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## Location-Based Games as Tools for Leisure in a Military Community

### Juegos basados en la localización como herramientas de ocio en una comunidad militar

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#### ABSTRACT

Digital media increasingly affect how people interact with their surroundings, leading to rising levels of indoor screen time. This study examines how locative media technologies can enhance meaningful leisure and learning experiences in outdoor settings. Our goal is to understand the role of location-based games in improving outdoor leisure by implementing a geolocation program within a military community at an Armed Forces base. Therefore, we conducted a qualitative case study based on the principles of the design-based research (DBR) method. By developing, implementing, and using a location-based game prototype, we increased contact with nature and found that locative play encourages learning in outdoor leisure contexts. We also found that the digital locative game promoted a sense of social belonging and positively impacted intergenerational activities, highlighting the immense potential of locative media and ubiquitous learning in outdoor leisure experiences and the creation of new educational opportunities.

#### RESUMEN

Las tecnologías digitales afectan cada vez más a la forma en que las personas interactúan con su entorno y han provocado un aumento del tiempo de pantalla en espacios interiores. En este estudio se analiza en qué medida las tecnologías de medios locativos pueden conducir a experiencias de ocio y de aprendizaje significativos en entornos al aire libre. Nuestro objetivo es comprender el papel de los juegos basados en la localización en la mejora del ocio en la naturaleza, mediante la aplicación de un programa de geolocalización dentro de una comunidad militar en una base de las Fuerzas Armadas. Hemos desarrollado un estudio de caso cualitativo, a partir de la metodología de investigación basada en el diseño (DBR), adoptando una serie de ciclos iterativos. Mediante la implementación y el uso de un prototipo de juego basado en la localización, se ha aumentado el contacto con la naturaleza y se ha observado que el juego locativo fomenta el aprendizaje para el ocio al aire libre. También descubrimos que el juego locativo digital ha fomentado el sentimiento de pertenencia social y ha repercutido positivamente en las actividades intergeneracionales, reconociéndose así el inmenso potencial de los medios locativos y del aprendizaje ubicuo en las experiencias de ocio al aire libre y en la creación de nuevas oportunidades educativas.

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## 1. Introduction

The dissemination of digital technology has caused intense changes in everyday behavioral patterns and a considerable increase in leisure activities mediated solely by technology. In this paper, we present a case study focused on identifying the potential of locative media (Gee, 2006; Hutchby & Moran-Ellis, 2000; McLean & Hurd, 2012) and location-based games (LBG) (Fonseca et al., 2022; Fránti & Fazal, 2023; Maia et al., 2021; Saaty et al., 2022) powered by GPS technologies, as mediational tools for leisure experiences and human development.

The resolution to dive deeper into this topic resulted from the pressing need to develop experiences in nature, promoting ubiquitous learning (Vázquez-Cano & Sevillano García, 2015) and seeking to offer a suitable alternative to the problematic reality of the massive use of digital media and the consequential lack of outdoor leisure experiences (Louv, 2008). In the following section, we present a theoretical perspective of: a) the outlooks of leisure as a necessity for human development (Cuenca Cabeza et al., 2010) in a digital society; b) location-based games as a means to promoting locative play; c) the use of digital media for non-formal education in outdoor settings.

Although the concept of “game” is intrinsically related to the idea of play, it is important to recognize that, through locative games, there is a crossing between virtual and physical spaces that enhances opportunities for active play and participatory learning (Monteagudo & Cuenca, 2012). McLean and Hurd (2012) say technology’s impact on play goes far beyond building commercial leisure spaces. Intrinsically related to the mobility of digital media, ubiquitous access to mediating tools is facilitated to provide learning content at flexible times and in various learning contexts (Vázquez-Cano & Sevillano García, 2015). This type of ubiquitous learning, mediated by digital technology and capable of creating new itineraries of leisure and play through LBGs, is a highly relevant topic that deserves further research. LBGs thus have the ability to incorporate elements of the natural world by creating a unique learning experience that draws on the intersection of the real and virtual embedded in the game (Silverstone, 1993; Thielman, 2010). In this sense, the setting created by LBGs (Gillin, 2010; Leorke, 2019; Wilken, 2012), such as Pokémon Go or Geocaching, is built in a digital, physical, and represented space in which the inherent experience depends not only on the digital components but also on the player’s location in the materialized physical space (Saaty et al., 2022). In the second part of the article, we discuss the empirical design research that consisted of developing and using a GPS-enabled geo game in a specific context: a military community.

