# Motivation, Interaction and Perceived learning: assessing the impact of an urban game with 7th grade geography students

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**Abstract:** The increasing development of mobile technology devices is revolutionizing education. In this context emerge the mobile location-based games. This research was carried out in an effort to understand the importance of mobile location-based games in informal learning and involved the design of an urban game - "MobiGeo". MobiGeo was implemented for an outdoor pedagogical activity and enrolled a group of 173 seventh grade geography students. In order to collect data, a questionnaire was developed and validated measuring three dimensions related to educational games: motivation, interaction and perceived learning. Results show that this urban game was an adequate activity to use in informal learning environments because it engaged students in gaming with high degrees of motivation and interaction. In fact, while solving the tasks proposed by MobiGeo, students´ developed their perceptions of learning, consolidating and acquiring new knowledge about the European Union.
**Keywords:** Mobile Learning, urban games, mobile location games

## INTRODUCTION

The advances in communication technology and its appropriation by students has encouraged teachers and educators to create and deploy innovative pedagogical activities that explore the potential of mobile devices (Vieira & Coutinho, 2013)

In this context emerges a new educational paradigm – the Mobile Learning – that takes advantage of the flexibility, adaptability and ubiquity of mobile devices (Coutinho, 2011; Fotouhi-Ghazvini et al., 2011; Sharples et al., 2009) that allow students to experience learning environments that go beyond the traditional classroom walls. According to the literature, the Mobile Learning paradigm incorporates and combines a multiplicity of different variables: time, space, learning environment, content, information technology, the mental abilities of the learner and the method (Savi et al., 2010).

Inside the emerging paradigm of m-learning, arise the so- called location-based mobile experiences (Benford, 2005), which focuses in the process of gathering information *in situ* as central to student´s learning in a personalized and motivating way. "Urban Games" are location-based mobile experiences that add context to knowledge, whereas the mediation between the game and the user is done through mobile technologies. However, the design and implementation of an Urban Game is not a simple process, since it must take into account several principles and anticipate possible constraints for students.

The research presented in this paper was carried out in an effort to understand the importance of mobile location- based games in outdoor education and involved the design, upon a review of literature, of an urban game that relates the advantages of flexibility, ubiquity and interactivity offered by mobile technologies with gaming and learning. The urban game was named "MobiGeo" and enrolled a group of 173 seventh grade geography students from a basic school in the north of Portugal. The activity was evaluated through the fulfillment of a questionnaire that measured three variables associated with experiencing digital games: motivation, interaction and perceived learning.

## THEORICAL FRAMEWORK

### Urban Games

Mobile Location-based Games are a new wave of educational activities mediated by mobile technologies and based on contextual learning. An example of these games is the "urban games" or "street games". Although, in the literature, there is a certain difficulty in defining them, certain characteristics gain consensus: i) be performed in a public space, ii) a large scale ("human scale"), and finally iii) aggregate communication technology (mobile phone, GPS, internet and digital cameras). According to Avouris and Yiannoutsou (2012) "these games are played in physical space, but at the same time, they are supported by actions and events in an interconnected virtual space", which can be classified into three categories: i) the ludic: games created just for entertainment; ii) the pedagogic: games with well-defined learning objectives, which can occur inside and outside the school; and iii ) the hybrid: include both the educational and the entertainment aspects, are conducted in informal learning environments and are usually associated with cultural and historical of the location where they are performed.

Silva and Delacruz (2006) argue that by being in direct contact with the subjects and move in a real context, students will have a more significant learning and this will result in the mobilization of knowledge in different contexts. In the design of an Urban Game the context should be the primary factor to be considered; according to Sharples et al. (2009) that "is a central construct of mobile learning, not as container through which we pass like a train in a tunnel, but as an artefact that is continually created by people in interaction with other people, with their surroundings and with everyday tools".

The literature reveals that urban games have very positive results in terms of learning and motivation, as well as interaction and cooperation among students, examples of which are the "Ambient Wood" (Rogers et al., 2004), "Savannah" (Facer et al., 2004) or "Butterfly Watching" (Chen et al., 2005). Reinforcing these results, Shih et al. (2010) have assessed that the cognitive learning of students had significant improvements and the satisfaction was high when they performed an activity of Social Sciences in which there was the integration of digital and physical environments: "by using mobile devices, students can have more customized learning pace and process, and can receive individual attention and learning guidance when they are distributed in the field".

However, Milrad (2006) mentions that in the design of innovative educational practices it is necessary to adopt an integrative perspective in which the catalyst forces are the theories of teaching and learning and not mobile technologies: "from this perspective, mobile technologies can be used as collaborative mindtools that help learners (...) to conduct activities and accomplish results that are impossible to achieve without these technologies."

