people
- Communication
- Community building
- Appropriation

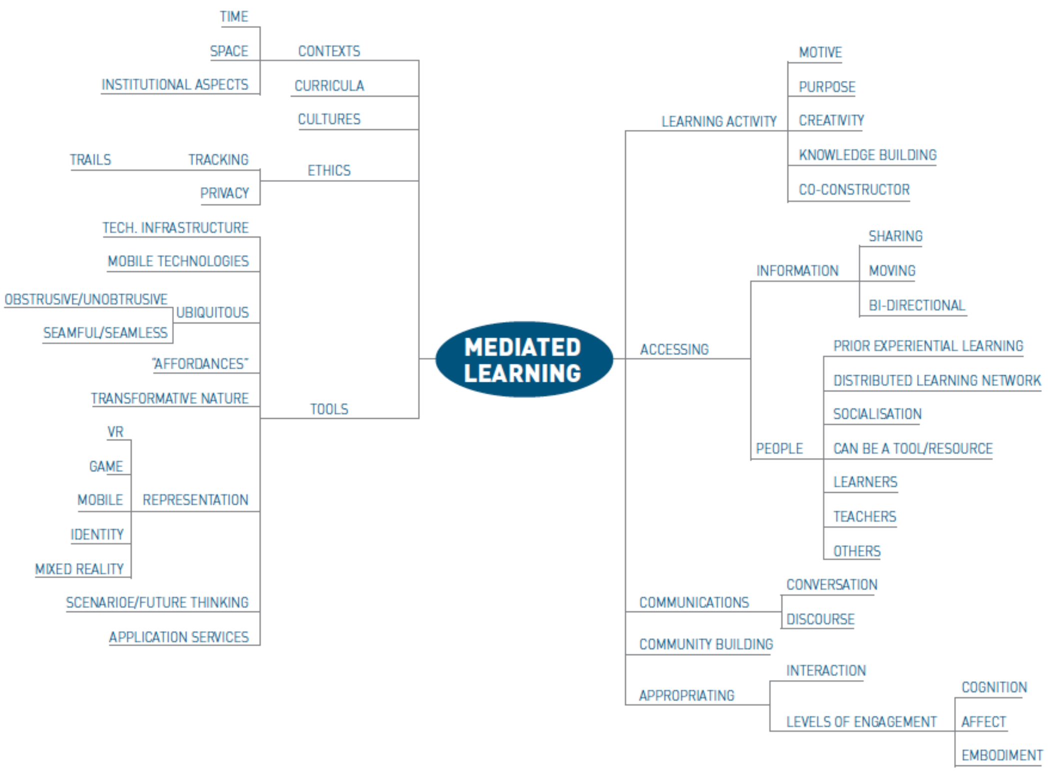


Figure 1: Mediated learning through mobile technologies (M2 learning)

3.2. *Mobile Technologies – Interaction with visitors*

The **use of mobile technologies** for educational purposes in museums can be classified in three main **categories** (Yiannoutsou, Papadimitriou, Komis and Avouris, 2008):

1. Includes applications that mainly deliver information to the visitor. These applications aim to enhance the learning process by supplying multimedia and context-related content.
2. Includes applications aiming to enrich the interaction between the user and the exhibits (Exploratorium, a science museum in San Francisco; and the Sotto Voce System).
3. Includes applications designed around a specific educational scenario where the users, are challenged to act a role and complete carefully designed pedagogical tasks. (MUSEX application deployed in the National Museum of Emerging Science and Innovation in Japan, the Scavenger Hunt Game in the Chicago Historical Society Museum, the Myartspace service for gathering multimedia information during museum visits.

Mobile technology facilitates the transformation of the one-dimensional relationship to a **dialectic relationship**. 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 (Yiannoutsou, Papadimitriou, Komis and Avouris, 2008). The **purpose of the visitor** is to see and learn more and not to explicitly use the technology.

Mobile technology mediates three **types of interaction between visitors and the environment of a museum** (Yiannoutsou, Papadimitriou, Komis and Avouris, 2008):

a) "Exhibit – visitor" interaction (e.g. information about the exhibit provided to the visitor)
b) "Visitor – exhibit" interaction (e.g. annotation of the exhibits, or comments about the exhibits by visitors) and
c) "Between the visitors" interaction concerning exchange of information and comments among the visitors

The **type of visitor's behavior** can be described through four metaphors (Raptis, Tselios, Avouris, 2005):

- The *ant visitors*, who follow a specific path and spend a lot of time observing almost all the exhibits;
- The *fish visitors*, who move most of the times in the centre of the room without looking at exhibit's details;
- The *butterfly visitors*, who don't follow a specific path, are guided by the physical orientation of the exhibits and stop frequently examining their details;
- The *grasshopper visitors*, whose visit contains specific pre-selected exhibits, and spend a lot of time observing them.

Deeply understanding of the needs of all the types of visitors is important during the design phase, to avoid disturbances that can destruct the visitor from her objective.

The museum visit is an emotionally intense learning process. It is well known that the emotions vary during the visit, affected by the visitor's personality and by the 'feelings' projected by the exhibits. In respect of the visitor's behavior, the most important factor, affecting the interaction, is the **content**, which is going to be presented. It must be attracting, forcing the user to dig up for details and increasing the levels of excitement. Because of the emotional involvement, the use of videos, audio descriptions etc., trigger the 'sensitive memory' and if are carefully mixed with the context, may lead to a richer experience compared to nonsupported museum visits (Raptis, Tselios, Avouris, 2005).

As a result, the design process should involve, as a factor of great importance, the generation of various forms of content, not only concerning type of content (i.e. video or text) but also concerning different approaches of the same subject, in order to anticipate varying visitor's needs.

We cannot expect that all the users have the same needs and as a result, design a system that is suitable for all. Taxonomy of user profiles should be built, reflecting user needs, expectations from a museum visit, user characteristics and background (Raptis, Tselios, Avouris, 2005).

3.3. The Framework of the Context

The notion of context is of fundamental importance to anticipate the design challenges in mobile applications. According to Dix et al., context is defined as any information that can be used to characterize the situation of an entity. An entity should be treated as anything relevant to the interaction between a user and an application, such as a person, a place or an object, including the user and the application themselves. In general terms, context is typically the location, identity and state of people, groups and computational and physical objects (Raptis, Tselios, Avouris, 2005).

This particular theoretical framework defines context through four dimensions, which complement and interact with each other. These dimensions are: system, infrastructure, domain and physical context. We argue that this view of context is useful for the design practice, and can be useful framework for many areas of mobile applications (Raptis, Tselios, Avouris, 2005).

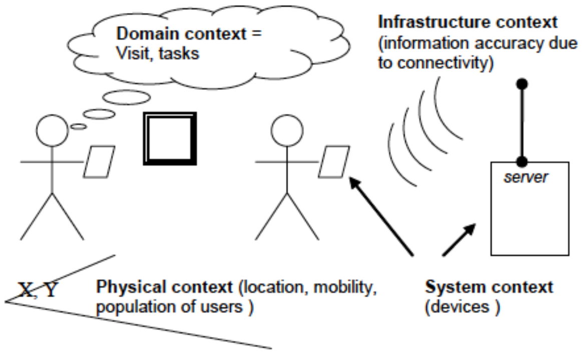


Figure 1. Framework of context dimensions

A. System Context refers to all the interconnected devices and their applications which constitute the system as whole. Is particular related with the awareness that every device has, about the existence of the others, and the way the overall functionality is distributed across them. Careful design of mobile applications should take into consideration the discovery and exploitation of applications and information distributed across the whole system.

The system context plays an important role in mobile applications design, as it influences the visitor's behavior towards the Museum and the tasks (the interaction between the visitor and the exhibits), so the various issues related to system context should be taken in consideration early enough in the design process, since inadequate design in system level most of the times leads to errors that are very difficult to deal with later.

PDA: Device that helps the visitor interact with the museum exhibits.