In this study, we implemented an activity inspired by Geocaching, a modern-day treasure hunt whose terminology was coined by Matt Stum (Groundspeak, 2012) and resulted from the connection between *geo* (earth) and *cache*, a dual-meaning term referring to something hidden or computer data storage. We intended to know how locative media can promote play and enhance contact with nature in a specific community with the overarching intent of exploring how digital media can be used to positively promote ubiquitous outdoor learning in the context of a military community stationed at Joint Base McGuire-Dix-Lakehurst, in New Jersey, USA.

## 2. Theoretical framework

### 2.1. Leisure Itineraries

Leisure embodies personal and/or community actions that people enjoy and do freely, without a utilitarian purpose. This construct brings together personal experiences that benefit the quality of life and human enjoyment and its potential to generate creative experiences that yield personal development (Cuenca Cabeza et al., 2010). The characteristics of the culture and the living conditions of those who experience it are considered two important leisure elements.

From a conceptual point of view, most relevant to the understanding of leisure studies, according to Monteagudo and Cuenca (2012), these concepts can be divided into two main subcategories determined essentially by the impact these practices have on human well-being and development. Those subcategories are active leisure and passive leisure.

Active leisure encompasses social activities with a main focus on social connection, cognitive activities directly related to personal hobbies, games, and other mentally stimulating activities, and, lastly, physical activity in general, which includes the practice of sports and physical exercise.

In their earliest publications on leisure (Cuenca Cabeza et al., 2010) is objective when referring to the power of leisure for human development, which is, in fact, part of everyday life. The absence of leisure experiences may result in a lack of creativity, interaction, and initiative, often manifested through feelings of tedium and isolation.

The same argument is corroborated by Spiers and Walker (2009) and De Lima et al. (2019), adding to the importance of leisure in the satisfaction and happiness of individuals.

Conversely, passive leisure generally includes activities that do not require high levels of active social, mental, or physical effort. These activities provide relaxation, which, although essential, are typically sedentary activities that have little contribution to human physical, social, and cognitive development.

In line with Dumazedier's 3-D definition of leisure (Dumazedier, 1974, Oliveira, 2014), there are three fundamental purposes that can occur or coexist, such as rest (as a form of fatigue release); fun (as a way to avoid feelings of boredom and monotony); development (as an amplifier of everyday practical knowledge). Over the last few decades, we have observed the strong impact of sophisticated new technologies that are contributing to the rise of new forms of leisure (McLean & Hurd, 2012).

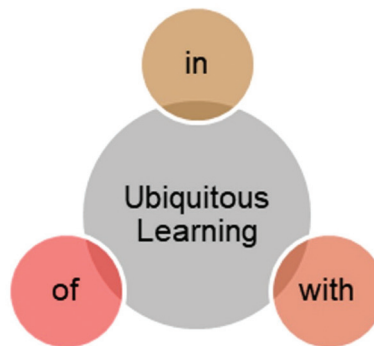
Many authors argue that overdependence on electronic devices can result in obsessive behaviors, where virtual reality affects social leisure, which is crucial for personal development (Zain et al., 2022). In *Last Child in the Woods*, Louv (2008) digs deeper into the concept of *Nature-Deficit Disorder*, arguing that technology should not be the sole form of leisure but instead should be used as a tool to enhance other forms of leisure that lead to human development.

## 2.2. Digital media and ubiquitous learning

Along with the progress in digital media, new educational concepts have emerged, presenting a new set of alternative learning environments, thus revealing the immense power of the new ICTs (Information and Communication Technologies) as a force for change.

Accompanying the increased mobility of digital media, ubiquitous tools have emerged as complementary training tools, allowing for the creation of learning content compatible with flexible schedules that can facilitate the development of educational activities recommended for extracurricular learning periods, see Figure 1 (Vázquez-Cano & Sevillano García, 2015). Ubiquitous education focuses on maximizing the huge amount of information available at our fingertips, making it available anytime and anywhere, in formal or informal settings (Neto & Sales, 2015).

Figure 1. Variety of contexts of ubiquitous learning.



Source: Vázquez-Cano & Sevillano García (2015).

Thus, the limitations of place (*in*), people (*with*), and tools (*of*) are mitigated with the extensive and inclusive potential of ubiquitous learning.

