Designing Serious Mobile Location-Based Games

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Abstract. The technical requirements of mobile location-based games have been met sufficiently well to make location-based mobile games an everyday object. Games like Ingress or Pokémon GO have experienced a huge popularity. Hence, the question arises how the obvious attraction of these games can be used to achieve goals other than entertainment, such as learning. This article describes the basic scientific background of a workshop of the ICEC-JCSG 2019 for the development of design principles for serious mobile location-based games. First the game types involved are defined, then relevant design principles are identified and presented providing a basis to substantiate design guidelines in the workshop and contribute to the purposeful design of mobile location-based games.

1 Introduction

In recent years, mobile location-based games have experienced the breakthrough to mass media, as the games Ingress [1] and Pokémon GO [2] demonstrate. From a didactic point of view, games have unique advantages that turn them into promising learning tools. For example, as interaction triggers, they can support situated learning just as much as they inherently support principles of multimedia learning [3], such as the contiguity principles or signaling.

Among the aims of this workshop are the identification of design guidelines for serious mobile location-based games, based on phenomena documented in literature [4–6]. Further, it is important to analyze the characteristics of suitable learning content for mobile location-based games [7] and frameworks for the integration of learning content into serious games [8–10]. Additionally, current software frameworks for the creation of serious mobile location-based games, such as PlayVisit [11] need to be

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identified. In the following, first the types of games under investigation are outlined. Thereafter, existing design guidelines are presented. The workshop is based, in part, on the experience gained during an earlier workshop [12] and the EU BEACONING project [13].

2 Serious Mobile Location-Based Games

This section briefly describes the terms used to denote game types under investigation. For this workshop, the term **game** implies a digital game. **Serious games** are games that serve further purposes in addition to entertainment, such as learning. If learning is the further purpose of a game, then such a game is also called **educational game**. **Mobile games** can be understood as games that are played with the help of mobile devices such as cellphones, smartphones or tablets. A further distinction can be made between games which require an internet connection to play and games which can be played on mobile devices without an internet connection.

Location-based games are in the context of this workshop interpreted as games whose game mechanics depend on the awareness of the current position and its temporal changes, i.e. the movement of the player through the space. Location-based games require positioning technology, such as GPS, to track the current position. The vast majority of location-based games are played on mobile devices and require an internet connection, so **mobile location-based games** can almost be considered a synonym to location-based games.

A categorization of **AR games** is provided by Wetzel et al. [14]. They distinguish systematically the dimensions device mobility and content spaces. In their categorization, "true mobile AR games", which is the type of games primarily covered in the workshop, are games that include high device mobility and a wide content space, i.e. players are required to roam through the real world, such as a city. There is no clear definition of how augmentation is to be performed for mobile AR games. For example, both Pokémon GO and Ingress are commonly called AR Games. While Pokémon GO implements true video-see-through AR, Ingress uses augmentations to display additional information about near real-world objects on the screen of the mobile device.

Pervasive games are close to mobile location-based games in that they also link their game mechanics with the elements of the real world [15]. Through the intersection of virtual and real world, pervasive games are very closely associated with augmented reality. However, pervasive games are not necessarily relying on location-awareness.

The game types described here are not commonly defined, and many other definitions that differ by nuances exist. For example, De Souza e Silva and Hjorth [16] distinguish between urban games, location-based games and hybrid reality games and state that there is a "range of types of games mediated by mobile technologies". Briefly, the workshop focuses on the design of digital games that are used for learning purposes using notions of location-based, mobile and/or augmented reality.

3 A Set of Guidelines

This sections provides an overview of existing guidelines for game design. It serves as a starting point for the workshop and follow a general-to-specific approach is: starting from the design of games in general, guidelines will be presented that complement the aspects of learning, mobile, location-based and augmented reality.