Four possible technological approaches, using PDAs:

1) The PDA consist the whole system. There are not any other devices or awareness mechanisms involved and the information presented to the user is stored locally in the PDA. (Projects "Sotto

Voce"[2] and the "Points of Departure"[3] systems)

2) RFID tags were used to establish communication between the PDAs and the exhibits. (Projects "Rememberer"[4] system in the Exporatorium Museum)

3) Bluetooth was used to establish communication with the exhibits and to deliver the content. (Project Imogl' system – had problems)

4) IrDA technology to estimate the position of the visitor in space. The IrDA tags are placed near every exhibit or in the entrance of each exhibition room. The use of Wi-Fi derives the information to the PDA from a server.

The dimension of system context involves also software components, or more specific, the set of applications that constitute the system. There is an awareness factor that implies that the user must know each time which applications are available, and in which state these are. All the interconnections between applications are part of system context.

In such distributed applications, it is important the feedback that the user gets from the system about the existing devices in the system, the existing applications etc.

B. Infrastructure Context describes the way the devices and their integrated applications are connected. It is related with the validity of the information, namely how timely and accurate is the information that every node of the system reflects. The central idea of infrastructure context is related to the variety of awareness mechanisms that a system has to give to each user about the existence of a component and the existence of timely presented information.

In some cases, this dimension may influence the well being of the users. If we consider a mobile device that projects levels of radiation in a possibly contaminated area, the consequences of a system malfunction, resulting in providing not timely information to the user, can have devastating effects.

[2] The "Sotto Voce" system is deployed in Filoli, a Georgian Revival House in Woodside, California and gives details about everyday things located in an old house, [20], by having pictures of the walls on the PDA's screen and asking from the user to select the exhibit she is interested in, by pressing it.

[3] The "Points of Departure" system, in San Francisco Museum of Modern Art [17], gives details, in video and audio form, about the techniques used in an artwork, the message that the artist wants to demonstrate etc., by having 'thumbnails' of several exhibits on the PDA's screen.

[4] The "Rememberer" uses cameras to take pictures from the visitors interacting with the exhibits. Through Wi-Fi, the comments that the users wrote in the PDAs and the pictures taken, are send to a web server, stored in the form of web pages, allowing each user to remember her personal visit afterwards.

The infrastructure context needs to be preserved not just in problematic situations. It is also related with the validity and timely updates of available information. This can be clearly seen in collaboration activities. Then, the user needs to know the other users, the virtual space, the shared objects, the manipulations that another user may perform in an object etc.

Also, as another example we can assume that there are applications with varying content, like the electronic messages the visitors leave at the exhibits. In such a case, it is important to give feedback about the changes in content

The systems we are studying use an indirect way of informing the user that her requests have been carried out: the user sees and hears the reflection of her requests on the PDA. There is no clear notification that the user's demands executed successfully or not.

But in general terms, the user is left alone when problems occur and the systems leave it up to the user to find it out, by observing that there is no progress.

We have to point that it is the nature of the interaction that prevents the designers to have feedback messages in every step (it could be very distracting and even annoying), but it is important, for designers, to include a non intrusive approach to inform that there is a problem and provide guidelines on what the user should do in order to tackle the problem.

C. Domain Context is related with the adaptability that every system must provide to the specific characteristics of different users taking in consideration the situated nature of the interaction with mobile devices. The identity and the needs of each user have to guide the system to alter the quantity and the type of information that is presented to her.

It concerns aspects related to the specific situated interaction that takes place in the specific domain.

In many applications, designers exploit the personal nature of these devices to associate mobile devices with users. In museum applications this is not of prime importance as we often lack information about user profiles and characteristics. It is however important to consider that each visitor in a museum has different expectations, and is interested in different aspects of the exhibits.

The domain context concerns alternative ways according to which the system allows users, to interact with the system in the best way.

In the studied systems, those that allow interaction of the users with servers, there is a possibility for personalized interaction. These systems require from the user to login, answer some specific questions, in order to build a model of the user and have the presentation of the information in her PDA according to her language, her expertise level and her physical needs (i.e. bigger fonts for those with sight impediments). Often systems limit their adaptation at this level. This, however, can be extended to other more domain related characteristics.

During the design phase we need to focus beyond issues of content delivery, which almost all the systems take care. As Dix, [6], predicted in his model, the four elements of context interact with each other. Therefore, decisions concerning system context, i.e. the technology used to deliver information, affect domain context.

So, the information may appear in the mobile device in two different ways, the system may:

- push information to the user or

- wait until the user decides to pull it from the system.

In the first case, special consideration should be taken to the user's specific activity and objective. If the user is engaged in an educational activity, probably she is not interested in information about a nearest exhibit.

So, questions related to situated domain context are the following: Does the system propose any relevant information based on the history of users interaction with it? Does it change its state in order to suite actions that are repeatedly made by the user? Does it provide alternative ways of presenting content? Are they flexible enough?

In "ImogI", the system rearranges the order of the icons, putting in front the ones that the visitor chooses most. In PEACH system, the user can select his personal virtual guide, depending on her needs, i.e. there is a guide who gives historical information and another who gives details about the techniques used to create the exhibit. In PEACH and in 'Points of Departure', the user can change the interaction medium from PDAs to Screens, and as a result she can see more visualized and detailed information. A different form of interaction takes place in the "Antwerp" system. The user holds a camera and takes pictures. By choosing specific parts of the exhibit, she changes the level of detail presented to her. In other words, she can make questions to the system by shooting the part of the exhibit she is interested in.

D. Physical Context is related to the nature substance of the device and the system as a whole, and its relation with the natural environment. It describes the ability that a device must have, to know its exact position in space, to move around the space, to identify natural conditions (i.e.

noise) and to communicate with other entities. Therefore, physical context can be further decomposed into three taxonomies: Location, Mobility and Population.

Location - describes the ability of a mobile device to understand its position in space, either by knowing the exact coordinates (cartesian) or in a more general level, i.e. inside a room (topological). Space has two dimensions: the physical and the virtual space.

The innovation that appeared with the use of mobile devices, compared with desktop systems, is that allowed the two dimensions of space to coexist and influence one another, i.e. when a user moves to another room (physical space) then the system changes the information presented to her (virtual space).

Mobility is related with the basic characteristic of these devices, which is the non static nature. It can be described accurately by three levels:

a) the level of mobility (fixed, mobile embedded and pervasive),

b) from the number of people that can interact with a component at the same time (personal, group and public) and

c) population, which is related with the entities of different type that the system can interact (people, devices and objects [exhibits in their physical or virtual form]).

3.4. Designing issues to take into consideration

Even though there have been many experiments using PDAs as a guide and exhibition learning tool, there have been trials and errors in the operation or content development, thus not many museums maintain the service permanently (Kwak, 2004).

SFMoMa, a museum with the most active use of PDAs, conducted a visitor evaluation and was able to report important findings. According to SFMoMa, any use of a PDA system, such as an electronic guidebook or other handheld device, must be designed to fit appropriately into the visitor's desired experience (Kwak, 2004).

SFMoMa defined 4 critical issues to be considered to design applications for a handheld device:

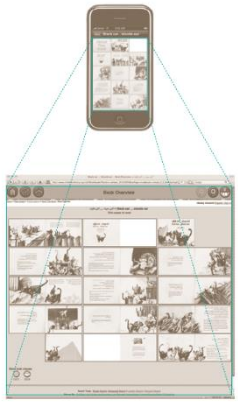
- What the visitor thinks
- Impact on visitor behavior
- What device is best for a given target audience
- What application is best for a learning outcome

Consequently, SFMoMa concludes that certain criteria must be assured to make the product more effective, namely:

- Make prototyping part of the museum or general learning experience
- Plan for user/visitor studies
- Be clear about what the objective is (and who your audience is) and only use the application when and where it is most effective
- Do not use PDAs to replace or take the place of things that already work well
- Be prepared for potential malfunctions and maintenance challenges

A. Develop: Build mobile learning interventions

Industry should be given more powerful incentives to (Shuler, 2009):



- Design educational innovations to capitalize on unique affordances of mobile – It is entirely ineffective to take educational applications that have been developed for a big screen and simply shrink them down to be used on mobile devices. Developers need to discern what is special about mobile devices and design interventions that take advantage of those attributes.
- Counter the disadvantages and limiting physical attributes of mobile devices – Mobile technologies have numerous disadvantages (e.g., can be distracting) and limiting physical attributes (e.g., difficult text entry) that — if not taken into consideration — might detract from the learning experience.
- Avoid constant defaults to the latest technology – In order to develop scalable models, it is important to emphasize features that will become ubiquitous. Relying on features that are more common on less-expensive phones will help ensure that mobile technologies can help close rather than amplify the digital divide.
- Create development tools for educators – Most development tools are oriented toward industry and computer scientists, and not accessible to educators or learners. Once there are more practical tools that conform to how educators design instructional materials, the opening up and consolidating of cell phone platforms could greatly accelerate the use of mobile devices for children's learning.

