Making Dead History Come Alive Through Mobile Game-Play

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Abstract
This work in progress presents a design approach to digitally enhancing an existing paper-based game to support young students learning history at an archaeological site, by making use of recent advantages provided by mobile technology. It requires minimal investments and changes to the existing site exhibition because it runs on the visitors' own cellular phones. It is expected that game-play will trigger a desire to learn more about ancient history and to make archaeological visits more effective and exciting.

Keywords
Mobile Devices, Educational Games

ACM Classification Keywords
H.5.1 [Multimedia Information Systems]: Artificial, augmented, and virtual realities; K.3.1 [Computer Uses in Education]: Collaborative learning-Distance learning.

Introduction
Recent advances in mobile technology are opening new possibilities in various domains, including e-learning and cultural heritage. By exploiting the imaging and multimedia capabilities of the last generation mobile devices, it is possible to create computer systems that can support learning of ancient history, by transforming a visit to archaeological sites and museums into a more complete and culturally rich experience.

Italy is full of cultural heritage. In particular, Apulia is a region of Southern Italy where it is possible to visit many historical sites dating back to about the year 1000 B.C.. Among current visitors of these historical sites, families and students, especially middle school children, account for 80%. It is difficult to estimate how lasting an interest in archaeological sites and museums traditional visits can generate in students. Archaeological sites pose further difficulties since students are faced with ruins of ancient settlements that have lost their original image and whose current appearance no longer reflects their initial purpose.

New teaching/learning techniques need to be defined, which can arouse the emotions of young visitors, stimulating their imagination and curiosity. In this paper, we present our preliminary experience in designing a mobile system to support middle school students during the visit of archaeological sites. Our approach uses game-play in order to trigger a desire to learn more about the site history and to make archaeological visits more effective and exciting.

Playing a game to learn history?

Play stimulates in young students an understanding of history that would otherwise be difficult to engender, helping players to acquire historical notions [1] [14]. There are various advantages in using play to teach/learn history [1]: 1) play is amusing and fun, and enjoyment is important when endeavoring to achieve learning goals, because what is enjoyably learned is less likely to be forgotten; 2) play requires different skills to be deployed simultaneously, and each player can practice those skills felt to be most congenial; 3) play is a relational activity, which encourages group activities, stimulates collaboration, helps with conflict management. The play phase must be followed by a reflection phase, separate from the true game, in which the acquired knowledge is revised and shared among students. This part of the activity is called debriefing and is fundamental in didactic game-play because it fosters generalization and conceptualization of the information acquired during the game [1].

At the University of Bari, researchers in the field of Teaching History have set up an association, called Historia Ludens, that has developed the excursion-game as a technique for teaching middle school students during didactic excursions to visit historical sites. “Una giornata di Gaio ad Egnathia” (Gaius’ Day in Egnathia) is an example of excursion-game designed for visiting the archaeological site of Egnathia, an ancient city in Apulia. The city walls date back to the Messapian phase, from the end of the 5th century B.C.. Pre-Roman tombs have been found within the city walls. The city was destroyed in 545 A.D..

“Gaius’ Day” is structured like a treasure hunt to be played by a class of students: it combines the excitement of both *chase* and *solving the case* with the joy of freely exploring a place and discovering its hidden secrets. This type of game is perfectly suited to the archaeological site context, with wide spaces where students can freely move and use their intelligence and imagination to conjure up how life used to be there, by observing the site and memorizing places, names and functions. Excursion-games have been designed by Historia Ludens for several archeological sites in Southern Italy. The experience with these excursion-games has been replicated hundreds of times with different classes and teachers, who appreciated a lot how students were stimulated by the game to know

more about the site and how they enjoyed the overall visit.

Enhancing the game using mobile technology

Edutainment is a recently coined term that merges education and entertainment in an electronic game, a television program or website [10]. Some empirical studies have shown evidence of children's effective learning from educational electronic games [6], primarily to teach Mathematics [2] [9] [12] and Physics [14]. Very recently, some examples of games to learn History [8] [13] and Music [3] have been proposed. Indeed, a remarkable feature of electronic games is their power to motivate, and motivation plays a central role in any learning activity [5]. The literature review of electronic games and handled devices indicates that they could be an effective tool for facilitating student learning [11] [12].

figure 1. The game masters explain the game.

figure 2. The groups perform the game.

Our work aims at improving the student's whole experience of playing a game in an archaeological site as well as its learning effectiveness, by making use of several advantages provided by mobile technology. Common features of electronic games such as active participation, intrinsic and prompt feedback, challenging but achievable goals, and a mix of uncertainty and open-endedness, contribute to children's motivation. Electronic games on cellular phones, more than any other interactive technology, have become a significant part of young people contemporary culture. In Italy, use of cellular phones by middle school students is very popular. This lead us to consider using games on handled devices to achieve educational goals. The system we are developing implements the electronic version of the excursion-game proposed by Historia Ludens to support students during the visit of archaeological sites.

We made use of the contextual inquiry technique to collect data about users' own activities [4][7]. We participated in an actual excursion-game performed at Egnathia by students (11-12 years old) of the middle school "Michelangelo" in Bari, Italy. The pictures shown in the paper were taken during that visit.

The excursion-game is as follows. After children arrive at the archaeological site, the game masters (teachers or Historia Ludens associates) give a brief introduction about place and period being studied. Then, they explain the game, the various phases and the rules (figure 1). Groups of 4/5 players are formed: each group has a *navigator* (group leader) and impersonates a Roman family that has just arrived in Egnathia, having received a plot of land and a house. Our experience with the paper version of the game has shown that playing historical roles strongly motivate students. Each group has to explore Egnathia by collecting information, identifying places and noting them down on a map of the site (figure 2). The group is provided with a "libellum", i.e. a booklet containing a letter, a map of the archaeological site and a glossary. The letter describes a typical day in the life of a person of that ancient time and the missions the group has to carry out. The map allows the players to find their way around and follow the right pathway; it also has a teaching function, because players have to mark places in the site, it fosters conceptualization and organization of the information. The glossary contains a detailed explanation of the places they will come across while playing the game.

figure 3. The game master assists a group.

figure 4. An example of the interface prototype.

