

# Learning in the City through Pervasive Games

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**Abstract.** This paper discusses learning in cities through pervasive game activities. Taking into account that in modern cities information infrastructure becomes an indispensable asset, it is argued that new kinds of games facilitated by information infrastructure and mobile technologies are conducive to learning. We present examples of games played in urban environments and discuss various ways through which learning may take place during game play.

Keywords: city games; mobile learning

## I. INTRODUCTION

Modern cities with their information infrastructure are becoming a new reality that needs to be studied and understood. Learning in such places takes new forms and characteristics. Pervasive learning, as suggested by Thomas [1], is related to community, autonomy, locationality and relationality, while De Jong et al. [2] have suggested a reference model for mobile social learning. Still, 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 hybrid cities can contribute to learning. A particular way that is of interest is to employ the motivational potential of games in this endeavour.

Over this last decade there has been increased attention on how to tap on the potential of mobile technology and related communication technologies as platforms for location-based gaming activities with regard to learning [3, 4]. These games take the form of playful activities situated in urban contexts and 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 [5]. 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 relate knowledge with physical activities situated in the real world, in particular with places rich in historic value, like historic city centres. The potential of these games for supporting learning has been framed early on by De Souza e Silva [6], in terms of three key characteristics that are supported: social learning, situated learning and experiential

learning. Learning in the context of these games is a process where learners construct knowledge through their interaction with their surroundings, their co-players and with the mediating technology. In a recent survey of location-based games three types of location based games were identified: ludic, pedagogic and hybrid [7], based on prime intention of their designers. Among the pedagogic games, scavenger hunt games, participatory simulators, games for situated language learning and educational action games were identified as the main categories of location-based games that can support learning. These games are conceived as tools that employ the fun of a game, so that the players can be engaged with a specific location. In Fig.1 an overview of different genres of such activities are shown related to their ludic and pedagogic value, inspired by the survey of [7].

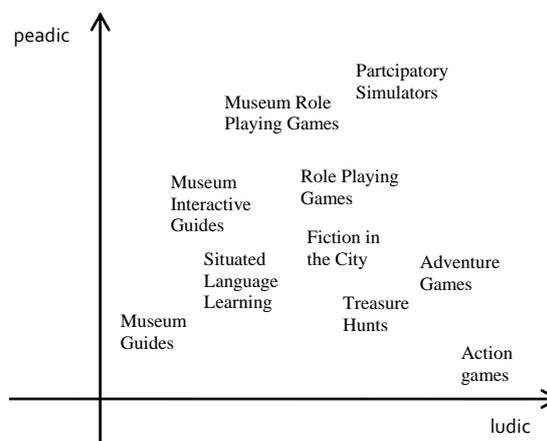


Fig. 1. Playful activities with spatial characteristics

Many studies stress the importance of employing games in the learning process focusing on the intrinsic motivation inherent in games. Gameplay is inherent in children and adults and, besides being a recreation, it promotes physical and intellectual activity. Interweaving a game concept with the content to be learned is a way of infusing the advantages of games (i.e. the motivation derived from the feeling of fun) into the learning process [8]. A successful mix between learning and gameplay in an educational activity can be achieved, some approaches suggest, by including characteristics or game elements in the educational activity. Another

approach is to employ successful game styles from known gaming paradigms, and to infuse them with content to be learned.

The concrete mechanisms through which these games do lead to learning are still not clear though and, more importantly, the empirical evidence that supports the notion of learning through pervasive games is not sufficiently conclusive, a fact rarely admitted, e.g. [9]. This, in part, stems from widespread differentiation across the field as to the initial assumptions and methodologies applied and as to what constitutes learning. Still, the interest of the community in further exploring the potential of these games is evident. The kind of learning that is possible with this kind of games needs thus to be further investigated.

## II. LOCATION BASED GAME SPACE

The terminology used to describe location-based games varies. They have been called pervasive games [10], hybrid reality games [6], augmented reality games [3], etc., and they have been defined according to the technology that enables them [11] and to their gameplay [12]. While the specific terms usually do reflect differences in focus, more often than not the definitions are actually overlapping. In truly location-based games technology plays a central role (while, e.g. pervasive games are sometimes defined more broadly as to include non-technological forms of games [10]) and the player activity takes place around specific locations. A recurring view of what constitutes the game-space of location-based games involves the consideration of their dual character of overlapping physical and digital dimensions. Some of the activity takes place in the physical domain and involves actions such as moving to a location, inspecting an artefact, taking pictures or recording sounds. At the same time, a part of the activity takes place in the virtual domain where the players interact with simulated characters and events, where they generate information in digital form and consume information or engage in problem-solving activities like solving puzzles. The two spheres are not clearly separated though and involve deep interconnections between the social, physical and virtual spheres.