B. Principles for the design of game activities and the accompanying software

Yiannoutsou, Papadimitriou, Komis and Avouris (2008) present a set of principles for the design of game activities and the accompanying software:

- Design in respect to the organization (museum). Technology was smoothly embedded in the museum ecology without demanding extreme changes of the arrangement of this traditional museum. Furthermore, 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. Technology was infused into the museum exhibits and it was designed so that it is fine tuned to the visitors' actions and intentions. This means that the software was designed so that it does not become an obstacle for the visitors to play the games. The underlying principle was to keep technical aspects (e.g. avoid issues of the type "what do I have to do in order to link one clue to an exhibit") out of the attention of the visitors and provide functionalities that will help them focus on the game and the exhibits involved.
- Design for engaging the users i.e. "playing with exhibits" instead of just viewing them. The exhibits and the relevant information are situated in the context of a game. This approach offers to the young visitors the opportunity to use the exhibits and the information about them in a meaningful way.
- 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 other visitors. The aim here is to see the museum visit also as a structured 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.

Technologies should be (Kukulska-Hulme, Sharples, Milrad, Arnedillo-S´anchez, and Vavoula, 2009):

- highly portable, so that they can be available wherever the user needs to learn;
- individual, adapting to the learner's abilities, knowledge and learning styles and designed to support personal learning, rather than general office work;
- unobtrusive, so that the learner can capture situations and retrieve knowledge without the technology obtruding on the situation;
- available anywhere, to enable communication with teachers, experts and peers;
- adaptable to the context of learning and the learner's evolving skills and knowledge;
- persistent, to manage learning throughout a lifetime, so that the learner's personal

accumulation of resources and knowledge will be immediately accessible despite changes in technology;

- useful, suited to everyday needs for communication, reference, work and learning;
- easy to use by people with no previous experience of the technology.

C. Designing applications

Flash in Pocket PC With the release of Flash MX Professional 2004, Macromedia has significantly improved and enhanced the mobile development environment, making it easy for developers to create Flash content for a wide range of platforms. Some of the new features are the built-in templates for mobile devices, the ability to embed MIDI, WAV, and MP3 sounds into content, and the ability to test and publish into the template directly from the authoring environment.

Standalone Flash Player for Pocket PC by Macromedia enables developers and publishers to create full-screen Flash applications.

Not to mention of the network related issues when hooked up in the Internet, the limitations of designing for PDA device are typically smaller display, slow processing power, less memory and power constraints The first thing to be considered is the frame rate. The higher the frame rate is, the higher the quality of the Flash movie because it makes the movement smoother. Higher frame rate, however, increases both the file size and the demand on the computer's processor (Kwak, 2004).

Another limitation is the use of the ***Action Script***. When someone is viewing a Flash movie on desktop, the Action Script is usually the least thing that affects the performance. Given the fact that the mobile devices have the processor limitations, the Action Script in Flash for mobile devices should be as lean as possible. The more Action Script is used, the more slowdown the movie will experience. To avoid this, Ethan Watrall (cit by Kwak, 2004) suggests that the Action Script should be optimized as following:

- Avoid any unnecessary characters
- Keep the variable, method, instance, and function names as short and as compact as possible
- Use Functions for menu and button events
- Use Functions for repetitive events in the movie
- Use Unload after the use of Load.

D. Devices

Wireless network malfunction or network inaccessibility: due to overload or user's particular position, cannot effectively anticipated and tackled. A useful approach could be to preinstall the most common functionality and information and design accordingly the nomadic application, to smoothly overcome such a temporal situation (system context dimension) (Raptis, Tselios, Avouris, 2005).

Type of PDA: Reflect on screen size, resolution and support the 'landscape mode' of projecting info, play MP3s and multimedia, ways of text entry, battery life, cost and requirement of computational resources (e.g. memory and processor), which kind of operating system supports better the needs of a visitor (Raptis, Tselios, Avouris, 2005).

RFID tags: These tags can be used only in short distances and every exhibit must have at least one tag in order to have a fully functioning system. The user has to locate the exhibit she is interested in, in the physical space, scan it with her PDA and then see or listen to the information about it. This procedure can produce a lot of problems, especially in museums that contain a lot of exhibits placed next to each other. It can be hard to locate the RFID card, and if the exhibit has a small size, no more than one people can interact with it simultaneously (Raptis, Tselios, Avouris, 2005).

IrDA: With the use of IrDA, problems also exist. Use of many IrDA beacons may be prohibitive, since they are more expensive and there can be mixing signals, if they are placed next to each another. They operate in a higher distance than the RFIDs, and so we can describe the interaction using a "remote control" metaphor (Raptis, Tselios, Avouris, 2005).

Cameras and laserpointers: have been suggested as interaction devices, however these may impose usability problems to some user groups, especially in people of certain age groups, who cannot hold for considerable amount of time steady neither the camera nor the laser-pointer. (Raptis, Tselios, Avouris, 2005).

E. Designing/Production issues

Screen size issues

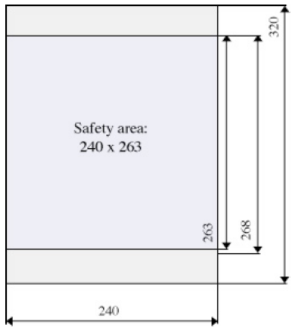


Figure 3 Pixel guide of Pocket PC Explorer

The largest display size for PDAs is 240 by 320 on the Pocket PC platform. The SWF file, however, cannot be displayed standalone without the help of special software.

Generally, it is published being embedded in HTML, so that the Pocket Internet Explorer can display the SWF file. The Pocket Internet Explorer has its caption bar in the top and the menu and address bar in the bottom, each of which takes 26 pixels vertically. The address bar can be removed, but the others can't. The Pocket Internet Explorer, however, has a bug that only allows you to use 263 pixels in height instead of the actual 268 pixels.

Therefore, if you carefully design the content so that the movie clip won't have any scroll bars, the optimal area will be 240 by 263. If you use a standalone player, you can use the whole area of 240 by 320 pixels.

There is another design issue of the Soft Input Panel (SIP) area. This is a small keyboard area in PDAs typically with the height of 80 pixels. If your content requires the use of the SIP keyboard, then you have to consider this area, under which your content will be hidden (Kwak, 2004).

User interface function issues

The biggest characteristic of the user interface design for PDAs is the use of stylus pen and touch screen. Unlike a desktop computer screen, it has a sensor right on the screen so that users navigate either by stylus pen or touch screen (Kwak, 2004).

Iconography and typography

The iconography for a small touch screen must be intuitive and effective enough to deliver a message of possible interactions. The product[5] only has two sets of simple buttons – green circle buttons and finger buttons. As it was mentioned in the interface design section of this chapter, limited set of buttons is effective for children to learn quickly how the interaction works.

Typography is a big design issue, too. Pixel fonts are commonly used in Flash for display in handheld devices. Pixel fonts are typefaces that exactly fit in pixels thus automatically display without any anti-aliasing. Pixel fonts have good legibility despite of very small font size. They are

[5] Scavenger Hunt Game

a nice choice to use for small display screens especially when a page has much text information to display.

There are a few things about pixel fonts to be aware of:

- Pixel font size should be an increment of 8 points.
- Pixel fonts must be placed on whole X and Y coordinates such as 20.0 instead of 20.5.
- If they are input or dynamic text, the font should be embedded in the movie. Pixel fonts work great for information intensive software.

