Extracting game design patterns from game design workshops

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Abstract: In this paper, we study the design of hybrid reality location-based mobile games. To support the design of such games, a set of design patterns is proposed, which were extracted from game design workshops. Six workshops for designing location-based games were organised and the designers were asked to generate game concepts for a hypothetical location-based mobile game for visitors of the site of ancient Pompeii, where the players should engage simultaneously with the real-world but also with its game-world counterparts. Having obtained the game designs, we applied methods from content analysis and grounded theory to identify the designers' decisions in the design documents and used that information to extract patterns that the designers applied. The resulting patterns are design elements that can support ideation and concept generation. They are part of a larger project which includes a design framework and a set of design guidelines for location based mobile games.

Keywords: design patterns; hybrid reality games; location-based mobile games; content analysis; game design.

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Biographical notes: Christos Sintoris holds a PhD in the Design of Location-Based Games for Learning (2014) from the University of Patras. He received his Diploma from the Computer Engineering and Informatics Department (2001) and he is currently a researcher in Human-Computer Interaction Group at the same university. He currently focuses on design methods for location-based mobile games and on how they can support learning. He is actively engaged in the design and development of mobile context-aware games.

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1 Introduction

In this paper, we describe how we extracted a set of patterns by analysing game concepts for multi-player hybrid reality location-based mobile games for learning. The game concepts were produced by the participants of a series of game design workshops. Multi-player location-based mobile games for learning are a multifaceted field of study. Modern mobile technology and the infrastructure that is weaved in our surroundings are becoming a new reality that needs to be studied and understood in order to harness its potential. The theoretical base of how to transform this technological potential into a form that can support learning can be considered nascent. In part, this stems from a lack of common ground as to what elements of the hybrid space, the merging of the digital and the physical, can contribute to learning. A particular way that is of interest is to employ the motivational potential of games in this endeavour (Avouris et al., 2013). In the past decade, there has been increased interest on how to utilise this potential of technology as a platform for location-based gaming activities with regard to learning (Klopfer, 2011; Kurti et al., 2007).

Hybrid reality location-based mobile games are playful mobile activities situated in real world contexts. They are believed to be conducive to learning that may lead to acquisition of skills like critical thinking, curiosity, creativity, collaboration, consideration of multiple perspectives, social awareness, responsibility and media fluency (Schrier, 2006). These games are mobile, in the sense that they require that the players move in the physical domain as part of the gameplay and not that the players 'carry' the game on them as in 'mobile games'. The underlying idea is that with these games the players interact with the real world, perform physical activities situated in the real world and relate knowledge with, in particular with places rich in historic value, like historic city centres or archaeological sites. As noted in a survey of location-based games (Avouris and Yiannoutsou, 2012), these games are conceived as tools that employ the fun of a game, so that the players can be engaged with a specific location.

The design and construction of such games can be a challenge in engineering, a challenge of balancing between playing and learning, of incorporating the physical context in a meaningful way, of engaging the players, of embedding a game in an educational context, etc. It can be studied at many levels and can be approached as a social, cognitive, mediatheoretic, interaction or game-theoretic problem. This complexity is a barrier for the wider use of games in education (Kelle et al., 2011; Westera et al., 2008).

The work presented here proposes a number of design patterns that can support the design of hybrid reality location-bases games that support informal learning. It is based on a study of evidence collected in six different design workshops. We explore how designers from different backgrounds use basic conceptual elements to generate design concepts for location-based mobile games. In these workshops, the participating designers worked in groups of three to five persons to create a game concept for a hypothetical location-based mobile multi-player game for the site of ancient Pompeii. The game design task that was devised for the workshops was comprised of a fixed procedure and accompanied by material and information related to the archaeological site. We asked each design team to use the provided materials and to generate a game concept for the site. Subsequently, we applied methods from ethnographic content analysis [Altheide, 1987; Krippendorff, (2004), p.16] and grounded theory to identify

codes in the game design documents that the teams produced. The game design documents were coded in two phases using a qualitative approach. Based on these codes, we extracted the conceptual elements, patterns and strategies that the designers employed for synthesising their game designs. The resulting patterns are not intended as components that can be combined in a mechanistic way in order to generate a game design, instead they are to be viewed as design elements and are part of a larger project which includes, besides the patterns, a design framework (Sintoris et al., 2010) and a set of design guidelines for location-based mobile games (Ardito et al., 2010, 2011).

2 Background

Game design workshops are intense meetings that typically last a few hours, where participants use one or several methods to create and discuss alternative designs for games [Paavilainen et al., (2009), p.29]. Game design workshops offer the opportunity to investigate the design practices and decisions of the participants. Our contribution focuses on:

a a method of organising and conducting game design workshops

b analysing the game concepts that were generated through these workshops

c employing content analysis methods to extract game design patterns.

