Chapter 20
An EUD Approach to the Design of Educational Games
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ABSTRACT
Distance education has experienced profound changes due to the introduction of new technologies, especially mobile devices of different types. It is necessary to define new learning techniques which are able to capture students’ attention and to engage them in their learning activities, reducing problems like distraction generated by the use of the device itself and/or by the surrounding environment. Game-based learning is a valuable possibility. The excursion-game has been recently proposed to support pupils learning history during visits to historical sites; its goal is to make the visit and the overall experience of cultural heritage more engaging. This paper describes the approach followed in the design of the system implementing the excursion-game; it takes into account an end-user development perspective in order to allow domain experts, i.e., experts in history and cultural heritage, contributing to design excursion-games for a wide set of historical sites.

INTRODUCTION AND MOTIVATION
The Instructional Technology Council defines distance education as “the process of extending learning, or delivering instructional resource-sharing opportunities, to locations away from the classroom, building or site, to another classroom, building or site by using video, audio, computer, multimedia communications, or some combination of these with other traditional delivery methods” (ITC, 2010). Mobile technology enhances the peculiar characteristics of distance education, e.g., freedom from space and time constraints, multimedia delivery. Researchers refer to mobile learning (or m-learning) as the combination of e-learning and mobile computing designed to facilitate the acquisition of knowledge or skills anytime and anywhere (Holzinger, Nischelwitzer,
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Despite the great interest surrounding this new learning paradigm, little is known about how best to design effective learning experience.

Our research addresses m-learning systems for pupils aged 10-13 years old. In order to capture pupils’ attention and to engage them, game-based learning is considered, since it offers several advantages (Prensky, 2001; Gee, 2003; Shaffer, 2006; Costabile et al., 2008). Games are amusing and fun, and enjoyment is an important aspect: what is enjoyably learned is less likely to be forgotten (Cecchini & Taylor, 1987). Games foster relational skills, encouraging young people to work in groups and collaborate to attain given objectives: each pupil can carry out the activities s/he feels most congenial and, by working together, the whole group is facilitated to overcome possible difficulties.

Many researchers have demonstrated the effectiveness of educational games, which are able to create a more pleasant learning environment than the traditional one (see, for example, Conati & Zhao, 2004; Cabrera et al., 2005; Rogers et al., 2005; Kardan, 2006; Kristensson & Zhai, 2007; Lanzilotti & Roselli, 2007; Di Bitonto, Roselli, & Rossano, 2009; Read & Beale, 2009). In Ardito et al. (2008) and Costabile et al. (2008), the excursion-game has been proposed to support pupils learning history during visits to historical sites, with the goal of making the visit and the overall experience of cultural heritage more engaging.

The excursion-game is structured as a role-play game in which groups of pupils, aged 10-13 years old, impersonating a character, have to solve a set of missions grounded in a specific historical atmosphere. To find solutions, players need to explore and understand the physical environment and are facilitated by cell phones endowed with several multimedia features, which augment the physical context by providing virtual, location-specific information, such as 3D reconstructions of historical buildings and places, and contextual sounds simulating those at ancient time, referring to people, animals, or objects used in daily activities. Field studies involving five classes of the middle school Michelangelo in Bari, for a total of 117 pupils, have shown the validity of the excursion-game as m-learning technique (Ardito et al., 2008; Costabile et al., 2008).

Italy is full of cultural heritage sites. A design requirement of the system implementing the excursion-game has been to code in XML files information about the game, including the multimedia content which depends on a specific site, so that it can be easily modified in order to adapt the excursion-game to different sites. Moreover, system design has taken into account an end-user development (EUD) perspective (Lieberman, Paternò, & Wulf, 2006; Costabile, Fogli, Mussio, & Piccinno, 2007), which acknowledges the importance of involving different experts in the design of effective interactive systems, since they bring different types of knowledge, which software developers usually lack. Of particular importance are the experts of the application domain, but for educational games described in this paper, education experts as well as HCI experts are required. Such experts not only provide input for the design, as in participatory design approaches (Schuler & Namioka, 1993), but they are active participants to the design, development and evolution of software.

This paper describes how the EUD approach has been applied in the design of excursion-games. The focus is on how domain experts, i.e., experts in history and cultural heritage, contribute to design excursion-games to be played in a wide set of historical sites. To this aim, they are provided with a software environment customized to their needs and culture (Costabile, Fogli, Fresta, Mussio, & Piccinno, 2003; Costabile, Fogli, Mussio, & Piccinno, 2006; Costabile et al., 2007). The advantage of this approach is twofold: it overcomes the drawbacks of current course management systems, which are very difficult to use by domain experts, such as teachers, history scholars, etc., who desire to create effective and personalized
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