Another issue about fonts in Flash is to embed device fonts. If a text area is not a static text but a dynamic or input text, fonts not installed in the device should be embedded within the SWF movie (Kwak, 2004).

Graphics and illustrations

Graphics created in Flash are vector-based. Vector graphics define the creation of digital images through a sequence of commands or mathematical statements that place lines and shapes in a two-dimensional or three-dimensional space. One advantage of vector graphics over bitmap graphics (or raster graphics) is that they make it possible to change any element of the picture at any time since each element is stored as an independent object. Another advantage of vector graphics is that the resulting image file is typically smaller than a bitmap file containing the same image. Examples of vector-image file types are PDF, encapsulated PostScript (EPS), scalable vector graphics (SVG), and graphics created in Flash. Due to its small file size and scalability without being pixelated, vector graphics work best in Flash. For bitmap graphics, it is best to export in the PNG format.

Two cartoon-style vector characters were created to facilitate the game. Jack, male preteen character, and Sally, female kid character, take turns in presenting an introduction, directions, right/wrong messages, and so forth (Kwak, 2004).

Sound design

Sound was recorded in an audio lab in AIFF format. Sally's voice was intended to sound like a little girl's voice. Using Peak, it was edited for each sound clip for each movie clip. The sound clips were exported as AIFs in Mono, 16 bit, 44.1 KHz setting because most Pocket PCs has only one speaker.

When importing sounds to the library, Flash automatically optimizes for a delivery in Flash. The publish setting has several options for the sound. Flash works best with MP3 option rather than Speech option even though the audio type is speech.

3.5. Benchmarking Educational Game Activities / Applications

Scavenger Hunt Game

The primary objective of this project is to design a handheld Scavenger Hunt game as an effective learning tool of history of Chicago. The product will enhance a museum experience for children aged 9 to 13. It will offer them a unique and fun experience that combines interactive media with artifacts. Throughout these activities, children will discover history facts and find personal meaning and connections through history.

The second objective is to design an effective interface for a handheld device especially for a full-screen Pocket PC using Macromedia Flash MX 2004 Professional. The design challenges include smaller screen size, limited memory and storage, low speaker quality, typography, and other hardware issues.

The Scavenger Hunt game will place participating children in the role of a history detective, provide them a Pocket PC with 10 customized questions to solve, and guide them to find the answers inside the museum with 2 types of hints. It will also have some simple game features such as game points and encouragement system. It may take about 20 minutes to complete the game.

After reviewing the collected content thoroughly, I figured out there can be three types of question-answer matches:

1) text questions with text answers, “In 2004 now, what rank is the Sears Tower in the World’s tallest building record?” with three multiple choices in text
2) text questions with graphic answers, “Which building below beat the Sears Tower in the World’s tallest building record?” showing three silhouettes of world’s skyscraper buildings.

3) graphic questions with text questions. showing the illustration of the John Hancock Center, "I'm the third tallest building in Chicago. Who am I?" followed by three multiple choices in text.

Due to the small screen size, another possible match, which is graphic question and graphic answer, was not considered.

The next step was to create a worksheet with all the content, which will serve as a database for the game. The database fields were Index number, Question, Answer, Genre, Location, Order, Hint 1 and Hint 2. Based on these data base fields, each screen's storyboard was created.

1. The greetings and the instruction of the game will be given first. The goal of the Scavenger Hunt game is to answer all the 10 questions correctly so the children can complete their mission as history detectives.
2. Users will choose among 10 categories according to their interest of Chicago history themes. These 10 categories are based on the museum's previous research about the history themes that elementary school children can easily understand. They can also choose random questions, which will generate 10 random questions, one from each category.
3. Each category has 1 to 8 questions. Most questions will be simple text-based questions with or without a help of visual elements. Some questions can be more interactive and richer in graphics and animations
4. 3 multiple choices will be given. One question is consisted of 10 points. Users may guess, but once they hit a wrong answer, they gain nothing out of 10 points. The first hints reveal related history facts or clues to the right answer. The second hints directly show a flashing light on a floor map where users can find the matching artifact. Skip option will be also globally available, passing the screen to the next question. Each Skip option, however, will have them give up the whole 10 points from a question.
5. Game rules are quite simple. After users choose categories of their interests and are given 10 questions, they can gain up to 10 points from each question. If they skip the question or guess wrong, they earn no points at all. They may use 2 hints, but with each hint, they gain 4 fewer points even though their answer is correct. For example, if they use all of these 2 hints and finally answered right, they will only earn 2 points out of 10, which is relatively small but better than zero points from one question. With these rules, children could be motivated to explore the museum and try to find the answer instead of staying somewhere at the corner and play around the device.

6. Once the answer is correct, it shows "OK" message and moves to the next question. If it's wrong, it shows "Wrong" message and also jumps to the next question.
7. Upon the completion of the whole 10 questions, users will be given the result of the Scavenger Hunt game and the level of their achievement. The goal of this game is to gain the full 100 points or as many points as possible. The achievement tells 3 different levels depending on their points. This feature encourages the children to try the game once again and gain more points.
    - 81 or up: Wow, you must be the master detective of history investigation!
    - 51 to 80: Good job! You have the quality to be a good history investigator.
    - 50 or below: Hmm… Looks like you guessed too much! Why not try again and ace out?
8. Then, users will be given a choice of trying another set of Scavenger Hunt questions or finishing the game. Information on how to return the handheld device will be given when users select to finish the game.

In this product, the interface has 7 different screens as following:

- CHS Logo intro
- Welcome
- Instructions
- Select questions
- Questions
- Result
- Start over

The "logo intro" is made from the original Chicago Historical Society logo, adding only a splash animation on it.

The "welcome" screen starts with Jack's welcome message. This screen is very important in a sense that users interact with the device for the first time. Jack says, press. Finger buttons are used as main interaction buttons in the rest of the game.

The "instruction" screen has Sally explaining the instructions and the rules. In this screen, the finger buttons are used both for the next and the back interactions. Unlike the welcome screen, the users might need to go back to make sure of the game rules.

Once users press the game start button, the screen moves to the "select questions" screen, showing Jack again. In this screen, users choose between two green circle buttons, which decide whether they want to customize their game play, or to use random questions. In case users choose to select categories of their own interests, the screen shows ten different themes with visual aid, along with yes or no finger buttons to press. After ten different screens are past, it confirms all the categories they selected and asks again with green circle buttons to choose between modify and OK.

The main interface for "questions" is identical throughout the game. A typical screen has one question, 3 multiple choices in the middle, 3 finger buttons, a hint button, and a skip button at the bottom, and current score at the top. The product uses simple finger buttons, which the users are already familiar with from the "welcome" and "instructions" screen. It doesn't use buttons directly on the text because pressing a tiny text button is too difficult without the use of a stylus pen. Jack holds the buttons for hints and skips. On click, the hint 1 pops up on a blue bubble with a close button, which follows a consistent comic book art style. The hint 2 was created with a mask that looks like a scavenger hunt map. It moves till the right spot of the exhibition where users can find the answer. A "skip" button changes to a "next" button after the users hit any of the finger buttons.

Result screen shows the total accumulated points and some message from Sally. Once again, the buttons are green circle buttons to select between No and OK. If they choose

No, it shows the information about where to return the device as well as the credits of the product. If they choose OK, it jumps back to the "logo intro" and starts the game over (Kwak, 2004).

Figure 4 Green circle buttons

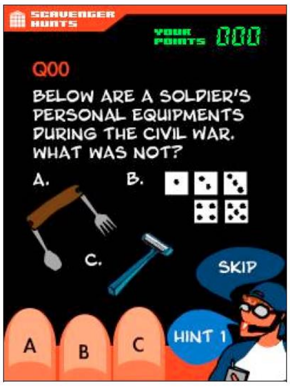


Figure 5 Finger buttons

Idea: Interpretative Center/ UV Garden

http://www.scavengerhunt.org - site with scavenger hunt games.

Mystery at the museum

In the **Mystery at the museum** groups of students are engaged in collaborative game-based problem solving to augment their interaction with the museum. Before the visit, the teacher provides general background information. At the museum, groups of students receive additional information through mobile devices, related to the exhibits and the problem-solving (‘mystery’) task.