The game design workshops involved the generation of design concepts for location-based mobile games that support informal learning in a specific site of cultural heritage. An important stage in the creation of these games is the initial concept generation, which typically relies on the ability of the designers to be creative and innovative. Creativity studies is a large and interesting field (Runco, 2004) and the most widely used structure within creativity research (Runco, 2004), "person, process, press, and product" (Rhodes, 1987), explicitly acknowledges the study of products, which are the results of a creative process, based on the assumption that they can be objectively studied (Runco, 2004).

Game design workshops are not an uncommon approach in regard to the investigation of game design (Fullerton et al., 2004; Paavilainen et al., 2009). They possess a number of characteristics that make them a suitable research tool (Paavilainen et al., 2009):

a they are a focused, low-cost practice that can involve a large number of participants

b they can generate rich data for analysis and they can function as empirical tools to study the production of game designs and they do, as has in fact happened in our case, produce new designs

c they can be studied rather easily (in contrast to other methods such as for example observing game designers in their workplace).

The theoretical framework on which the structure of the game design workshop was based on earlier work (Sintoris et al., 2010, 2013; Ardito et al., 2011). It involved:

a interaction modalities with the real world (Avouris et al., 2013)

b an understanding of game mechanics as "the various actions, behaviours and control mechanisms afforded to the player within a game context" (Hunicke et al., 2004)

c the learning dimension of the cultural experience (Hein, 1995; Dodd, 2009)

d the role of technology in re-considering the characteristics of this experience (Yiannoutsou and Avouris, 2012).

2.1 Patterns for game design

The idea behind design patterns is that these are recurrent elements that are repeated across many instances in a design domain. The seminal work in the identification of patterns is that of Christopher Alexander in architecture (Alexander et al., 1977). Specifically in the domain of games, Church (1999), an influential and accomplished game designer at the time, proposed the formal abstract design tools with which he identified the problem and called for the creation of a 'game design vocabulary'. Another notable work is by Björk (Björk et al., 2003; Björk and Holopainen, 2004), who compiled a list of approx. 200 patterns that can be used to compose game designs. Interestingly enough, though their list contains game design patterns in general, the work was initiated by their frustration for the lack of support for designing specifically "games for ubiquitous computing environments" (Holopainen, 2011). The approach that they followed was based (Björk et al., 2003) on:

a transforming existing game mechanics (rules) to patterns

b analysing games in five steps: recognise, analyse, describe, test and evaluate patterns in existing games

c interviewing professional game designers.

Continuing on this work, Davidsson et al. (2004) extended the initial list with 74 new patterns for mobile games. Björk and Peitz (2007) applied a grounded methodology to a total of 120 pervasive, mobile games, web-based games but also games that used no technology and identified 53 new patterns that were classified as pervasive game patterns. A different avenue is followed by the game ontology project (Zagal et al., 2007), which aims at "identifying the important structural elements in games and the relationships between them".

2.2 Contribution

In order to support the design of hybrid reality location-based mobile games, we first developed and then implemented a number of game design workshops that are focused on generating game designs for hybrid reality location-based mobile games, with an emphasis for cultural heritage sites. Having implemented the workshops on six occasions (Section 3), we then analysed the game designs using content analysis techniques (Section 4) and, based on the resulting codes, we developed and open list of game design patterns that are applicable to hybrid reality location-based games (Section 4.3.1). This work brings a number of contributions,

- a repeatable and documented method to stage design workshops for hybrid reality location-based games
- a method for extracting design patterns by applying ethnographic content analysis

- an extensible collection of game design patterns, cross-referenced with design guidelines (Ardito et al., 2011).

The study described in this paper is an extension of previous work on developing design support for location-based mobile games (Sintoris et al., 2010, 2013; Ardito et al., 2011) and is integrated with previous work on heuristic design guidelines (Ardito et al., 2011, 2010).

Table 1 An overview of the game design workshops that have been analysed

	Participant characteristics in each case	*Game concepts*	*Codes total*	*Codes exclusive*
1	2011, HCI Class in Patras, Greece xxxxx Engineering students, 8th semester, programming experience, little or no game design experience	5	83	7
2	2011, PAKE training class in Patras, Greece Education specialists, partly members of design teams for ICT in education, experience in ICT in education	4	51	5
3	2011, DEG Workshop – 'Involving end users and domain experts in the design of educational games' in Torre Cane, Italy Postgraduate students, professional designers, experts in educational technology, experts in design science	2	20	2
4	2011, GBL Summer School in Autrans, France Game-based learning professionals and academics, partly experts in mobile games and mobile learning	13	226	49
5	2012, HCI Class 2 in Patras, Greece Engineering students, 8th semester, programming experience, little or no game design experience	3	-	-
6	2013, Cultural Heritage Management Summer School in Pécs, Hungary Postgraduate students in engineering, cultural management	5	-	-

Notes: In the last two columns is shown the number of codes that the coder assigned to the design documents of each workshop after the initial coding (Section 4.2) was completed but before the focused coding (Section 4.3). Exclusive codes are those that were found only in the design documents of the respective workshop. The coding began from case #4 and then cases #1, #2 and #3 were coded.