Ubiquitous learning is therefore regarded as a new educational paradigm that offers alternatives for interaction and access to diverse learning content in a non-formal environment with digital media. Consequently, ubiquity is synonymous of omnipresence, meaning information can be easily attained and shared thanks to the combination of technological progress and human learning abilities.

In order to ensure ubiquitous learning, it is necessary to incorporate mobile technologies around convergent scenarios, since these technologies expand the educational possibilities of conventional virtual learning environments. Thus, we see that learning by using digital media powered tools is rapidly growing, hence the ever-growing need of reflecting on this progress from a perspective of human development and learning in leisure contexts.

### 2.3. Play and location based games

Carlos Neto (2020) has researched the relevance of learning through play and argues that play is essential for a child's development. Along those lines, several efforts have been made to introduce playful learning, such as the *Educational Escape Room* (ERE). According to Moura and Santos (2020), this concept is drawing attention worldwide. This type of learning follows gamification principles based on the fundamentals, aesthetics, and playful thinking to engage the users, motivate action, and promote learning using mechanisms closely related to gaming. Much like GeoQuest, the LBG developed in this project, the ERE is an educational activity that deviates from the normal routines of formal learning environments in a sense that is inherently playful. Locative media brings a set of new possibilities capable of producing creative curricula that are more engaging and stimulating. The use of principles of locative media has expanded into many different fields, including games in education, health, and entertainment (Fränti & Fazal, 2023). Location-based games foster new social interaction dynamics, impact and reinforce local neighborhoods' public spaces, and may aid practitioners in designing new game activities (Fonseca et al., 2022; Maia et al., 2021; Xanthopoulos & Xinogalos, 2018).

For Gee (2006), the potential for learning through gaming is not in the game itself nor in the characteristics of the game. The game is an excellent learning tool because the user becomes a part of the simulation (Gee, 2006). The same is applicable to other types of games beyond the classic video games. In this project, we developed an adventure game based on locative media, such as GPS, to envelop the users in real nature environments that target specific learning purposes in subjects such as Science, Math, Geography, and/or History. In a recent study, Silva et al. (2019) presented a case study that explains the process of learning social history precisely through locative media. This study was centered on combining formal and non-formal learning in conjunction with the principles suggested by the use of locative media for learning in outdoor settings and human development (Alha et al., 2023; Filho & Veloso, 2019).

In our research, we created GeoQuest, a game prototype developed as a data collection tool. It was our intent that the GeoQuest would motivate users in nurturing skills and gaining knowledge about the history of the physical locations visited as part of the quest, as well as understanding endemic species and developing additional educational skills that are activated when all the five senses are engaged, something that does not by definition occur in the context of formal education.

According to Wilken (2012), locative media terminology relates to a variety of technologies and practices dependent on a geographic location. At its core, it is based on the idea that location-based technology suits digital media aggregated to real physical spaces. In locative media, communication is intrinsically linked to geolocation, thus encouraging authentic social interactions (Fonseca et al., 2022; Thielman, 2010). Digital locative games can facilitate contact with nature by promoting mediated learning opportunities in physical and tangible settings and by creating playful experiences that result in the attainment of new perceptions and solid, positive, active leisure experiences (Hallnäs & Redström, 2001). Locative media are, therefore, seen from a perspective of experiences aggregated to a specific place, space, and time.

As stated by Leorke (2019), there is no clear definition of locative games since each locative game is different depending on the combination of technologies and environments related to geolocation. Thus, LBGs present an interconnection between physical spaces and virtual spaces, reusing them for new play methods. The unique features of location-based games encourage players to overcome social and geographic barriers in real environments.

In 1993, Silverstone began exploring how new information and communication technologies could transform individual perceptions and time and space connections. The author suggested that studying daily patterns inside and outside the home served as a basis for understanding how time patterns change using technologies in domestic environments (Silverstone, 1993). In relation, we can identify two fundamentally divergent points of view. Whereas some advocate for a naturalistic mindset, in which digital technology is seen as a disruptive element in contact with nature, others argue that the use of digital media is positively rewarding, which relates to the ever-growing interest in effectively utilizing digital technology in the great outdoors.