Each group is assigned a different part of the task that they have to carry out collaboratively. The plot involves a number of puzzles that relate to the exhibits of the Museum and their solution brings rewards to the players. These puzzles, the most typical examples of which involve scrabbled images of certain exhibits and verses from manuscripts of the Museum, necessitate collaboration for their solution, as the necessary pieces are spread in the mobile devices of the members of the group. A negotiation phase is initiated then that results in exchange of items that can lead the group to a solution of the particular puzzle. The rewards have the form of clues that help the players solve the mystery. Since a large number of children (e.g. a school party) may be organized in multiple groups, the intention is to create competition among different groups. The aim of the activity is to mix the real and the virtual world and to make children work together in a collaborative way in this setting.

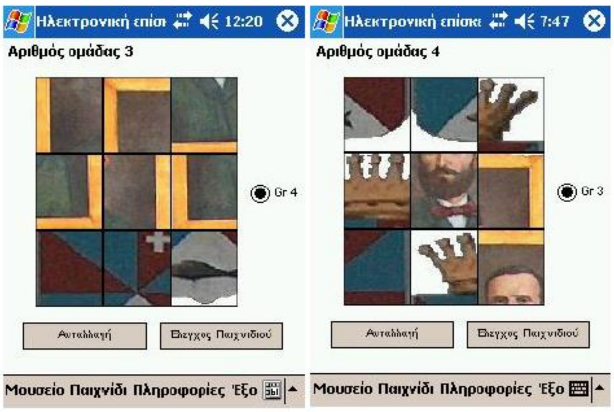


Figure 2 – The ImageGame. Side by side the screenshots of two members of one group

The typical age of the expected participants in the activity is 13 to 19.

The developed activities for the students visiting the museum include sequences of two puzzles – the Text Game and the Image Game - that have a common interface and they act as plug-ins for the mobile device front-end.

The *TextGame's* goal is to compose correctly a manuscript out of fragments of text. Each group member sees different verses of a poem in their PDAs. Afterwards the students should explore the room they are in order to find the manuscript that fits the verses they have received. So, they should attempt first to put in order the sentences they have received. The problem is that they only receive a subset of the verses. So they have to exchange them with the other group members in order to form correctly the poem. Once they receive all the needed verses, they have to place them in order in order to complete successfully the particular game.

In the *ImageGame* each student has to solve a puzzle. Each one receives a set of image pieces that belong to different images, split into pieces and shuffled. Due to this, they will have to exchange the pieces between them in order to have all the parts of the chosen image, a necessary step for solving the puzzle correctly. When the users receive the pieces of the puzzle they should look for the item they think it could be the solution of its puzzle. The fact of seeing the solution of the puzzle – that for example can be found in the physical environment like a painting, a picture, statue etc –supports them in solving the puzzle.

There are also available post-visit aiding elements – the server produces a centralized log file (in XML) of the actions that take place during the visit and optionally this log file can be combined with a video recording of the visit allowing evaluation of the activity of the students during the visit.

Several observations have been made:

- In all teams for all games the log had a common pattern that shows that the participants were engaged first in exploring at first the interface of the games
- After the period of exploration they start the real game play to achieve the desired goal. The interface is very intuitive considering that none of the participants have used before a handheld
- The TextGame generally took much longer to complete than the ImageGame as there were no fragments of the text in the physical space, though the poems chosen were well known to the children.
- The TextGame involves some scrolling in order to place the verses in the right spots and it does not support an overview of the text. Students had difficulties to scroll the text with the stylus and often they tented to miss a phrase when they moved from one scroll page to another.
- The children that have not succeeded to solve the text puzzle expressed their wish to

have the solution presented in the game – feature that is not present.

- It is possible that the games are too difficult for children of the target age group. If children find the games difficult to play they will lose interest in them. However the developed authoring environment has the capability of adjusting the level of difficulty in various ways, so thorough testing of future activities with children of the target age group should be done before introducing the activity in a museum (Cabrera, Frutos, Stoica, Avouris, Dimitriadis1, Fiotakis, Liveri, 2005).

Donation[6]

The "Donation" is a group activity that aims at the engagement of children in collection and manipulation of information about the museum exhibits. It is based on a scenario, according to which the children are asked to discover a specific exhibit in order to help an imaginary art benefactor to donate an artifact to the Museum. Children scan with their PDAs the RFID tags and receive information about the exhibits. In the collected information they have to locate some hidden hints. These hints describe the sought exhibit. The players, can store these hints in a notepad in their mobile devices and use it in order to solve the given problem. Two teams play the game. They are asked to exchange hint phrases between them as an encouragement for collaboration. Collaboration is also encouraged through a set of restrictions that do not allow teams to collect all available hints. Each team can collect only up to three of the six available hints. So, teams need to exchange their pieces of information in order to obtain a meaningful description of the exhibit they are looking for. Also agreement on the exhibit is needed between the two teams. Both teams need to point, by using the PDA, to an exhibit to check if it is the exhibit they are looking for. This activity is completed successfully once both teams point to the correct exhibit (Yiannoutsou, Papadimitriou, Komis and Avouris, 2008).

Museum Scrabble[7]

The Museum Scrabble game is based on the idea of linking exhibit properties with other exhibits. The basic components of the game are the clues, the triggers and the exhibits. Clues are pieces

[6] Museum of Solomos and Eminent Zakynthians, a traditional historical and cultural museum in Zakynthos, Greece. The museum exhibits are mainly paintings, personal belongings, original works of historical persons of the region, that is mostly literary people, like poets, writers, composers etc.

[7] Idem.

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).

The main information about the exhibit is stored in the game as items/triggers of the relevant 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 score.

When the game starts, the clues are automatically stored in the PDA, the players can select any clue they want, check out its triggers and decide if they will play with the specific clue or they will move on to another clue. In order to link the exhibit to the trigger of the clue, the children have to search in the museum for the most relevant exhibit and point to it using their PDA. Once the exhibit is stored in the PDA children can decide if they will link it to the trigger they are working with or if they will keep it stored for another trigger. Thus the trigger provides a point of view, or a criterion for 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 linking to the other group. Only the group that built 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 rationale behind the design of this game is to offer some basic information about a set of key exhibits and engage students to use this information as a point of view for searching for other relevant exhibits. Thus a trigger (i.e. a property of an exhibit) and an exhibit might share the same colour, might involve the same theme (e.g. two different paintings of the same theme), might have the same property (i.e. they are both works of the same artist), might involve the same historical event etc. Like the known scrabble game any link is possible as long as there is a common point between the linked objects. The educational aim is to help students focus on specific information about a set of key exhibits, think about this information and use their imagination and their skill to observe as tools for searching and finding relevant exhibits in the museum (Yiannoutsou, Papadimitriou, Komis and Avouris, 2008).

Idea: Values Scrabble. Visitors (individual or in group) fill in a Scrabble Board with a value that they learned during the visit. All visitors can see the board in the entrance tv and on their mobile device. Not aloud to repeat the same value.

HandLeR

Figure 1 a,b

Through design discussions, the team produced an interface based on the notion of an animate 'mentor' that could act both as a learning guide and a means of interaction. In the interface, clicking on body parts launches tools, such as the eyes for a camera, hands for a writing pad, and brain for a concept-mapping tool. Figure 2 shows the main HandLeR screen and the concept mapping interface. The concept map provided a general tool to view and browse information.

Figure 2 a,b

Whenever a photo is taken, note made, or web page accessed, this is shown in a timeline on the concept map (shown at the right of Figure 2b). An item in the timeline can be dragged and attached to the concept map. To browse through the map the user clicks a node (box) on one of the outer links which moves it to the centre of the map and displays its connected nodes. Clicking on a central node opens the resource (photo, note, drawing, web page) associated with it. This interface proved to be an easy and powerful way to view and link items created in the field. The 'avatar' interface (Figure 2a), was less successful. Although children liked the idea of an animate mentor, the relations between parts of the body and tools were not clear and, most important, the children regarded a cartoon rabbit as 'childish'. A mentor in the shape of a TV character or sports star might have been more successful (Kukulska-Hulme, Sharples, Milrad, Arnedillo-S´anchez, and Vavoula, 2009).