3 Research characteristics

In this section, a description of the research design is provided and the characteristics of our approach are outlined.

3.1 Approach

The approach followed was based on ethnographic content analysis [Altheide, 1987; Krippendorff, (2004), p.16]. We started with the acknowledgement that patterns are not derived from theory, but emerge from practice (Dearden and Finlay, 2006). In the context of patterns for design, this means that patterns emerge from design solutions (Dearden and Finlay, 2006). In our case, the game design concepts we studied were generated by participants in six different location-based game design workshops (Table 1). Then, we employed content analysis techniques and identified several patterns within the design concepts. The research design was informed by the questions:

a what concepts and elements do the designers apply in order to compose game ideas

b how do they integrate learning into the game concept

c how do the designers perceive the design space.

3.2 Participants

The designers who participated in this study had varying backgrounds. They were recruited on six different occasions (Table 1):

a 8th semester engineering students who participated in the workshops as part of a on human-computer interaction class (cases 1 and 5)

b researchers and professional designers who participated in workshops related to game-based learning and/or cultural heritage management (cases 3, 4 and 6)

c public education specialists who were training as instructors for the application of ICT in education (case 2).

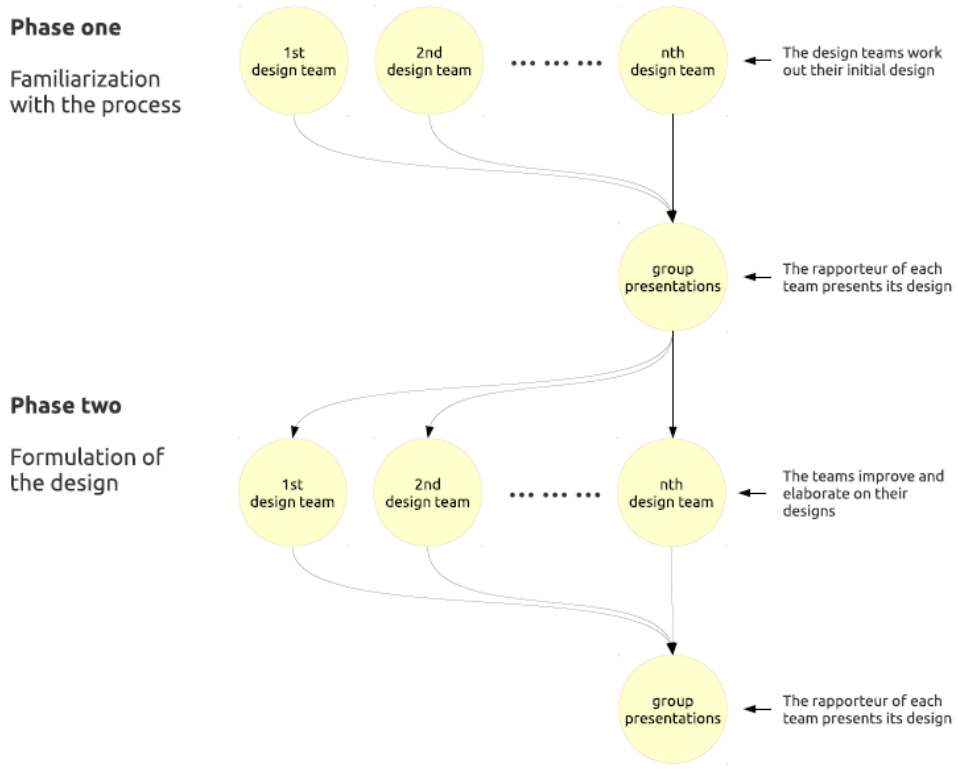
The participants covered a range of professional backgrounds that was expected to provide a varying perspective, while at the same time the profiles covered typical backgrounds for multidisciplinary design teams for location-based games for learning: cases 3 and 4 were comprised of more experienced interaction and game designers, while cases 2 and 6 covered expertise that is more leaning towards educational and cultural heritage experts.