### Design of Urban Games

As the Urban Games emerged from Mobile Learning, the principles that guide both are interconnected, so in our research, we have tried to take into account the ideas of authors like Parsons et al. (2007), Herrington et al. (2009), Valentim (2009) and Moura (2010), which address the

major issues of Mobile Learning and its applicability in educational activities with those that focus specifically on mobile location-based games, like Brown (2010), Jacob and Coelho (2011) and even Wake (2013).

When designing an activity with mobile technologies in outdoor environments we should have attention to a set of guidelines that should influence the decision-making. Herrington et al. (2007) presented a list of principles to which the activities of Mobile Learning should obey:

1. Real world relevance: Use mobile learning in authentic contexts;
2. Mobile contexts: Use mobile learning in contexts where learners are mobile;
3. Explore: Provide time for exploration of mobile technologies;
4. Blended: Blend mobile and non-mobile technologies;
5. Whenever: Use mobile learning spontaneously;
6. Wherever: Use mobile learning in non-traditional learning spaces;
7. Whomsoever: Use mobile learning both individually and collaboratively;
8. Affordances: Exploit the affordances of mobile technologies;
9. Personalise: Employ the learners' own mobile devices;
10. Mediation: Use mobile learning to mediate knowledge construction;
11. Produse: Use mobile learning to produce and consume knowledge.

The model of Parsons et al. (2007) focuses on four perspectives: generic mobile environment issues; mobile learning context issues; learning experience and learning objectives (Figure 1). This was the model used in

the idealization of MobiGeo because that can add, as a unifying manner, the technical and the knowledge/learning dimensions. For Valentim (2009) and Moura (2010), this model contains the requirements that should guide activities mediated by mobile devices.

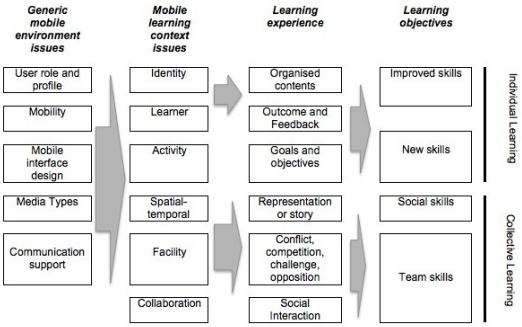


**Figure** 1**.** A framework for Mobile Learning design requirements (Adapted from Parsons et al., 2007)

In another way, Jacob and Coelho (2011), more incisively, mention that the major issues in the design of a location- based games – Urban Games – are: i) the game design; ii) the limitations of hardware; iii) the availability and adequacy of providing location information; iv) the physical condition of the players; v) protection of player data.

From these examples, we conclude that the design of an Urban Games always revolves around the learner-device-context/learning triad and that none of these elements can be seen in an independent manner in any of the stages of the designing of an Urban Game.

## THE CASE OF MOBIGEO

### Design

The urban game MobiGeo was designed based on four theoretical frameworks: constructivism (the student takes an active role in the production/construction of knowledge); Situated Learning (authentic context is a sponsor of knowledge); Connectivism (mobile devices are a source of web connections for knowledge acquisition) and Conversational Theory, which according to Naismith et al. (2004), is fundamental to understand the processes of collaboration in Mobile Learning activities. The Figure 2 illustrates the dynamics that are established between the different elements that make up the process of Mobile Learning in outdoor education.

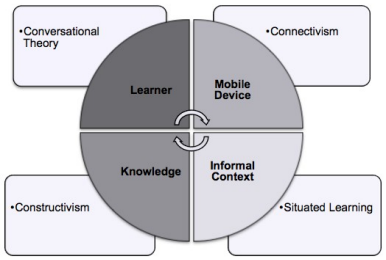


**Figure** 2**.** Framework of the Application of *Mobile Learning* in Informal Learning Context

Defined the theoretical framework that, according to Milrad (2006) is an essential step, we proceeded to the second stage which involved the most practical component, including the field visit and the design of pedagogical strategies and activities, as well as the technical operation of required devices. For this propose we use the organizational schema of Parsons et al. (2007) that was fulfilled by the research team so that no parameters were forgotten.