GeoHistorian project

The goals of the GeoHistorian project are to investigate mobile phones as educational tools inside and outside the classroom, reduce the barriers between schools and community resources such as zoos and museums, and above all, to give students the opportunity to create digital resources for their community.

The project utilizes wireless mobile technologies to link classrooms with local historical landmarks. Technologies include mobile phones with video capturing capabilities, built-in GPS, wireless Internet access, and Internet-based mediasharing sites such as PocketCaster. Using these technologies allows students to become video historians, creating and sharing a living history of real people and real places.

Children use mobile phones to take photos, videos, and audio clips of local landmarks, which are then combined into short movies and uploaded to the Internet. Then, using QR codes, regular citizens passing by these historical landmarks can access the student-created content. This innovative example capitalizes on mobility to provide situated learning opportunities for students, both in the creation of their own content and in the on-demand learning experience.

Collaborators: Mark van't Hooft and Thomas McNeal, Kent State University (Shuler, 2009).

Idea: Multimedia center.

Geocaching

Another innovative and increasingly popular use of location-based data in handheld devices is Geocaching (www.geocaching.com), a high-tech treasure-hunting game played in over 100 countries by adventure seekers equipped with GPS devices. The basic idea is to locate hidden containers, called geocaches, outdoors and then share your experiences online. While this novel concept was not developed for educational purposes, innovative teachers from around the world have documented successful use of this concept with their students.

While GPS may present much educational potential, there are other ways that mobile devices can receive location-based data and context sensitivity: QR codes/mobile tagging A QR code is a 2- or 3-dimensional barcode that can contain various data types, with URL being the most common. A mobile phone user can access the information embedded in a QR code simply by taking a picture of it. At present, this form of mobile tagging is most prevalent in Asia and Europe

Idea: Cultural Circuit

Yellow Arrow

Yellow Arrow, began in 2004 as a street art project on the Lower East Side of Manhattan. It is built around the general philosophy that every place is distinct and engaging if seen from a unique perspective. Participants place uniquely coded Yellow Arrow stickers to draw attention to different locations and objects. By sending a text message from a mobile phone to the Yellow Arrow number beginning with the arrow's unique code, Yellow Arrow authors connect a story to the location where they've placed their sticker. Messages range from short poetic fragments to personal stories to game-like prompts to action. When another person encounters the Yellow Arrow, she sends its code to the Yellow Arrow number and immediately receives the message on her mobile phone. The website yellowarrow.net extends this location-based exchange by allowing participants to annotate their arrows with photos and maps in the online gallery of Yellow Arrows placed throughout the world. Yellow Arrow is currently in more than 35 countries and 380 cities globally and has become a powerful way to experience and publish ideas and stories via text messaging on mobile phones and interactive maps online. (Shuler, 2009).

Idea: Cultural Circuit

MyArtSpace project

MyArtSpace is a combined mobile phone and web-based service to support learning between schools and museums in the U.K. The MyArtSpace project enables children visiting a museum with their school to work in groups and carry out inquiries related to the museum content. Before the visit, the teacher sets the class a big question to explore in the museum, and works with them to develop related skills of evidence assessment and collection. On arriving to a museum, children are loaned mobile phones running the MyArtSpace software. They can view multimedia presentations of museum exhibits, take photos, make voice recordings, write notes, and see who else has viewed the exhibit. After each action, the content is automatically transmitted to a website, which stores a personal record of their visit. Back in the classroom, they can review their visit and the media they have collected, share material with other children, and create presentations. MyArtSpace has been deployed in three museums for a yearlong trial during which more than 3,000 school students used the service on organized visits. Studies have shown that MyArtSpace had a positive impact on school museum visits and identified areas for improvement in the technical and educational aspects of the service.

Collaborators. MyArtSpace was designed and developed by TheSEA and funded by Culture Online, part of the U.K. Department of Culture, Media, and Sports. The service is now a commercial service, branded as OOKL (www.ookl.org.uk) (Shuler, 2009).

Gidder

The aim of the **Gidder** project is to support and extend collective knowledge building across classroom and museum settings. In advance of the museum visit, the students work in groups in the classroom to select artworks in the Gidder wiki that interest them, select those they will be focusing on in the museum, and write related labels (Pierroux, 2008). Each group has its own workspace. At the museum, students explore the exhibition and their selected artworks and use their mobile phones to send multimedia messages (MMS) with labelled information to the wiki's blog. These are shared with the rest of the class. Back at school the groups use the wiki and blog resources to discuss and develop their group interpretations. The wiki labels from all groups appear in a tag cloud, which helps to foster awareness of the interpretation process across groups as well as to scaffold interpretation (Kukulska-Hulme, Sharples, Milrad, Arnedillo-S´anchez, and Vavoula, 2009).

Bletchley Park Text

Bletchley Park is a historic site of secret British codebreaking activities during World War II and birthplace of the modern computer. While touring the site, visitors can use their mobile phones to send text messages (SMS) containing specific text terms to a dedicated mobile phone number about exhibits that interest them. The text terms are displayed on special **Bletchley Park Text** signs next to the exhibits (Mulholland et al., 2005). Back home, visitors then have access to additional content related to their selected exhibits. Access to the web site is authorised by their mobile phone number. After login they can semantically browse their selected content and add further text terms as needed (Kukulska-Hulme, Sharples, Milrad, Arnedillo-S´anchez, and Vavoula, 2009).

San Francisco's Exploratorium

A special case study has been made of San Francisco's Exploratorium (2001), which teamed up with Hewlett Packard (HP) to test ways to integrate the physical world of a museum with the virtual world of the wireless Web. Twenty five Exploratorium exhibits were connected to a museum network and handheld portable computers through infrared connections. By creating a guidebook for visitors, the project attempted to enable visitors to 1) capture their museum experience through online records; 2) provide context for exhibits through computer-based orientation; and 3) extend their interaction with exhibits to engage in measurement, data collection, and other experimentation to better understand the phenomena demonstrated by the exhibits. (Kukulska-Hulme, Sharples, Milrad, Arnedillo-S´anchez, and Vavoula, 2009).

"Cooltown" museum

The work of Hewlett Packard (2004) has involved several museum initiatives, including the creation of its own "Cooltown" museum. In the Cooltown Art Gallery implementation, HP developers laid out a room with pictures on the walls and implemented a Web presence for these entities using active, URL emitting devices (beacons) that allow for a type of discovery direct sensing. Next to each painting is placed infra-red beacons that supply PDAs with the URL of the corresponding point of Web presence. (Kukulska-Hulme, Sharples, Milrad, Arnedillo-S´anchez, and Vavoula, 2009).

Idea: Multimedia Center

eDocent

The eDocent (1999) presents information to the visitor automatically, based on the visitor's proximity to an object. The visitor's location is determined by the device's infrared contact with "tags" placed near selected objects, or demarcating the various sections of the Museum. Once eDocent downloads information relevant to the visitor's position, the visitor can explore a variety of topics related to the artifact, or section, at their own pace and according to their own interests. During their explorations, visitors may also bookmark information that interests them for further Museum-guided study via the Web at home. The device used in the first prototype, a Casio Cassiopeia Fiva, is much larger and heavier than the device planned for the future. A smaller device, the Compaq iPAQ Pocket PC, was also part of this month-long demonstration. In the future, visitors will be able to use their own Palm Pilots, telephones, or other personal digital assistants to access information about artifacts in the Museum (Kukulska-Hulme, Sharples, Milrad, Arnedillo-S´anchez, and Vavoula, 2009).

3.6. Other studies

Shihsanhang exhibition

(Sung, Hou, Liu & Chang, 2010)

Furthermore, mobile devices are applied in museum learning in diverse ways and strategies; an important question is **how to design interactive guides/learning strategies that facilitate the interactions and learning between learners, the physical exhibits and their peers.**

In order to reduce learners' aforementioned sense of isolation and limited interactions with exhibits when using the guide system, more and more guide systems now adopt the problem-solving strategy (e.g. Kwak 2004; Cabrera et al. 2005). In other words, a system provides learners with problem-solving tasks and guides them to complete the tasks through observations of the exhibits.