3.3 Workshop layout

The workshop was designed to involve group work (more than one group was involved in designing a game). In this process, groups work on the game components in two phases. The process that the designers followed is based on unpacking location-based mobile games into their components, each of which is addressed separately but also in relation to the other components. This approach is grounded in a framework of design principles defined by Sintoris et al. (2010) and it partially draws elements from the

mechanics-dynamics-aesthetics (MDA) framework by Hunicke et al. (2004). In the workshops, the designers formed teams of three to five members and attempted to sketch out a game design in two phases (Figure 1). During each phase, the teams used the available tools (which are described below) to generate their design. At the end of both phases, all teams presented their game designs. The two phases are similar, with the difference that there is more time available for the second phase. The rationale for this is to use the first phase in order to become acquainted with the process and the tools and the second phase in order to work out and describe more thoroughly the game idea. At the end of each phase, each team specified its concept by filling out a worksheet. One of the team members took the role of the rapporteur, who presented the team's design. During the presentations, the designers were allowed to comment and appropriate the presented ideas in their own designs. After the first phase, the process was repeated and the workshop session ended after the second round of presentations. The duration of the workshop was between 1 and a half and 2 hours.

Figure 1 The structure of a game design workshop (see online version for colours)



Notes: The workshop runs in two similar phases. First, a familiarisation phase and then the main design phase. The total duration of a workshop session is 1 and a half to 2 hours.

3.4 Workshop material

The material created for the game design workshop concerned the archaeological site of ancient Pompeii. It contains descriptions of selected landmarks, main ideas or concepts (from the economy and everyday life in Pompeii) and a map of the archaeological site. At the start of the workshop session, the participants received the following materials:

a a worksheet that will contain the final game design

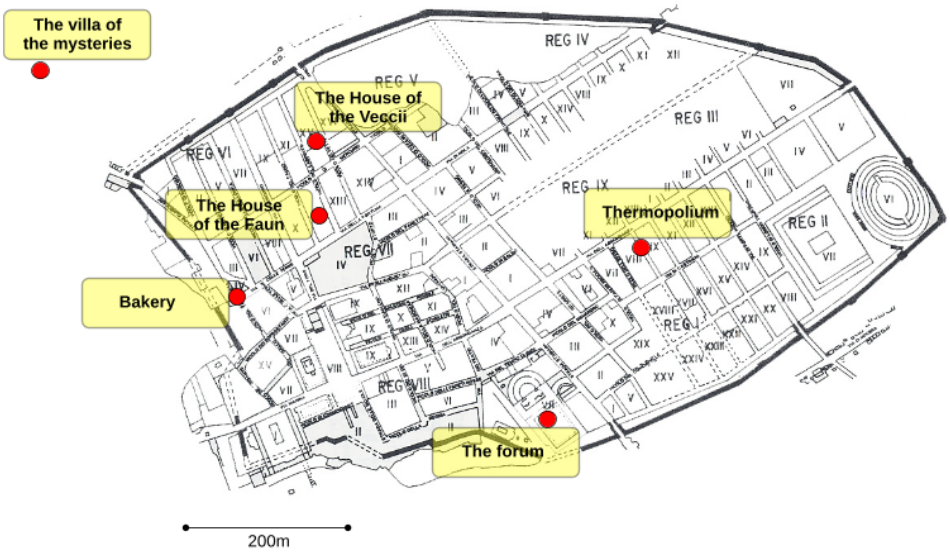
b a map of the archaeological site of Pompeii (Figure 2)

c a description of interesting sites in ancient Pompeii

d concept cards that describe aspects of the live in the ancient city

e an instruction card (the material is available at http://hci.ece.upatras.gr/pompeiigame).

Figure 2 This map of Pompeii, with the locations of six landmarks, is one of the workshop materials (see online version for colours)



3.5 Worksheet components

The teams used worksheets to describe their game concepts. Each worksheet contained a number of items that were to be described or specified by the participants, on which they could contemplate and use as fill-ins to describe their game concept:

- *The title of the game*: The title can be something funny, curious, strange and/or representative of what the game is about.
- *The goal of the game*: The goal of the game involves what the players need to do in order to win.

- *The rules of the game*: The rules delineate the behaviour of the players and define the ways in which they can interact with the (real-world or digital) objects of the game with their co-players or with their opponents.
- *Use of technological means and tools*: Location-based mobile games employ technology in various ways: as information screens, as communication media, as barcode scanners, as GPS devices, as map displays, etc.
- *Mechanisms*: The mechanisms of the game involve mainly the pacing of the game and the type of interaction between players.
- *Behaviours and aesthetic result*: This item involves how the game will evolve over time and what is the envisaged player experience.

3.6 Design task and data collection

The workshops were realised in six different occasions (Table 1). The profiles of the participants varied in most of the cases. While the design task was kept constant, the resulting designs reflected the profiles of the designers. In two occasions, 8th semester engineering students participated in the workshop sessions, another two sessions were conducted during summer schools, one during an international workshop on game design and one were the participants were education professionals. The most productive session took place during the Game Based Learning Summer School (case 4, Table 1) where the participants had a variety of profiles (both academic and industrial) and were strongly related to a game studies background.

