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Enjoying Cultural Heritage Thanks to Mobile Technology

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It was early October, after the first month of school, when my 12-year-old son came home and told me about something very interesting he had done that morning with his teachers and schoolmates[1]. They had visited the archaeological park of Monte Sannace, located about 40 miles south of our hometown of Bari, Italy, where the ruins of a Peucetian city date back to the ninth century B.C. What he liked most was that instead of visiting the park with a traditional guide, they played a game very similar to a treasure hunt. The students were divided up into groups of three or four and given a paper sheet of both a list of tasks to carry out to discover some places and a list of clues, together with a map of the park to mark down the places once discovered. The first group to discover all of the appropriate locations was the winner. Once everyone had completed the game, the game master, a member of Historia Ludens, the association that developed the game, urged them to reflect about their experience, the history of the site, and all the fine details they had a chance to appreciate while they explored the park. When they returned to school the next day, the teacher discussed the visit in more depth with the class, in order to widen and reinforce the historical information they had acquired.

I later spoke with my son's teacher, who explained Historia Ludens was created by some researchers in the department of history at my university. They have performed a lot of research on novel techniques to engage young students in learning history and, having worked with hundreds of classes, experienced the advantages of replacing the traditional visit to historical sites with playing educational games. My son's teacher had taken several of her classes on such visits and is convinced of their educational validity; she said that she and her colleagues would love to make more visits, but they were not easy to plan. Historia Ludens members were not always available, and the limited school budget could not always bear the cost.

All of the above considerations and my son's enthusiasm about his visit—the details of which were well impressed in his mind—led me to consider, together with my young collaborators and co-authors Carmelo and Rosa, the possibility of creating a computer system to implement such games. At that time, we were involved in a project about advanced multimodal systems, with a focus on smart-phone technology. We realized that a system implemented on such devices would offer several advantages: It could be used to engage young students, who are fascinated by current game technology; replace the expensive game master; and implement different games, each specific to a certain park.

Indeed, nowadays PCs and all technological gadgets, especially cell phones, are essential elements in young people's daily lives. Cell phones are gifted earlier and earlier in life, and they have become a normal part of interpersonal dynamics, since they offer limitless communication opportunities. In addition, multimedia technologies are important resources studied in school; young people learn how to use them to widen their education and extend their cultural range. The teaching sphere has been strongly boosted by the advent of technological tools and especially mobile devices. They provide added value in terms of stimulating learners' engagement, increasing their motivation, and arousing their curiosity, while permitting immersion in the learning environment.

So we met up with our history-department colleagues and associates of Historia Ludens. Our discussions with them and analysis of their literature provided further evidence that in younger

[1] Maria Francesca Costabile is telling how the idea of the m-learning system that the authors later developed came out.

students, play stimulates an understanding of history that would otherwise be difficult or boring. There are several advantages in using play for learning purposes:
1. Play is amusing and fun, and enjoyment is important in achieving learning goals, because what is enjoyably learned is easier to remember.
2. Play requires different skills to be deployed simultaneously, and each player can practice those skills they find most fun.
3. Play is a relational activity that encourages group collaboration and helps with conflict management.

Structuring the game as a treasure hunt makes it possible to combine the excitement of both chase and solving the case, with the joy of exploring a place and discovering its hidden secrets. This type of game is perfectly suited to archaeological parks. With their wide spaces, students can freely move about to observe the site and memorize places, names, and functions, using their intelligence and imagination to figure out how life was once lived.

Everyone knows that there is a huge amount of cultural heritage in Italy. In Puglia, a region of Southern Italy, there are many historical sites dating back to around the year 1000 B.C. Schoolchildren, especially middle-school students, are typical visitors of these sites. However, they often find traditional visits boring; they are faced only with the ruins of ancient settlements whose current appearance no longer reflects their initial purpose. This is another reason why it is useful to develop a computer system, since the imaging and multimedia capabilities of the latest generation of mobile devices can be exploited to provide a 3-D reconstruction of the original places, thus making the whole experience much more stimulating.

We set up a multidisciplinary and participatory design team that includes human-computer interaction and software engineering experts from our Interaction, Visualization, and Usability Lab; members of Historia Ludens and history-teaching experts; archaeologists; the director and staff representatives of the Egnathia Archaeological Park, one of the main archaeological parks in Southern Italy; and students and teachers from a local middle school in Bari.