Sung, Hou, Liu & Chang, 2010 explore the learning behaviours under a museum mobile-guide system that applies a problem-solving strategy, using 'lag sequential analysis' (Bakeman & Gottman 1997) by using 1 Problem-solving mobile guide system; 2 Audio–visual mobile guide system; 3 Paper-based guided-learning sheet:

<u>1 Problem-solving mobile guide system:</u>

We designed a problem-solving mobile guide system for the Shihsanhang exhibition. The system's hardware consists of the PDA, the Adobe Flash software and the database web programs as the framework of its applications. The system provided problem context (including stories and quests) and guided the learners to look at the exhibits, browse the information of the exhibits on their PDAs, gather and compile information, discuss these with their peers, and solve a series of questions on their PDAs in order to complete the quests (similar to those by Kwak 2004; Cabrera et al. 2005; Sung et al. 2010). The questions included multiple choices (displayed on the PDA, where a learner answered them based on the acquired information and by examining the actual exhibits) and interactive scenario-based quests (e.g. dragging icons of artefacts to matching scenarios such as a burial or iron-smelting on the PDA in order to understand what life was like in Shihsanhang). The system designed for this study was a typical problem-solving scenario based interactive guide system that helps us understand how this kind of strategy/tool helps learners.

2 Audio–visual mobile guide system:

We also designed a typical audio–visual mobile guide system for the Shihsanhang exhibition. The main page of the system displayed the categories of all the exhibits in the museum, and a learner could click on the hyperlink of a certain category (e.g. ceramics) and see the information on each exhibit on the PDA (including pictures, texts and voice narrations) that facilitated his or her tour.

3 Paper-based guided-learning sheet:

Where each learning sheet contained information on the exhibits and questions to be answered. The types of the questions were identical to those given to the problem-solving guide group, including multiple choices and scenario-based items (which were open-ended and answered in short passages) (Control group).

We discovered that in terms of the learning behaviours of peer–peer and learner–exhibit interactions, the problem-solving group showed peer-discussion behaviours and two-way interactions (learner–exhibits and learner-description boards) as well as showing certain concentration levels. The audio–visual group also showed a certain degree of concentration and the learners linked peer discussions with the descriptions of the exhibits. Past studies have also suggested that the audio–visual guide is more effective than empty handed tours (Sung et al. 2008). However, as audio–visual systems in general only provide picture/text/voice information instead of problem-solving tasks, the interactions between learners and exhibits under this kind of guidance are often not two-way.

In terms of the content of the discussions, our analysis of learning-related discussion-content frequencies suggest that the problem-solving group also demonstrated more learning-related discussions, whereas the audio–visual group demonstrated the least, indicating the latter requires teachers' special attention and guidance.

Generally speaking, the problem-solving group had better performance in terms of the diversity and level of attention in interactive learning and the frequency of learning-related discussions, whereas the other two groups have their own specific characteristics in terms of behaviours and discussions.

The findings showed that the problem solving mobile guide system we designed for this study (similar to those by Kwak 2004; Cabrera et al. 2005; Sung et al. 2010) allowed for more peer–peer and learner–exhibit interactions and concentration than the audio–visual mobile guides and the traditional learning sheets.

We thus suggest that if the audio–visual system could include appropriate situational tasks and discussion activities or the learning sheet could adopt strategies that improve learner's concentration and motivation, these two types of guide modes may also be enhanced.

Mobile lecture interaction tool for activating students' participation to the lecture interaction

(Järvelä, Näykki, Laru and Luokkanen, 2007)

The aim of this study was to explore how the Mobile Lecture Interaction tool (M.L.I.) can be used for regulating and supporting students' thinking and participation in the lecture interaction. It was studied how higher education students used the M.L.I. tool during lectures and in what ways the students view the M.L.I. tool as a support for their learning.

The basic idea of the M.L.I.-tool is as follows: using personal, mobile devices (smartphones), students can anonymously ask questions, answer polls, and give feedback during the lecture (See Table 1). The tool allows every student and the lecturer to see these lists of questions. Furthermore, students have a possibility to vote on presented questions. Voting raises questions ranking in the display, encouraging the lecturer to give those questions precedence.

Table 1. The M.L.I Pedagogical Structure

Description of activities in the Lecture	Pedagogical idea
Send a question	Encourage students' cognitive activity and self-regulation in the lecture, engage students to the learning in the lecture
Send a comment	Enhance reflection
Vote for a question or comment	Enhance students' metacognition and engage students' learning in the lecture

Results show that the students used the M.L.I. tool mostly for voting.

The students reported that with the M.L.I. tool they were more active in thinking of questions and evaluating the presented questions' meaning for themselves than they normally are during the lectures. Furthermore, the use of the M.L.I. tool supported students' feelings of belonging to a group. The students mentioned that the use of the M.L.I tool supported their engagement in the content of the lecture. Their concentration did not stray as much as it did in lectures.

Awareness of other students' questions offered new ideas for the students and therefore that was seen as valuable for their learning

Mobile mind map tool for stimulating collaborative knowledge construction in groups

(Järvelä, Näykki, Laru and Luokkanen, 2007).

The aim of this study was to investigate the process of collaborative knowledge construction when technology and self-generated pictorial knowledge representations are used for visualizing individual and group shared ideas. In particular, the aim was to find out how students contribute to the group's co-regulation of collaborative knowledge construction and use each other's ideas and cognitive tools as a provision for their jointly evolving cognitive systems.

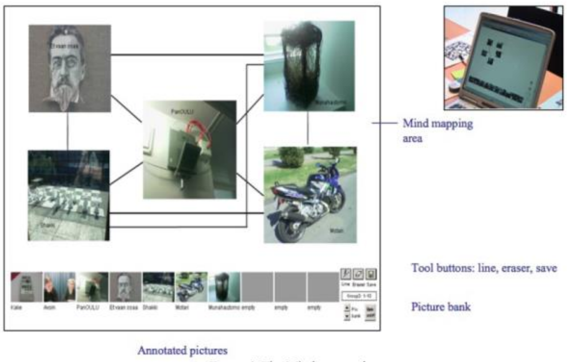


Figure 1. The Mind map tool

Student activities were structured around different phases in which they brainstormed, explored real-life examples to visualize their thinking, and used pictures as knowledge representations to answer to the learning task. The Mobile Mind Map tool (Figure 1) allowed students to take pictures with a smart phone and to add text annotations to the pictures. The annotated pictures were sent to the server and they were used to construct a mind map with the computer (See Table 2).

Table 2. "The Mobile mind map" pedagogical structure

Description of group activities	Pedagogical idea	Outcome
1. Mind mapping with paper and pen	Grounding	Mind map with paper & pen
2. Campus area exploration for evidence with mobile phones	Inquiring	Annotated pictures
3. Mind mapping with Mind Map Tool and pictures by the laptop computer	Constructing	Mind map with pictures
4. Reflection on the experience	Reflecting	Shared experiences

The data-driven qualitative content analysis revealed that pictures as self-generated knowledge representations were used for carrying individuals' abstract meanings. Furthermore, students' activity in processing each others ideas further, as well as a level of cognitively challenging activities, indicates that pictorial knowledge representations and technology tools scaffolded co-regulation of collaborative knowledge construction. However, students were of the opinion that pictorial knowledge representations are challenging and thorough negotiation is needed for grounding pictures on the content discussions.

Idea: Multimedia Center

Mobile "Edufeeds" for creating shared understanding among virtual learning communities

(Järvelä, Näykki, Laru and Luokkanen, 2007)

The aim of this study was to explore how mobile technologies and social software (weblogs, wikis, RSS-aggregators and file-sharing services) can be used for scaffolding collaborative learning; sharing understanding and building virtual communities. The main assumption was that students' interactions will be enriched when possibilities of social software are integrated in the learning situations, and thus, building virtual communities will be more fluent than in more traditional virtual learning environments.