Each workshop session started with a brief presentation of the design task, the materials and context about Pompeii. The design scenario prescribed that the participants are impersonating game designers with the task of designing a game for visitors of the archaeological site of Pompeii. The game should thus have the characteristics of a location-based mobile game, adapted for this site. The participants were asked to design a game that can be played in a 'physical space' by multiple players, who will use mobile devices or smartphones as interaction tools. They were also asked to make use of pervasive computing technology in their game, in any manner they can envisage, such as physical hyperlinks (e.g., quick response or near field communication tags), unrestricted wireless communication, location-sensing, augmented reality, etc., without constraints. Finally, the designers were asked to engage the players in a learning process about the specific site, ancient Pompeii. In all, the design task given to the participants was, given a place of high information density and the goal to achieve any kind of learning outcome and after taking into account the profiles of the prospective players, to sketch out a game concept by describing elements such as the rules, the mechanics, the typical player behaviours, the available technology and they way it should be used. The designers were allowed to assume that they have unlimited resources for their game concept. These 'ideal designers' had thus to cope with a number of issues:

- How the technology will be used in their game concept. To describe the technological means and the way they will be used.
- How to connect the domains of the digital and the real world.
- How to employ playful interaction in the game concept.

Data was collected mainly by digitising the generated worksheets. During some of the workshops, it was possible to keep audio or video recordings of the discussions (cases 2, 3, 4, 5). The game concepts were subsequently analysed by employing a content analysis approach. Content analysis is not a singular method but rather a set of methods in the social sciences that are used to analyse communication and texts. Content analysis offers a number of methodological means. We employed ethnographic content analysis [Krippendorff, (2004), pp.16, 21; Altheide, 1987], a data-driven content analysis method. Next, we will describe the specific approach with more detail.

4 Data analysis

The collected game designs were processed and analysed with the aim of detecting patterns in them, which could allow inferences as to the concepts that the designers employed. The processing and analysis of the material had the following characteristics:

1 The unit of analysis was the design decisions that are reflected in the design documents. To detect those, a coder collected the design documents, prepared and digitised them and finally imported them to NVivo (2008), a specialised code analysis software.

2 The coding of the game designs was conducted in an iterative manner in two stages, employing first initial and then focused coding.
   - During the initial coding stage, the coding scheme was devised freely based on the experience and interpretations of coder a.
   - In the focused coding stage, the codes were revised and re-organised in new categories by coder a, based partially on feedback by a second coder.

3 Description of the codes and elaboration upon them, in order to produce the design patterns.

A total of 32 game concepts were produced by the design teams (one design in case 3 was not documented in the final worksheets).

4.1 An example: 'Pompeii Total War'

'Pompeii Total War' is one of the concepts from the workshop at the Game Based Learning Summer School in 2011. The complete document that was provided to the participants after the 1 and a half hour session is provided below. The designers were clearly inspired by the 'Total War' series of video games and have modelled their design accordingly. The language of the original design has been preserved.

- *The aim*. Conquer and protect the flag of/from every team (other players). Your devices assist you: You can see buildings and non-player characters (NPCs) through it. It also features a dynamic map of your camp flags and conquered flags. NPCs will give you hints and help you to solve puzzles and enigmas through a dialogue interface. Beware, you will often need to gather several clues to solve puzzle in the same time in different places. So split the team and use the simplified com-system to stay in touch

- *The rules*. You must protect and conquer flags by answering puzzles: – a foreign flag can be captured when resolving the puzzle that an NPC guard gave to the team – you can recapture your own captured flags by answering a new enigma to the NPC guardian – you can recapture a lost flag by answering again to the guard (another enigma of course). You have 2 hours for the contest.
- *Use of means and tools*. Tablets/smartphones with GPS (location), camera (augmented reality) dynamic map of Pompeii with list of team flags (conquered) network connection to a ?? (–word is unintelligible in the original text) (real-time changes on the world).
- *Game mechanics*. RTS, capture the flags – several located enigmas – time challenge (capture the most flags) – collaborative resolution (ubiquitous problems for teams) – building strategies with several roles in the team – communication with legendary known NPCs (gods, generals, famous).

  Some enigmas: on the same flags there are several possible enigmas. They are asked in a progressive way: the easier first, the harder last. Puzzle: the mosaic with Alexander and find the place where the mosaic is. A non-playing character asks the players to find a picture in the pool. But to see the pic, the pool must be full. So they have to split into two groups. One must stay near the pool, the other has to find the valve. Once the valve is found, they open it and tell the others to look at the pool. Attention, the valve must be shut down whether the other teams can find it. Then all players have to go back to the NPC and explain who is on the pic and his role in the mythology (Dionysos, god of wine). If they are wrong, the NPC explains them but they loose the flag.
- *Player behaviour and aesthetic result*. Competition and pressure – discovery of amazing [places | people (NPCs)] – self efficacy improvement when a cooperative problem is solved – fun! – Learning a lot about past Pompeii.