Among the game design guidelines, the work of Schell [17] is well-known and established. When it comes to learning games, Harteveld et al. [18] contribute the model of "1. Fun (game), 2. Learning (pedagogy), and 3. Validity (reality)", which is characterized by inherent tensions and leaves the design process to become a complex problem. The notion of fun is associated with engagement-causing motivation. Peters et al. [19] discuss the options to design for engagement. For location-based games, Kiefer et al. [20] specify the following dimensions of design that have to be considered in game design: dimension of game environmental embedding, game conceptual dimension and game spatial and temporal dimension. Montola et al. [21] describe design guidelines for pervasive games. In the following, three selected design frameworks are described: First, the PGDF identifies the areas that need to be covered during design. Another framework for designing mobile AR Games focuses on entertainment games, while the last framework deals specifically with mobile location-based games for learning.

3.1 The Pervasive Game Design Framework (PGDF)

The PGDF [8, 22] names the components of consideration when designing pervasive games for learning (Table 1), but without any specific rules on the implementation.

Table 1. Components of the PGDF

Component	Description
Pervasive context	The Pervasive Context describes the integration of the game into the real world, i.e. the meaningful linkage of game mechanics and real-world objects
Pedagogical objectives	Since the aim of the PGDF is the design of pervasive games for learning purposes, a description of learning objectives is required
Assessment metrics	Educational technology, is also inevitably tied to measuring the achievement of learning objectives. Therefore, it must be defined how the achievement of learning objectives is measured
Difficulty level	A serious game should be able to provide tasks of varying degrees of difficulty
User skills	Since the players most probably have different skill levels, it should be determined which requirements are placed on the skills of the players and also how games can respond to different skills
Social interaction	Social interaction is one of the key triggers of learning processes. It is therefore rewarding to analyze the extent to which social interactions can be stimulated by the game mechanics in each serious pervasive game
Motivation	Motivating players to engage with the game and thus indirectly with the learning objectives is the basic rationale behind using learning games. Therefore, it is essential to describe the game mechanics that should provide motivation

3.2 Mobile AR Games

Wetzel et al. [14] present guidelines for designing mobile AR games. The guidelines in Table 2 also focus on the narrative connection between the objects of the real and the virtual worlds. This aspect is rather neglected in the design of serious games due to the effort involved.

Table 2. Guidelines for designing Mobile AR Games [14]

Category	Guideline
General	• Justify the use of AR • Engage players physically
Virtual elements	• Create meaningful AR content • Create fully-fledged characters • Create a rich scenery • Go beyond the visual
Real world elements	• Make the journey interesting • Comprise atmospheric elements from the reality • Think about security • Plan ahead
Social elements	• Use complementing roles • Use non-player characters • Encourage discussions • Avoid crowded areas
Technology and usability	• Make the technology part of the game • Keep the interaction simple • Take display properties into account • Take tracking characteristics into account • Avoid occlusion-rich areas • Design seamfully and for disconnection

3.3 Design Guidelines for Location-Based Mobile Games for Learning

Ardito et al. [23] provide guidelines especially for learning games. The guidelines are divided into five categories. Most of the guidelines are generally applicable for learning game design. Table 3 shows an extract of the guidelines especially relevant for designing mobile location-based games. The category "Control/Flexibility" seems to comprise solely guidelines applicable for general game design, thus it has not been included in Table 3.

Table 3. Design guidelines focusing on location-based mobile games [23]

Category	Guidelines (literally cited from [23])
Game general design	• Minimize the changes to the physical places • Consider the social conventions of the place (e.g. not loud speaking in a church) • Consider to include activities/events that are not part of the game, but happen in the real world (e.g. the ceremony of change of the guard at noon)
Engagement	• Provide contextual cues linked to specific places or events to convey additional information (e.g. sounds reproducing noises of daily activities in an ancient city) • Minimize the interaction with the game tools. Players' attention should be focused on the game and the environment
Learning aspects	• Game should emphasize either vertical or horizontal exploration of a place/topic, i.e., deeply exploring a limited space […] vs. more superficially exploring a broad space […]) • Tasks should require players to link areas, locations, physical objects to concepts, topics, etc.
Social aspects	• Assign responsibilities and tools (e.g. mobile devices, maps, etc.) among team members to induce collaboration. Consider to force, forbid or allow responsibilities exchange among team members

4 Summary

Starting from the positive and engaging experiences of location-based AR entertainment games, this workshop aims to facilitate knowledge transfer towards education communities and set the stage for analyzing key design principles that could guide the creation of serious location-based AR games.

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