The National Wildlife Federation highlights the importance of effectively utilizing digital media to enhance personal development experiences in the outdoors. Regarding the specific context of our study, although there is not a great diversity in the research on locative games in military communities, and in particular on leisure activities, several authors have pointed out the importance of leisure in the cohesion and well-being of close-knit communities (Pollock, 2018), while others point out the importance of the building relationships and a stronger sense of community (Francis et al., 2012); outdoor leisure activities directly contribute to the well-being of war veterans (Duvall & Kaplan, 2014; Kaplan, 1995; Lundberg et al., 2016). Considering these communities' particularities, our research's main goal is to promote outdoor activity by developing

new behaviors directly related to the practice of adventure games mediated by locative media (Fränti & Fazal, 2023; McCullough, 2006).

### 3. Research methodology and context

#### 3.1. Research methodology

The aim of this research is to explore how locative media can enhance contact with nature and outdoor leisure in a military community. The study was guided by the following research question: How can locative media technologies promote leisure and enhance contact with nature in a military community at an Armed Forces base?

Through a qualitative study, we seek to identify and understand a phenomenon within a well-defined context, emphasizing processes and analysis using participatory methodologies. For Merriam (1998) and Creswell (2007), qualitative research is based on the idea that reality is constructed by individuals interacting with their social environments. The study's starting point was the development and practical application of the LBG prototype within a military community in New Jersey and, in a second step, the use of the LBG by a sample of individuals who lived in this community. We intended to provide outdoor learning and adventure experiences in a non-formal environment using digital geolocation technology while collecting valuable data.

This study was guided by the principles of Design-Based Research (DBR) (Anderson, 2005; Barab & Squire, 2004; Mazzardo et al., 2016) applied to developing the GeoQuest LBG. Given the nature of the research topic and considering the goals previously described, we considered it appropriate to choose a methodology that would allow us to study the development and application of a location-based game in a participative and dynamic process, as illustrated in Figure 2.

Figure 2. Empirical study stages according to the DBR methodology.



Source: Elaborated by the authors.

#### 3.1.1. Design-based research: Main features of a phased methodology

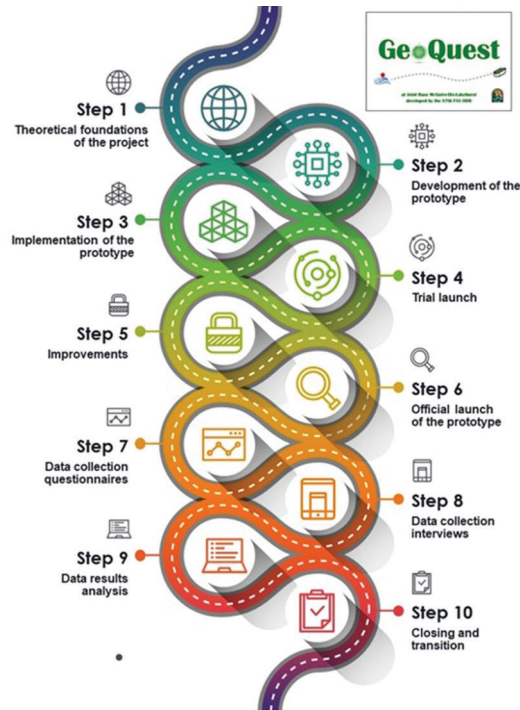
DBR is a methodology that operates in four phases (Anderson, 2005): informed exploration/diagnosis, enactment/implementation, contextual evaluation/data collection, and broader impact evaluation. Thus, this approach is focused on processes of development (Peterson & Herrington, 2005).

In practice, the development and implementation of the LBG GeoQuest took place between April 2019 and February 2020, including the pre-test phase of the prototype. In the diagram presented in Figure 3, we identify the classic phases of the game development, namely, planning and construction of the geocaches and respective descriptions and locations; implementation of the game in the initial phase, during which the prototype was improved; and finally, the official implementation and validation of the game.

Considering the main characteristic of the DBR approach, which accepts the combination of qualitative and quantitative methods (Mazzardo et al., 2016), we applied a comprehensive methodological approach that allowed the researcher and target community to play an active role (Anderson, 2005). The research was developed in a real context to produce new perspectives and practices that positively impact learning. Barab and Squire (2004) state that the DBR differs from other methodological options because this method focuses on understanding the complexity of the real world.