Figure 3 A team contemplating on their design, during the 2011 Game Based Learning Summer School in Autrans, France (see online version for colours)

Table 2 The codes after the end for the focused coding (Section 4.3)

Codes	*Workshops:*	*1*	*2*	*3*	*4*	*5*	*6*	*T*
Enthusiasm		0	0	0	1	0	0	1
Joy		0	0	0	1	0	0	1
Pride		0	0	0	1	0	0	1
Anti-cheat		1	0	0	0	0	0	1
Combining collected objects		1	0	0	0	0	0	1
Competition for limited resources		1	0	0	0	0	0	1
Dexterity		0	0	0	1	0	0	1
Innovate		0	1	0	0	0	0	1
Obstruction		0	0	0	1	0	0	1
Stealing		0	0	0	1	0	0	1
Based on board game		0	0	0	2	0	0	2
Multiplayer shooter		0	0	0	2	0	0	2
Quest-based game		0	0	1	1	0	0	2
Based on open area multiplayer game		0	0	0	2	0	0	2
Engagement		0	1	0	1	0	0	2
Satisfaction		0	2	0	0	0	0	2
Hot-cold mechanic		1	0	0	1	0	0	2
Race		1	0	0	1	0	0	2
Territory defence-attack		1	0	0	1	0	0	2
User actions influence narrative		0	1	0	1	0	0	2
Emotions		0	0	0	0	3	0	3
Cooperation		0	2	0	1	0	0	3
Curiosity		0	0	0	2	0	1	3
Balance between cooperation and competition		0	0	0	2	1	0	3
Sabotage		1	0	0	2	0	0	3
Game tools		1	0	0	1	1	0	3
Thrill		2	1	0	0	1	0	4
Bluff		1	0	0	1	2	0	4
Co-locality, sychronisity		0	0	0	3	1	0	4
Economic		1	0	0	2	0	1	4
Game master		1	1	0	0	1	1	4
Information exchange		0	0	1	1	1	1	4
Mechanisms of game immersion		0	0	0	4	0	0	4
Based on digital game		0	0	0	5	0	0	5
Balance between challenge and available options		1	1	0	1	1	1	5
Find		0	0	1	2	1	1	5
Strategy		0	0	0	5	0	0	5

Notes: Columns 1 to 6 list the codes that were identified in the game concepts of the respective workshop. The last column (T) lists the total game concepts where a code was identified.

Table 2 The codes after the end for the focused coding (Section 4.3) (continued)

Codes	*Workshops:*	*1*	*2*	*3*	*4*	*5*	*6*	*T*
Roles give different goals		1	0	0	3	1	0	5
Fun		4	0	0	1	0	1	6
Stress		0	0	0	6	0	0	6
Explore the map		3	0	0	2	0	1	6
Trading information or objects		0	0	0	6	0	0	6
Motivation factors		0	0	0	5	1	0	6
Game mechanics		2	0	0	5	0	0	7
Score keeping		3	1	0	1	1	1	7
Flow between digital and physical world		0	2	0	5	0	0	7
Cooperation between teams		0	0	0	6	0	1	7
Competition		4	1	0	3	0	0	8
Target group		0	2	0	4	0	2	8
Identifying and collecting		2	1	0	4	1	1	9
Rewards		2	0	0	4	0	3	9
Primitive action		3	0	0	5	0	1	9
Information awareness		2	0	1	6	1	0	10
Competition between individual players		1	0	0	4	2	3	10
Assistance and help (clues, etc.)		2	2	0	4	0	3	11
NPC		0	0	1	9	1	0	11
Structure-temporal		2	3	0	4	1	1	11
Interaction with the digital interface		4	1	1	5	0	1	12
Winning condition		3	2	0	3	2	3	13
Structure-spatial		2	2	2	2	1	4	13
Against time		1	1	1	10	0	1	14
Climax		3	0	1	10	0	0	14
Competition between teams		5	0	0	7	0	2	14
Game objects		3	1	0	7	2	2	15
Player goals		3	1	0	10	1	1	16
Cooperation between individual players		1	2	1	11	2	1	18
Player differentiation, roles		2	2	2	10	2	1	19
Puzzle		5	2	1	7	2	2	19
Players form teams		3	4	1	10	0	3	21
Interaction with the physical space		4	4	0	13	1	2	24
Learning trajectories		3	2	1	13	1	5	25
Narrative		5	2	2	13	2	3	27
Tools		5	4	2	14	3	5	33
Totals		97	52	20	282	97	60	

Notes: Columns 1 to 6 list the codes that were identified in the game concepts of the respective workshop. The last column (T) lists the total game concepts where a code was identified.