User requirements were established through contextual inquiries. The students' (11- to 13-year-olds) behavior was observed while they played the original version of the game in Egnathia Park, using paper-based tools without any support from electronic devices. The observation provided useful information on how the game was played, on the problem-solving strategies adopted by the students, and on the subsequent debriefing phase during which students reflected on their experiences together with the game master and their teacher. Interviews and focus groups with Historia Ludens associates, students, and teachers captured further details. By interviewing the park's staff and archaeologists, we learned more about the history of Egnathia, an ancient Roman city in the Puglia region, and discussed how to model the 3-D reconstruction, which was implemented in the electronic version of the game.

The first version of the system was implemented during spring 2007. Called Explore!, it supports exploration of the park and the acquisition of historical notions while playing, making archaeological visits more effective and exciting. Explore! is actually a framework for mobile learning designed to implement different games for different parks. Gaius' Day in Egnathia is one such game; it is designed to be played in the archaeological park of Egnathia. After creating and evaluating this first version of Explore! [1], a new version implementing contextual-awareness capabilities was developed to increase the students' engagement in the park [2].

In Gaius' Day in Egnathia, each student group impersonates Gaius, a Roman citizen who has recently arrived in Egnathia and sets out to explore the city. The group receives two cell phones, a paper map of the park, and a backpack carrying a pair of loudspeakers. In order to involve each student equally, the recommended group size is three students: one carries the first cell phone and the backpack, another is responsible for the second cell phone, and the third holds the map. The group has to discover places in the park following the clues provided by the first cell phone. The players have to formulate hypotheses, discuss them, retrace their steps when they go wrong, and correct their mistakes. If players need help in discovering a place, they can ask the "Oracle," which is a software module that provides further clues for the game, available on the second cell phone. The clues support both the game and students' learning. Rather than simply giving the right answer, the clues lead the students in the right direction, helping them discover the right answer for themselves. The loudspeakers, which are connected to the first phone and installed on the backpack, emit multiple sounds to ensure a realistic as well as an engaging environment (e.g., people chatting at the market,

carts rumbling on the paved road, fire crackling at the furnace, etc.). The intensity of each sound changes dynamically according to the players' physical position, acquired from GPS technology available on most commercial cell phones.

Once the group has correctly identified the locations, it receives "Gods' gifts," consisting of 3-D reconstructions of these places. The students can interact with such reconstructions and visually compare the ancient appearance with the existing remains. They are emotionally involved in the learning process because of a sense of "being there" in Roman times, that is generated by this enhancement of the observed real environment with contextual sounds and 3-D reconstructions.

Fig. 1 A group performing the game in the Egnathia archeological park.

After the game, the teachers meet with the students for debriefing at the museum. This phase has been enhanced by the use of technology, which makes the activities more engaging. The debriefing application is installed on a laptop, together with a projector, allowing students to play a "collective memory game." They must locate the monuments and archaeological objects they found while playing the game in the park, marking them on a virtual map. The system can also show high-resolution 3-D models of other area that might not be accessible in the park. Finally by analyzing the log-files of the game recorded on the cell phones, the system can replay the activities of any or each group, showing the path they took across the archaeological park, and declaring the winning group.

So far, Explore! has been tested in the field with 124 middle-school students, who expressed excitement about the opportunity to use technology during their visit and commented on how nice it was to use a cell phone for the game and see the 3-D reconstructions. They also enjoyed interacting with the application in the debriefing phase, in which they could compete to show how much they had learned during the game. The studies confirmed the educational efficacy of the proposed game and also demonstrated that students are not distracted by the technology, which could have been a problem.

A great advantage of Explore!, which makes it very attractive for use in archaeological parks across Italy with very limited funds, is that the game infrastructure requires almost no investment by the park. The system runs on commercial cell phones, and the software is all contained in the phone's memory card. Only a laptop and a projector are required for the successive debriefing phase, which can also be performed at school the next day. Students can use their own cell phones, provided they are equipped with GPS receivers. Another advantage is that the system is ecologically friendly—no hardware infrastructure needs to be installed in the park itself. Finally, the system is available at any time with no need to book a guided visit in advance.

Explore! is designed to be used in a wider set of historical sites. The game content (historical information, 3-D reconstructions, sounds, etc.) is provided by XML files and can be authored in numerous ways and adapted to different sites. An authoring tool has been developed that allows end users with no computer programming expertise, e.g., history teachers, to create games to be played in different sites.

About the Authors

M.F. Costabile is a full professor in the department of computer science at the University of Bari, Italy. She also coordinates the Interaction, Visualization, and Usability Lab, staffed by young researchers, including Carmelo Ardito and Rosa Lanzilotti. Research interests of the IVU Lab include multimedia and multimodal human-computer interaction, information visualization and visual analytics, usability and user experience, and end-user development. Cultural heritage is one of the main application domains currently being investigated.

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