### Implementation

The Urban Game designed for this project arose from the partnership between the Middle School ("Agrupamento de Escolas de Vila Verde") and the Knowledge House of Vila Verde ("Casa do Conhecimento de Vila Verde")[1]. The

1 The Knowledge House is implemented in the municipality of Vila Verde has, associated to the University of Minho and The Computer Graphics Center. It has as its primary objective the digital inclusion of people in the society of information and the strengthening of their skills and qualifications in a space of creativity and innovation for the development of technology.

trail was conducted between the school and the Central Square of Vila Verde, a space with free public wireless connectivity (Digital Plaza).

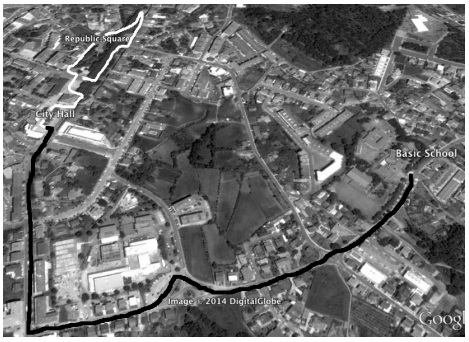


**Figure 3.** Geographical game area of MobiGe**o**

The theme of MobiGeo was the "European Union", a specific content of the discipline of Geography, so the several tasks incorporated in the different trails of the activity aimed the acquisition of specific topics of the 7th grade Geography program.

In this Urban Game participated all the 9 classes of the 7th grade of the Basic School of Vila Verde, a total of 173 students (82 boys and 91 girls), with ages between 12 and 15 years and the teacher of Geography that was the same for the whole group. Each class was divided into four teams – GeoFrontiers, PDA, Support and Mural.

The GeoFrontiers and PDA teams were accompanied by a class teacher and had a mobile phone that through "AtiveTrack" application received a set of geo-referenced points that formed a trail. These two teams made different trails: the PDA team (black trail in Fig. 3) started on the school EB 2,3 de Vila Verde and ended at City Hall while the team GeoFrontiers (white trail in Fig. 3) performed all activity around the Republic Square and the City Hall.

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The PDA team, as they went along the trail they received messages through “AtiveTrack” with tasks that should resolve. Both PDA and GeoFrontiers teams had a diary where they had to write down the responses of the various tasks which they were requested to solve along the trail; only after performing the task proposed they could proceed to the next step.

The Support team stood next to City Hall where they had laptops with Internet. This team had the main task of assisting the other teams of their class getting information so that colleagues respond to tasks and forward along the trail; communication between teams was established through the mobile phone.

Finally, the Mural team, also stood beside the City Hall and was intended to build a wallpaper with major historical events of the European Union that were contained in the envelopes that GeoFrontiers team had to deliver to them.

The winner of MobiGeo was obtained when all the teams of the same class completed their tasks and gathered at the City Hall holding the flag of the European Union.

Subsequently, the Geography teacher of all the classes that participated in MobiGeo evaluated the diaries and the murals constructed, since this activity was part of the formative evaluation of the theme of "European Union". The results per class were ranged from Satisfy (one class), Good (6 classes) to Excellent (2 classes), which leads us to believe that the MobiGeo contributed to students mobilize and properly apply the knowledge gained in the room class.

## METHOD

### Instruments for Data Collection

To measure the impact of MobiGeo a questionnaire was adapted upon a similar instrument developed by Savi et al. (2010). Our instrument also took into account the level 1 of the training evaluation model of Kirkpatrick (Chapman, n.d.) that encompasses three major dimensions in educational gaming experiences: Motivation/Interest, Interaction and Perceived Learning. To assess the first dimension - Motivation/Interest - items of the rubrics "Fun", "Immersion" and "Challenge" of "Game User Experience" of the Model ARCS (Attention, Relevance, Confidence and Satisfaction) were selected. The Interaction was evaluated by items of the Social Interaction dimension of the "Game of User Experience", and the Learning Perceptions were based on the Bloom's Taxonomy (Knowledge category).
The final questionnaire had three parts: the first section collected respondents' personal data such as gender, age and team in the MobiGeo game. The second part contained a total of 27 items investigating respondents' perspectives on three psychographic dimensions: motivation/interest (13 items), interaction (5 items) and perceived learning (8 items) (see Table 1). Most sentences were formulated in a positive manner but five items were in a negative format in order to avoid response pattern. All scales used a 5-points Likert type scale, anchored by 1 -"Strongly disagree" and 5 - "Strongly agree" and were adapted from prior research studies. To ensure content validity, the scales were translated into Portuguese and then translated back into English. Finally, the third part included two open-ended questions asking students to list the top positive and negative features of MobiGeo.

| Scale | Number of items | Model |
|---|---|---|
| Motivation/ Interest | 11 | ARCS Model<br>Game User Experience |
| Interaction | 5 | Game User Experience |
| Perceived Learning | 8 | Bloom's Taxonomy<br>Game User Experience |