4.2 Initial coding stage

The coding started with what was at that point the most recent workshop, the Game Based Learning Summer School (case 4 in Table 1). Coder A read the documents and applied codes to parts of the text. The codes were in the form of single words or small phrases and were organised in categories by the coder. The method followed in this stage is that of *initial coding* [Charmaz, (2006), p.47; Saldaña, (2009), p.81] and was driven by the content of the game design documents. Initial coding can generate both descriptive and conceptual codes [Saldaña, (2009), p.85]. In this case, no dictionaries or other pre-existing code sets or coding schemes were used. The procedure which was followed by the coder involved inspection of a game design document (which was structured as per the components of the worksheets) and applied the codes that had been identified up to this point. In this stage, the coding was conducted thematically, i.e., the codes were based on what the coder identified as the topic of a specific part of text (e.g., competition between the players, score, how technology is used, mechanics, etc.) During the process, if the coder identified a concept that could not be described with the available codes, a new code was devised and applied. The coder also reviewed the already coded game designs and applied the new code where it was deemed that it fitted. In this iterative process, the codes gradually became more analytical and less descriptive. The coder then continued with the same process and coded cases 1 to 3.

The coding scheme after this stage was thus the product of:

1 what the coder recognised as the factors that contributed to the forming of the game design

2 what the coder recognised as the elements that the designers deemed important to incorporate in the design.

The categories that were identified during the initial coding of the first four cases are *emotion*, *mechanics*, *interaction*, *motivation*, *narrative*, *social interaction*, *base on a game*, *other*.

The resulting set of codes or coding scheme was subsequently used by a second, external coder (Coder B) to code a random document in order to gauge the inter-coder reliability, as a measure of robustness of the coding scheme. The resulting κ value was calculated to 0.46 (a κ between 0.46–0.7 is interpreted as 'satisfactory – good agreement' (according to the NVivo documentation. A slightly different but widely known scale (Landis and Koch, 1977) splits the range 0–1 in five ranges, where the range 0.40–0.60 is interpreted 'medium agreement').

4.3 Focused coding stage

After the initial coding, the second stage of coding was conducted. The method followed in this stage is that of *focused coding* [Charmaz, (2006), p.57; Saldaña, (2009), p.155]. Focused coding, as was the case with initial coding in Section 4.2, is a qualitative method and "some interpretive leeway is necessary" [Saldaña, (2009), p.150]. The goal of the coder was to intentionally interpret the data [Richards, (2005), p.95] in order to formulate analytical codes which are preferably not descriptive, but which amount to conceptual categories. The coding scheme of the first stage was revised, codes were renamed or re-assigned to new categories. For example, the descriptive code 'NPC' was merged with

the code ‘interaction with an NPC’. A secondary strategy was to eliminate redundant or very rare and specific codes and prefer more general ones and in the same time split overly used codes to more specific ones. The overall goal was the emergence of an underlying model that is suitable to describe the game design documents.

Table 3 A list of the patterns that were produced based on the results of the focused coding (Section 4.3)

	Pattern title
P1	*Interaction between the players*
P1.1	Balance between competition and cooperation
P1.2	Competition for limited resources
P1.3	Competition between players or groups of players
P1.4	Roles, player differentiation
P1.5	Cooperation between players or groups of players
P1.6	Team forming
P2	*Playability*
P2.1	Interacting with the digital space
P2.2	Interacting primitive
P2.3	Help and support
P2.4	Balancing challenge and available options
P3	*Challenge*
P3.1	Puzzle
P3.2	Against time
P3.3	Finding object (and/or recognising object)
P3.4	Exploring
P3.5	Information awareness
P3.6	Dexterity
P3.7	Path finding
P3.8	Hot-cold
P3.9	Territory defence-attack
P3.10	Stealing
P3.11	Transporting object
P3.12	Bluffing
P3.13	Fog of war
P3.14	Sabotage
P3.15	Scoring
P3.16	Synchronisity
P3.17	Collecting objects
P3.18	Co-locality
P3.19	Trading information or objects
P3.20	Combining collected objects
P3.21	bstructing (physically)

Source: The descriptions for these patterns have been posted on a wiki at http://hci.ece.upatras.gr/l-bags/doku.php?id=en:patterns:nodes

Table 3 A list of the patterns that were produced based on the results of the focused coding (Section 4.3) (continued)

	Pattern title
P4	*Narrative*
P4.1	Narrative flow
P4.2	Background story
P4.3	Narrative is influenced by player actions
P4.4	Climax
P4.5	Non-player character – NPC
P5	*Players*
P5.1	Rewards
P5.2	Motivation
P5.3	Target group
P5.4	Player goals
P6	*Space*
P6.1	Interacting with the physical world
P6.2	Proximity
P6.3	Shared space
P6.4	Spatial structure
P7	*Game*
P7.1	Equipment
P7.2	Tools
P7.3	Immersion mechanisms
P7.4	Based on another game or concept
P7.5	Ending condition
P7.6	Coordinator/game master
P7.7	Temporal structure
P8	*Learning dimension*
P8.1	Strategy
P8.2	Learning trajectories

Source: The descriptions for these patterns have been posted on a wiki at http://hci.ece.upatras.gr/l-bags/doku.php?id=en:patterns:nodes

The coding scheme that resulted from this procedure (Table 2) was given to two external coders (coder b and coder c) who applied it on one of the designs. The κ value for the codings of coder a and coder b was calculated to 0.55 – 'satisfactory – good agreement', while the κ value between coder a and coder b was calculated to 0.36. Note that coder b is the same person who did the second coding after the initial coding stage and whose feedback and comments flowed in the second coding scheme. Thus, the better agreement of coder b can, at this point, be interpreted as being the result of better training and familiarity of coder b with the material.