A more detailed space to describe and understand location-based games is by plotting out its main constituting dimensions: the ludic, the learning, the spatial, the social, and the interaction dimension [13].

The ludic dimension is what constitutes the «fun» of playing a game. A consenting view traces the emergence of fun in their ambiguity and the way these games blur the boundaries between everyday life and play [10, 12].

This obfuscation stems, at least in part, from the spatial expansion of the game space into the hybrid city. The urban landscape gets populated with game objects and goals [14], and the lines between the virtual, the real and the ludic get less clear.

The motivations of the players, who are driven by the purpose of playing or even winning, can serve as a vehicle that promotes learning and sense-making. As

Huizenga et al. reported, mobile games “are excellent ways to combine situated, active and constructive learning with fun” [15].

## III. MODALITIES OF INTERACTION

Any time we are engaged in playful activity we cross a “magic circle” [10, 16] and enter a new domain: that of game play. Rules, characters and stories evolve in this new domain. In many cases of game activity the physical space may play a limited role in this, e.g. computer games are played by just interacting with a computer screen. In that case there is an interaction between the game space and a digital space in which the game state and digital characters and information reside. However in location-based games the game activity takes place in a space where places may carry a meaning and participate in the game activity. In this case we observe the co-existence of three interrelated spaces: the game space, the digital space and the physical space (see fig. 2). Technology and mobility interrelate the three spaces. Next we examine the modalities of interaction between physical and virtual spaces (digital and game space). A conceptual overview with some examples and functionalities and how to introduce them during the design of mediating activities are also included here.

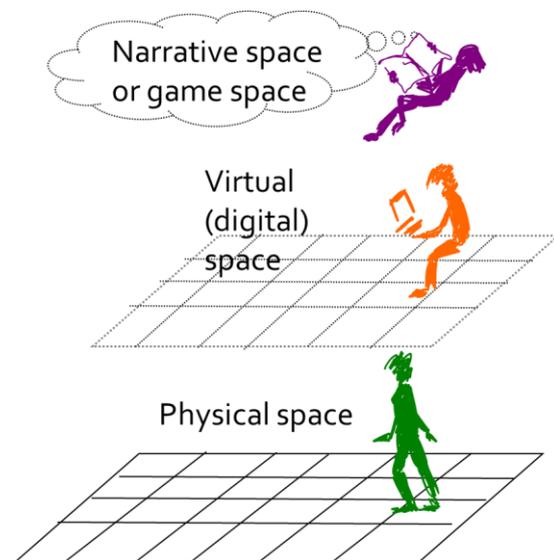


Fig. 2. Technology is expected to link three different spaces: game space, digital space and physical space

At the level of primitive actions, the players, usually through a mobile device, perform operations (select an item, reply to a quiz, etc.) that affect the state of the game. The context of these operations in game space and physical space, as well as the identity of the player (role or character played) give different value to them. In addition, more complex operations may be performed, that take advantage of capabilities of powerful mobile devices, like gestures a player performs such as waving or moving a device in a specific way, as for example was the case in REXplorer [17], or taking a picture of a specific object that then is recognized by other players (headquarter team in Frequency 1550 [15]) or even images recognized by an image recogni-

tion algorithm to confirm the position of the player or the accomplishment of a task (Paul Getty project Google Goggles<sup>i</sup>). Simple operations involve just scanning a tag that identifies a specific place or object<sup>ii</sup>. The semantic meaning of such scanning actions may vary and depend on the game state. It may be related to:

1. Collecting some information to be interpreted,
2. Unlocking a part of a narration,
3. Receiving further instructions,
4. Replying to a question, doing a puzzle,
5. Linking objects action (scanning being part of a sequence),
6. Transporting “virtual objects” between positions (scanning being part of a sequence),
7. Modifying the state of the object, i.e. locking or unlocking the object, or changing its description, changing the content of its display or its appearance, etc.

In addition the position of a player in a specific place may be detected<sup>iii</sup> and the information to affect the game state, e.g. proximity of two players may allow some possible interactions between them, based on the fact that they belong to the same or competing team.

These primitive interactions are used in location-based playful activities in many different ways. A prominent example, particularly relevant to modern hybrid cities with information infrastructure is that of *fiction in the city*. This is discussed in more detail in the next section, in which special attention is provided on the narrative dimension of pervasive games.