**Table 1.** Questionnaire Theoretical Framework

The questionnaire analysis was undertaken using SPSS software for closed items and content analysis techniques were used to categorise and interpret the open-ended questions.
This research was carried out in an effort to understand the importance of developing innovative learning activities in the schools taking advantage of the potential of the mobile devices most students own and use in their daily routine. The research explored the differences on the three dimensions under measurement – motivation, interaction and perceptions of learning - based on the variable type of team in MobiGeo. These variable were chosen based on researchers interest in understanding more deeply the impact of MobiGeo tasks on students perceptions. The research hypothesis was then formulated:
H1. There are significant differences in MobiGeo teams concerning motivation, interaction and perceived learning
To test this hypothesis we used the Kruskal-Wallis test for independent groups. The significance level for rejecting the null hypothesis was $\alpha<0.05$ a standard value accepted by educational researchers to support decisions based on probability when using large samples. However, we also admitted the values of $0.05 < \alpha < 0.1$, assuming however that they are a low presumption against null hypothesis, as this values are also considered in the literature (Field, 2013).

## RESULTS

A total of 173 questionnaires were returned and considered usable for data analysis. Among the respondents, were 82 male and 91 female.
After reliability analysis, every measure was calculated as a mean indicator of the retained items (see Table 2). Results indicate high levels for motivation (values range from a minimum of 2.32 to a maximum of 5), interaction (values range from 2,40 minimum to 5 maximum) and also for perceptions of learning among participants in the MobiGeo game. Perceptions of learning reveal the lowest variability, since students' responses vary from a minimum of 2,63 and a maximum of 5.

| Measures | N | Min | Max | Mean |
|---|---|---|---|---|
| Motivation | 173 | 2.36 | 5 | 4.21 |
| Interaction | 173 | 2.40 | 5 | 4.36 |
| Perceived Learning | 173 | 2.63 | 5 | 4.00 |

**Table 2.** Measures Indicators and Statistics

In order to explore the existence of significant differences, students' responses were analyzed considering respondents' type of team in MobiGeo.

**Motivation**

Looking at the teams (Table 3), the GeoFrontiers team had the highest values of motivation/interest and the PDA team had the lowest score of the four teams and the presence of several outliers, showing a higher dispersion on student's.

| Teams | N | Mean | Std. Deviation | Min | Max |
|---|---|---|---|---|---|
| PDA | 60 | 4.10 | 0.59 | 2.36 | 5 |
| GeoFrontiers | 78 | 4.3 | 0.48 | 2.64 | 5 |
| Support | 16 | 4.19 | 0.61 | 2.91 | 5 |
| Mural | 19 | 4.19 | 0.57 | 2.64 | 5 |

**Table 3.** Descriptive Statistics for Motivation by Team

The Kruskal-Wallis test was applied to assess the significance of differences between the four teams (CS=3.922, $\alpha$=0.27), showing that the values of significance obtained did not confirm any statistical relevance of differences observed (no validation of hypothesis).

**Interaction**

Interaction was also analysed considering type of team. The global mean value for this dimension was 4.36 (Table 4). The mean values are similar for the four teams what is confirmed by a non-significant value on the Kruskal-Wallis test for independent groups (CS=1.829, $\alpha$=0.609) (no validation of hypothesis).

| Teams | N | Mean | Std. Deviation | Min | Max |
|---|---|---|---|---|---|
| PDA | 60 | 4.30 | 0.56 | 2.40 | 5 |
| GeoFrontiers | 78 | 4.39 | 0.49 | 3.00 | 5 |
| Support | 16 | 4.39 | 0.63 | 2.60 | 5 |
| Mural | 19 | 4.43 | 0.47 | 3.40 | 5 |

**Table 4.** Descriptive Statistics for Interaction by Team

**Perceived Learning**

Exploring the differences on perceived learning by teams, Table 5 shows the data obtained:

| Teams | N | Mean | Std. Deviation | Min | Max |
|---|---|---|---|---|---|
| PDA | 60 | 3.98 | 0.48 | 3.00 | 5 |
| GeoFront. | 78 | 4.00 | 0.53 | 2.63 | 5 |
| Support | 16 | 4.06 | 0.59 | 3.13 | 5 |
| Mural | 19 | 4.26 | 0.60 | 3.13 | 5 |

**Table 5.** Descriptive Statistics for Perceived Learning by Team

The first overall impression that emerges from data is the high levels of perceived learning in all the four teams under study. The Mural team had the highest mean value and the lowest was for the PDA team. The application of the Kruskal-Wallis test to assess the significance of differences between the four teams (KW=2.740, α=0.433) revealed no significant difference among teams (no validation of hypothesis).