4.3.1 Extracting design patterns

The codes that resulted from the focused coding of the second stage can then be considered general enough as to be viewed as candidate patterns. We found that some codes were used recurrently by the participating designers across all workshops while some codes were used only rarely. Codes that correspond to expected player emotions (e.g., 'joy', 'pride') were discarded at this stage, since they amount to expected or desired emotional response of the players of the game.

To generate the design patterns, we followed a two-stage process. Initially, the final coding scheme was examined closely and descriptions were attached which, for each code, outline the underlying concept. Then the codes were cross-referenced with each others and accordingly modified to accommodate overlappings that resulted from the cross-referencing. At this stage, they were also cross-referenced with the design heuristics that were described in earlier work (Ardito et al., 2011). As discussed already in Section 2.1, this approach differs from similar endeavours to describe game design patterns. In the case at hand, the proposed patterns emerge from the content analysis of actual game design documents and are not extracted from theory (Dearden and Finlay, 2006) or inferred retrospectively from individual designer accounts.

The proposed design patterns constitute motifs that where repeatedly applied by the designers who participated in the workshops and can be viewed as building blocks or partial solutions to recurring design problems. The design patterns do not constitute a complete design tool but are rather to be viewed as a complementary design tool that can be used in conjunction with other tools, such as the game design guidelines for location-based games for learning which were proposed in Ardito et al. (2011).

We identified 53 final design patterns which are organised in eight categories (Table 3). These categories reflect those of the coding scheme of the focused coding stage and are: P1 – Interaction between the players, P2 – Playability, P3 – Challenge, P4 – Narrative, P5 – Players, P6 – Physical space, P7 – Game and P8 – Learning. The final design patterns do not constitute a complete pattern language but should be viewed as a list that can constantly be enhanced, conditional on the coding of further design documents.

Below follows an example for the pattern information awareness. This pattern was found on ten game concepts. In italic are marked cross-references to other design patterns.

Pattern: Information awareness. Information awareness concerns the extend and type of information a player has about the other players' actions and states. It concerns the management of the information that will be available to other players. *Competition* and cooperation can be regulated by adjusting information awareness. Note that in a location-based game information can also be regulated by proximity: nearby players can observe or listen to other players or even spy on their devices or listen to the sound that other devices make. Information can leak intentionally (*bluff*, *sabotage*), in which case it might be misleading. Even if the game has built-in channels for information dissemination, players who use their personal devices can use their phones for coordination and information exchange, subverting or extending the game's built-in channels of information. A simple example is the *fog of war*, where the actions of the opponents who are not nearby are covered behind a 'veil'.

It can be combined with *player differentiation*, e.g., two players with different roles to have access to extra information if they decided to cooperate or if they are in proximity to each other.

Link to heuristic 3.7 (Ardito et al., 2011).

5 Conclusions

Designing a location-based mobile game is a complex undertaking. Besides considerations about game mechanics and fun, which are complex in themselves, other aspects such as interaction between the players, the physical location and objects, learning outcome, etc. make this endeavour even more difficult. The work presented here proposes a number of design patterns that can support the design of such games. It also presents and documents the procedure followed for extracting these patters, which was by performing content analysis on game concepts that were created by designers in structured workshops. The design patterns are envisioned to be fruitfully used in the initial stages of generating concepts for location-based mobile games. The process that was followed in this study was limited in that it was performed on a single design task – a game for the site of ancient Pompeii. Another, apparent, limitation is the pool of designers who participated, which did not include individuals who are professionally generating concepts for location-based games. In itself this limitation has a rather difficult to overcome, since location-based mobile games are still a nascent commercial field and most of the relevant activity takes place in an academic context. On the other hand, the profiles of the participating designers do cover a population which broadly contains game experts (case 4, Table 1), interaction experts (case 3), cultural and educational experts (cases 2 and 6), engineers (cases 1 and 5), which suggests that it is representative of multi-disciplinary design teams. Concluding, it should be noted that the design patterns proposed here are to be seen as building blocks or as partial solutions that can support the generation of game concepts and not as strict rules or recipes to be followed blindly. As to be useful design tools, the design patterns aim to strike a balance between the aim to give designers enough options and to avoid prescribing static solutions.

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