The students were introduced to the content of the course with six lectures and after the each lecture the students reflected on the content of the lectures in groups. The given task for each group was to first reflect on the content and to name five important themes in the lecture. After that the students were asked to choose one of the themes and to formulate their group's working problem based on the theme with which they continued to work by finding real-life examples to represent their shared discussions. In practise, the group work was followed with a one-week phase of independent on-line work, where students were asked to use mobile phones to take pictures and/or video clips to represent their ideas of the learning content. While taking the pictures/videos students were also asked to answer the following questions: what is the name of this picture, what does this picture represent, and how is it related to the learning content, by typing a short description for the picture. The pictures and descriptions of the pictures were sent automatically to the each student's own weblog. This same task continued after each lecture. Weblogs were used as personal journals, where students reflected their ideas further by writing journal entries around the respective pictures/videos. Furthermore, students were asked to follow each others' contributions to their personal weblogs by using RSS-aggregators in their mobile phones. In the middle of the course, students had a "meaning-making session" where they reviewed all the group members' weblogs to see the pictorial material everyone had collected. The students were asked to introduce the pictures by explaining what they represent and to negotiate and choose among the pictorial knowledge representations those pictures that could represent the group's shared understanding. This session was repeated twice, in the middle of the course and at the end of the course, and the session was followed by the virtual group working phase, where students continued to share their ideas with the chosen pictorial knowledge representations.

MOBILearn

(Kukulska-Hulme, Sharples, Milrad, Arnedillo-S´anchez, and Vavoula, 2009). Ver documentos disponibilizados no http://www.mobilearn.org/ (em especial o designer dos jogos)

MOBIlearn aims to develop, implement, and evaluate an architecture for mobile learning, based on theories of effective teaching and learning in a mobile environment. The focus of the project was to develop and support learning outside the classroom, including learning in museums, studying for a workrelated MBA, and gaining basic medical knowledge.

The ambition of MOBIlearn was broad: to provide ubiquitous access to knowledge for target users including mobile workers and learning citizens through appropriate (contextualized and personalized) learning objects and innovative mobile services and interfaces. It proposed to develop new models of learning in a mobile environment, new systems architectures to support the creation, delivery and tracking of learning content, new methods to adapt learning materials to mobile devices and new business models for sustainable deployment of mobile technologies for learning.

One key product of MOBIlearn was a general architecture for interoperable services, the "Open Mobile Access Abstract Framework" (OMAF). This provided generic services, such as user registration and messaging, management of content, and specific tools for mobile interaction and context awareness. The services could be distributed across the web and were accessed through a portal that adapted to mobile devices including mobile phones, PDAs and tablet computers

The trials were successful in demonstrating that people could interact with the technology in a museum setting, and that the context-awareness system could provide information and guidance depending on the users' location, route, and time at the location. The trials also indicated a number of issues including the importance of offering variety in content and ways to perform a task, opportunities for synchronizing activity through messages and prompts about the location of other users, the value of spatial movement as a way to interact with a mobile system (for example, the user moving from one painting to another, or waiting in front of an exhibit could be used by the system to infer their knowledge or interest) and the need to develop a simple and coherent interface across a variety of devices.

M-Learning

(Kukulska-Hulme, Sharples, Milrad, Arnedillo-S´anchez, and Vavoula, 2009).

Like MOBIlearn, the M-Learning project was funded by the European Fifth Framework programme, but its aims were different: to help young adults aged 16 to 24, who were disaffected learners and had not succeeded in the education system.

The project developed a Learning Management System and a microportal interface to provide access to learning materials and services from a variety of mobile devices, plus web and TV access. Example applications included an authoring system to create and deliver SMS quizzes for topics such as health information and drugs advice, mobile phone games, for example to allow learner drivers to practice driving theory questions, and a media board for learners to build online web pages by sending messages, pictures and audio from their phones.

Reports from the project concluded that mobile learning can work, reaching places that other learning cannot, it is best provided as part of a blend of learning activities, it offers a collection of pieces to be fitted to a learning need rather than a single solution, it is not simply a tool for delivering teaching material but can be used for learning through creativity, collaboration and communication , and that the best way to get started with developing mobile learning is to try it in practice through trial and experiment with simple tools.

4. Pedagogical Model (updated)

This model has been developed by the partnership within its strategic research in Social Literacy, having now been updated in the light of the findings in this document, being the pedagogical reference for the technology enhanced learning environments of the UVM.

A. Personal Competences

Competence Area	Competence Context	Values – Foundations of Competence	Key Competences Profile
PERSONAL	Character	Humility, patience, modesty, gratitude, serenity Integrity, truth, sincerity, honesty, honour Love, altruism, solidarity, kindness, generosity, caring, compassion, self-esteem, self-respect Discipline, responsibility, flexibility, obedience, deprivation Excellence, determination, persistence, autonomy, courage, optimism, enthusiasm Conscience, reflexivity, critical thinking	Demonstrate sensitivity, tact and empathy for others; Being able to adapt the behaviour to the needs and characteristics of individuals or groups; Be able to learn from mistakes and successes; Apply continuously self-control of emotions and behaviours; Have the ability to distinguish between positive and negative influences, whether in relation to peers or the media; Acknowledge ones value and a balanced self-esteem; Be able to identify good models of conduct; Identify and resolve moral dilemmas, being able to make choices that protect the conscience and the common good; Be able to set a course of life, envisaging the contribution to society and trace the main objectives of life; Cultivate an attitude of Lifelong Learning and Learning to Learn.

Erasmus+

	Spirituality	Faith, trust, hope, patience Devotion, concentration, serenity Purity, perfection, innocence Forgiveness, compassion, mercy, understanding	Have strong and coherent beliefs about the higher purpose, the meaning of life and of the universe; Have consistency between beliefs, attitudes and behaviours; Be able to create moments of introspection / meditation / prayer.

B. Interpersonal Competences

C. Competence Area	Competence Context	Values – Foundations of Competence	Key Competences Profile
SOCIAL	Family	Respect, obedience, loyalty, honour, service Responsibility, altruism, dedication, sacrifice Sharing, solidarity, brotherhood, generosity, friendship	Develop awareness of the importance of fundamental social institutions, such as the Family; Adopt principles of loyalty and belonging to traditions and the agents that contribute to the sustainability of family relationships as educational spaces of excellence; Develop basic personal abilities of service and dedication to others and of self-denial, that support the adoption of responsibilities in the future; Be able to integrate and relate, recognizing the different social roles that the family represents, in an atmosphere of harmony and solidarity between

Erasmus+

	Love, intimacy, trust, understanding, tolerance, cooperation	generations; Be able to appreciate the bonds of trust and intimacy as the foundation for lasting and stable relationships; Develop the ability to foresee different points of view, with understanding and tolerance, contributing to the constructive resolution of conflicts.
Work	Leadership, excellence, self-motivation, initiative Discipline, creativity, competitiveness, perseverance Strategy, assertiveness, innovation Cooperation, collaboration, negotiation	Have the ability to accept challenging tasks, enduring the obstacles; Accept, plan and implement projects/complex tasks, applying a sense of responsibility and leadership; Acknowledge the necessity of learning by doing, by experience, pursuing the highest standards of excellence in the workplace; Be able to solve team conflicts in a a constructive way; Work with a future orientation mind, being able to develop activities by defining and achieving specific goals and objectives.

D. Civic Competences

E. Competence Area	Competence Context	Values – Foundations of Competence	Key Competences Profile
CÍVIC	Political and Democratic Institutions	Participation, responsibility, subsidiarity Fairness, justice, impartiality Freedom ,equality, security Welfare, good governance Duty, right	Recognize the importance that the citizen strengthen his power by participating in democratic institutions; Recognize the fundamental rights and duties of citizenship and participation in democratic life; Be capable of involvement in mechanisms of deliberation, discussion and political discourse; Develop a sense of responsibility for the construction of the Common Good in political and democratic institutions.
	Public and Community Space	Social cohesion, sustainability, peace, hope Reflexivity, leadership, participation, service	Understand pluralism and tolerance as crucial challenges to a healthy community integration; Acknowledge the challenges that confront communities, locally and globally; Be able to take responsibility for participation and leadership in the associative and community life; Develop critical thinking about social life situations, with a view to boost participation in finding solutions for communities.

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