**Discussion**

The MobiGeo game was designed with pedagogical aims in order to motivate students to interact and collaborate in an informal learning context as a way to assimilate/consolidate a set of transversal and specific skills of the discipline of Geography.
The results show that this urban game with QR codes was an adequate activity to use in informal learning environments that engaged students in gaming with very high degrees of motivation, interaction and perceived learning in order to solve the tasks presented to them and so consolidate and acquired new knowledge about the European Union.
The research explored the differences between the type of team in MobiGeo. Table 6 summarizes hypothesis' test results.

| Measures | Hypothesis |
|---|---|
| Motivation | H1 not validated |
| Interaction | H1 not validated |
| Perceived Learning | H1 not validated |

**Table 6.** Hypothesis Test Summary

The analysis of Table 7, allowed us to verify that the type of group are not a relevant factor that explain differences in motivation, interaction and perceived learning on the MobiGeo game. The results of the analysis by teams showed no significant differences among groups; however, the very high levels of motivation, interaction and perceived learning in all the four teams, is undoubtedly the most relevant aspect to retain (see Table 7).

| Mesures | PDA | GeoFrontiers | Support | Mural |
|---|---|---|---|---|
| Motivation | 4,11 | **4,30** | 4,19 | 4,20 |
| Interaction | 4,38 | 4,38 | 4,38 | **4,44** |
| Perceived Learning | 3,98 | 4,08 | 4,06 | **4,16** |

**Table 7.** Mean Levels of the Measures by Team

Among team type, the GeoFrontiers revealed the highest level on motivation, a finding we associate to the use of QR Codes in their trail as observed by [24] and [25] in their studies: students consider the activities with QR codes very interesting - the discovery of the encrypted message was a fantastic experience - and reveal high levels of curiosity about this new approaches that are so different from their daily classroom routines. As they said in one of the open-ended questions of the questionnaire, MobiGeo allowed a "nice way to learn in another space "(…) that made "(…) learning a bit easier."
The Mural team had the highest values for Interaction and that can be explained if we consider that these team members had to communicate with all other class teams in order to build the wallpaper with specific historic

moments of the European Union; the high level of interaction also can explain the better scores that this team obtained in the Perceived Learning dimension.
Unlike what happened in the study reported by Law and So (2010) in which some student's didn't demonstrate motivation to perform an activity whose contents had already been discussed in the classroom, in the MobiGeo gaming activity students revealed motivation and interest despite the fact that the content was not new for them. We believe that the students were motived by the challenge to discover what was behind the GPS position and the use mobile phones for that propose, in their words "using GSM motivated the commitment of the group" and "the location of the points on the GPS was the most liked". The curiosity allied to mobile technologies was a great impulse to the success of MobiGeo game. The students said that "we can enjoy the activity to interact with our colleagues and learn", assuming that the MobiGeo allow "learning by playing" and "learn more stuff about European Union".
With this study, we can conclude that mobile location- based games with Qr codes have potential to improve the process of teaching by motivating the students to apply their knowledge, allow the interaction and cooperation and therefore compromise positively the perceived learning.

## CONCLUSION

We assumed that our research could contribute to the state of the art on the educational potential of mobile learning in general and in urban games in particular. Reflecting on the overall work done, we believe that these goals were achieved in the process of designing and implementing the MobiGeo game with 9 classes of Geography students from a basic school from the north of Portugal. In fact, our study showed that, as defended by Molnar and Frías-Martinez (2011), educational games using mobile devices can contribute to an alternative way of teaching and learning, and so that the challenge is to show that the urban games are not simply an outdoor activity with motivation, interaction and learning perceptions.
Urban games goes further by allowing students to interact and explore culturally, socially and historically a certain location. Tangney et al. (2010) referring the intervention of Mike Sharples, claim that young people spend too much time locked in their rooms, divorced from the real world, and, therefore, all the moments that can be lived and experienced in outdoor settings must be offered and stimulated, and mobile technologies are the link that allows this rapport with the surroundings.
Another contribution of our study is the adaptation of existing scales to the design of an instrument that intends to measure the three variables that, according to literature, better fit the requirements of mobile educational experiences like the Urban game MobiGeo: motivation interaction and learning perceptions. The scale was validated with a sample of 173 students and showed to be a reliable instrument to assess the variables under study and is now available for other Portuguese speaking researchers and educators to use and test.

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