Initially, we had planned that, in the electronic version of the game, each group would receive information about the missions on the cellular phone. After observing students really playing the game in an archaeological park, we realized that, in order to highlight the collaboration aspect, it is best to give each group a mission letter. In this way, each student in a group performs complementary activities: reads the mission letter, searches on the map, uses the phone. Moreover, the mission description is too long to be comfortably read on the cellular phone.

To carry out the missions, players have to formulate hypotheses, discuss them, retrace their steps when they go wrong and correct their mistakes. If students have difficulties in reaching the place that is the mission target, they ask a game master for help (figure 3). In the electronic version, the actual game master is substituted by a virtual one. By clicking the button "Can't find", the system shows a help message (either a film of the *virtual game master* giving a few hints, or a screen showing glossary items that can solve players' doubts). Hints, provided by the system, support both game-play and students' learning of the underlying educational content. Rather than simply giving the right answer, they lead the students in the right direction to help them discover the right answer for themselves. In short, help is designed not to simply reveal the right answer after children's first wrong guess, since that would prevent them from trying to figure out the right answer.

A particular type of mission is the *ghost mission*, i.e., its target is not present in the archaeological site, for example, identifying the harbor that is not visible anymore, or the civil basilica, which is assumed to exist but has not yet been dug out. In the traditional version of the game, the ghost mission causes several difficulties to the students who often fail to identify the hidden target. Our current prototype of the electronic system shows a 3D-reconstruction of that portion of the site when the students click on the "Can't find" button (figure 4).

When the group believes they have identified the target place of a particular mission, it marks that place on the map. In the electronic version, the group leader digits the place code on the cellular phone or photographs the place visual tag, if the phone has a camera. Place codes and visual tags are assumed to be distributed across the site. After completing the last mission, the group has the possibility to see on the phone the 3D-reconstruction of the identified place. When the game is over, game masters meet students for debriefing, to reflect upon their experience. This phase can be carried out in a lecture room in the museum or on return to the classroom. The electronic version of the game facilitates this phase as well, since it relies on a notebook with a digital map of the archaeological park and a complete virtual reconstruction of the entire site. This offers the possibility to play a "collective memory game" where monuments and archaeological objects (previously encountered by the students as part of the game) are to be placed in the "right" place and the whole school class is encouraged to participate and collaborate.

A slim system architecture

Striving for a simple and cheap digital gaming infrastructure, we propose a design based on cellular phones, complemented with compatible memory cards containing the game software. Visitors will use their

own cellular phone so that the archaeological site does not need to provide any hardware infrastructure. To reduce costs and architectural complexity, no data is transmitted from or to the cellular phone during the actual game. Instead, all data exchange is (at least at this stage in the project) taking place between the cellular phone and the memory card inside it. A notebook equipped with a large screen/projector is needed by the game master for the debriefing phase. Some information, such as the map of the archaeological site, is left on paper media.

Specifically, each student group needs a cellular phone able to run a Java Virtual Machine (J2ME), equipped with a memory card slot and also (optionally) a digital camera. The memory card is handed out to each group at the start of the game session and contains: a) the actual game "Gaius' Day", b) game data including 3D-reconstructions of (parts of) the archaeological site, c) game-play logfile, which is continuously updated as the group visits different parts of the site and answers questions. In addition, a letter containing game instructions and missions is handed out on paper.

The game master notebook has a Bluetooth and/or memory card reader. The Game Administration Application, residing on the notebook, collects logfiles from each group as they come in with their concluded missions, and analyse the logfiles in various ways using statistics and visualisation tools. The application may replay activities of an arbitrary group, based on the corresponding logfile and using higher-definition 3D-reconstruction of the archaeological site than the ones on the mobile memory cards handed out by the student groups. The game master is recommended to replay the winning group's performance at the debriefing event on a projector in front of the whole school class, as a reward to the winners but also to recapture some of the things learned throughout the visit.

At the time of writing, the system prototype is able to ask questions, collect answers on the memory card, and make a 3D-reconstruction of the places referred to in the game.

Conclusion and future work

A great advantage of the proposed system is that it does not require any special hardware (e.g. network infrastructure, totems, etc.) at the archaeological site (which administrations are often unable to afford), and visitors can use their own cellular phone equipped with a camera and a memory card reader.

Furthermore, the system is expected to provide a much richer experience in reviewing the previously performed game-play at the debriefing event, as well as statistical data for the game designers, helping them in constructing suitable game missions on the basis on actual game-play performance. By being so simple and cheap, we believe the architecture to be realistically applicable to many outdoor archaeological sites.

We believe that, even with this slim architecture, game-play will engage students and permit an effective and exciting visit of the archaeological sites. This belief has, of course, to be established more systematic empirical evaluations planned for spring 2007, when schools usually perform didactic visits to archaeological sites. Future work will also include what follows. *Augmented Reality 3D visualisation*. If the phone has a camera, the 3D-reconstruction could consider the position and rotation of the phone in relation to the

visual tag attached to the captured place, providing an augmented reality experience. This extension requires the phone to be enough powerful, as it is expected to be in short time.

Inter-group collaboration. The present infrastructure makes no use of the possibility of using the mobile device as a way to communicate among groups, and collaborate while actually playing the game.

Adapting the game to adults. With small changes to the game, we believe that an enhanced, fuller experience can be provided also for other user groups including adults.

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