#### IV. TELLING STORIES IN THE CITY

A mobile activity with inherently prominent narrative elements is what is called mobile fiction, or *fiction in the city*. The playful character and the situated nature of the reader / player experience make this activity similar to a location-based game, while some learning side effects are expected, as they result in exploration of the setting. The design of activities of this kind is based on a story, usually in traditional form (e.g. a crime novel) that is adapted and integrated in a location that can be associated with it, usually the place in which action takes place. Then, interactivity is built in the story. The users are asked to move to different locations in a city or a building in order to follow the story that is delivered through a mobile device and possibly interact with or play the part of story characters, engage in the action and use props, in the same way as in a theatrical performance. So the participants are engaged in a combination of mental and physical activity, the former when they are asked to solve puzzles in order to advance the story and the latter when they are asked to walk between places in order to move on with the narrative. This, ac-

ording to [18], supports the “diegetic immersion” of the participant. This is because user actions, like walking from place A to place B, are the same in the story world and the real world, so the problem of who is in control between the author of the story and the participant is tackled since the players contribute to the delivery of narrative material contribute to the delivery of narrative material through meaningful actions ~~contribute to the delivery of narrative material~~. The purpose of mobile fiction may be the enjoyment of immersing in a story in location, or the pleasure of discovering a place through a story. Examples of fiction based location-based mobile storytelling include: ‘Riot!’[19], ‘Hopstory’ [20], ‘Who killed Hanne Holmgaard’ [21], and ‘Tracking Agama’ [22]. In addition some commercial products exist mostly in the form of alternative tourist city guides.

Kjeldskov and Paay [23] have explored and discussed different kinds of fictional mobile guides, in terms of the way the parts of the story are related. They distinguished the following cases:

1. Linear stories, in which the parts of the story are linked in a certain fixed order, so that the participants have to follow the exact steps in order to reach the end of the story, providing the author with high degree of control over the narrative.
2. Non-linear stories, that consist of a number of parts that the participant may read or listen to in any order they like in order to create the whole story. These, from the user experience point of view, increase the level of interactivity in terms of composition and have a built in quality for exploration for finding the next piece, as well as putting the pieces together, an example of this kind being ‘Riot!’.
3. A third kind is a narrative that contains a set of self-contained short stories related to physical locations, where the next possible story depends on the current one. However in this case there is no overall storyline, but at each step there is a link from one story to the next by means of some similarity between them, the meaning laying in the transition. A typical example is ‘Hopstory’, with its linear plot, delivered from different character viewpoints, that provides a collection of scenes that can be collected in any order.
4. A fourth case includes narratives that are made up of many small fragments which can be put together in many different ways, however in this case it is particularly challenging to author meaningful stories, while most of the control is left to the users and the serendipity of events that take place around them.
5. Finally a fifth case is narratives that are based on self-contained short stories related to physical locations but with no predetermined relation to each other. In this case the model is simple, since when the participant enters a particular place, she is offered with a number of stories that fit the

<sup>i</sup> <http://mobile.getty.edu/gettygoggles/>

<sup>ii</sup> Various technologies have been used, like NFC near field communication, 2-dimensional codes like RFIDs, bar codes, etc.

<sup>iii</sup> Positioning technologies vary too, some related to proximity, using GPS positioning systems outdoors, or various sensors indoors.

location. The author has full control over each short story, and the participant controls the overall picture, made of the individual stories.

On the other hand, Gentès & Jutant [24] observe that the narratives of pervasive games may be distinguished along the dimension of realistic/unrealistic mapping of perceived objects. On one hand, some stories are truthfully based on the perceived reality, thus exploring and enriching it (mimetic storytelling), while others are uncanny stories, which provide objects with new meanings, creating suspicion and increased curiosity, that conducting to learning.

Fiction in the city, in its realistic, exploratory version has taken recently the form of alternative tourist guides that challenge the most traditional database-like approach that fragments narration according to different places of interest. Whaiwhai is a publisher of a number of such guides for various cities around the world. A typical example of such a guide is ~~that one~~ built for the city of Florence, called Firenze 2054. This is based on a story by L. Artusi, a local writer. The participant is provided with a map and a notebook, the guide. The guide is cut into three sections. Clues for the puzzles to solve are provided through SMS messages. The narrative starts “...on October 27th, 1954 when twenty unidentified flying objects soar through the skies of Florence ... looking for something that fell to the Earth centuries ago”. The narrative is segmented in forty-five stories about forty-five different places in Florence and evolves in a non-sequential fashion. It is possible to advance the story only by physically visiting the places of the city, however finding out where to go is not a trivial task. In addition, it is also not trivial to find the clues on the spot. Mostly, the game hands down to the players’ anecdotal knowledge on the urban places it utilizes about certain names, structures, conformations of the city.

A typical example of fiction in the city genre is presented by Paay et al. [21]. In this, users experience the mystery story ‘Who killed Hanne Holmgaard’ interactively, as they move through the city of Aalborg. In this activity the users become part of the narrative as they play one of the characters described in the story. In this case there is a pre-constructed story line which is expected to be followed and “discovered” by the users. The users do not establish the relationships between the different parts of the story but they use the offered information to discover them. As of what concerns the structure of the narrative, it is linear and based on a temporal sequence, as the users can only go from location A to location B (and accordingly from episode or chapter 1 to chapter 2) in order to collect all the necessary clues and solve the ~~case~~mystery. In each location however, the two participants that form a team, can act in parallel interrogating different suspects and then combining the evidence they collected. It seems then that in the sequential structure of the narrative there are key points where things can happen in parallel but the result of these parallel actions feeds back to the sequence of the storyline. In this case, space is important for structuring the narrative and it is the context where the enactment of the story takes place. Specifically, dif-

ferent episodes of the story were “attached” to the places of the city (e.g. the killing of Hanne took place in a park, interrogation of some of the suspects took place in a convent of the city as Hanne was a nun, etc). In order to solve the case of the murder, users had to visit each of the different places, where the story was taking place, in order to collect the necessary information. Even though the story happens in different places, the objectives of the user’s actions (e.g. go from one place to another, or to search for evidence in one place) are oriented towards the content of the story (i.e. who killed Hanne). Thus, in this case acquaintance with the city of Aalborg seems to come as a side effect of following the killer of Hanne.

In terms of physical-virtual space interaction this took the form of solving of puzzles, discovering hotspots, interacting with virtual characters through selection of a predefined set of questions, and combining the parts of the signs using mobile devices. In the same example, interaction with the story concerns the users enacting part of the narrative by undertaking the role of characters of the story. The enactment is implemented through a set of predefined questions which are differentiated according to the character enacted and to the virtual character interrogated. Other than that, the user reads information related to the story delivered in different ways (in the form of newspapers, torn letters etc.) and combines the different parts of information, or establishes relationships between the different parts of information, into a coherent whole in order to solve the case of the murder. User’s interaction with space involves navigation and way-finding based on a map. Social orchestration involves collaboration between two users who form a team of investigators aiming to solve the case of Hanne. A question related with fiction in the city genre is the playful character of the activity. In this case the emphasis is on narration rather than on playfulness. However the story, even though it is not stated by its creators, develops around a variation of a treasure hunt game as the participants in each location collect clues that will lead them to the next place in the city. The idea of clue - following has been implemented as follows: the two participants need to complete the collection of evidence in a “key location” then the system awards the user with half a sign which when combined with the other half obtained by their partner indicates on the map which will be their next location.

It is evident from these examples that learning about the city of Aalborg was just a side effect of the activity of solving the murder case of Hanne. However the fact is that the story takes place in a historic time, while the players become active characters of ~~that~~ate time and have to imagine what it was like to be living in those times in the city, an exercise with high learning potential.

## V. ON LEARNING IN THE CITY

Concluding this overview of using games as instruments for learning [18], we need to confirm that the social, situated and experiential character [6] of location-based games in the city, that were discussed here, provide a strong indication that this approach may support modern citizens in acquiring new competences and

skills [19] that are needed for living in modern cities and societies in a pleasant way, like tourists become acquainted with history of a visited place. -Research on mobile learning games with a special focus on addressing the historical aspect of a city, reports visitor engagement, motivation and knowledge about objects of attention (see for example [15]). On the other hand there is a criticism questioning what the players seem to learn in the context of these games. In the analysis offered in typical such games [25, 26] it was shown that the content involved mainly factual information (previous use of a building, information about the owner of the building etc.). In this context the game becomes a vehicle for transferring new, "hidden" information to be stored by the player. This is the mimetic storytelling tradition according to Gentès and Jutant [24].

It should be observed that as shown for the case of the Game 'Rebels vs. Spies' in [25], and for the game 'Explore!' [27] in the context of games the search of this factual information might take place in an intriguing and pleasant way and might involve interesting processes such as hypothesis testing, reflection on actions etc. There is no doubt that factual information is an important part of living the city experience. However this needs to be related to more creative tasks and more personal experiences. For instance, living one's own neighbourhood in the past and getting engaged in everyday activities similar to his own of that time may become a personal experience that enriches the player's understanding of today. The possibility of adapting game elements in order to accommodate such possibility and personalize the characters and the story results in more creative game play where meaning making becomes an active process as it is introduced by the constructivist perspective.

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