As previously stated, this method allows the design to be reviewed and improved upon successive iterations, determined by the evaluation and analysis of each previous phase (Pereira et al., 2021). This approach requires direct participation at every step of the study. Considering the predominant features of this methodology (Figure 4), we emphasize how crucial it was to follow the DBR approach, mainly for the interactive, flexible, and contextualized features. Given the complexity of the physical context, this approach allowed for the active involvement of the researcher and participants, allowed the redesign and readapting of processes through

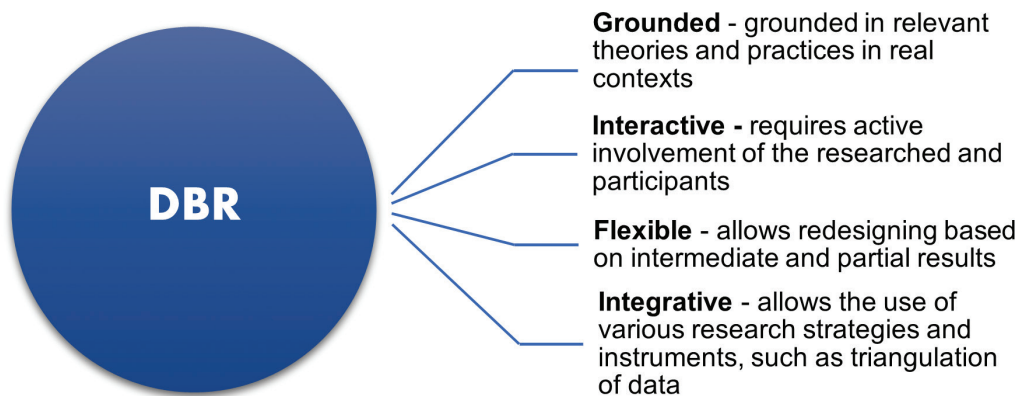
Figure 3. An iterative and incremental process by steps in the development of the LBG GeoQuest.



Source: Elaborated by the authors.

installment and intermediate results, and, finally, allowed for the situated collection of data according to the research context. Thus, the conclusions of studies of this nature are seen as a basis for future investigations and not as abstract principles and theories.

Figure 4. The main features of the Design-Based Research methodology.



Source: Pereira et al. (2021).

### 3.1.2. Iterative and incremental prototyping process

The following discussion highlights the incremental process of developing the LBG GeoQuest to respond to the proposed objectives.

Given the nature of the project, the methodology was developed in the following phases: (1) construction of the theoretical model of the project; (2) preparation and development of the GeoQuest adventure LBG; (3) participated implementation of the prototype; (4) experimental launch of the program; (5) readjustments and

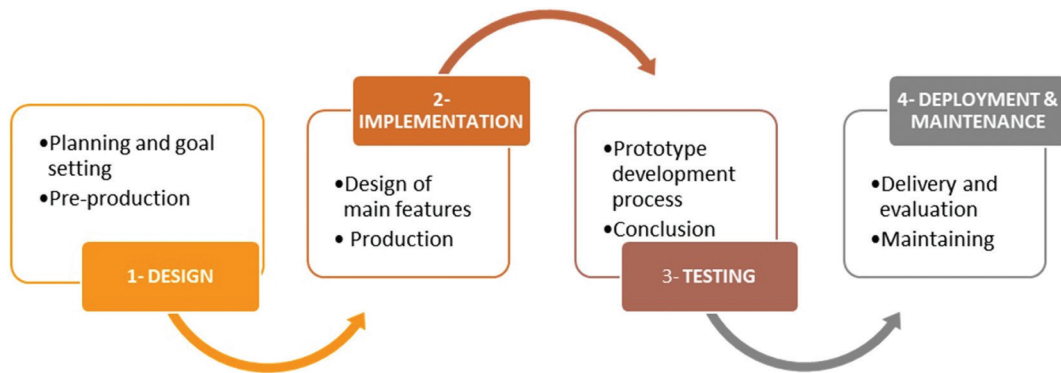
improvements (6) launch of the game in real context; (7) observation of survey users; (8) narrative interviews (9) analysis and evaluation of results and (10) conclusion and transition of the project to an official program offered by Outdoor Recreation at JBMDL.

The GeoQuest LBG was developed based on the premise of the game Geocaching to promote outdoor leisure and learning activities through mediated technologies. This tool increased the military community's access to leisure areas and recreational parks within JBMDL.

The process of developing a game in a traditional sense involves techniques and methodologies of trial and error that help mitigate the risk of failure. Prototyping is one of them and can be applied in any area or discipline related to game development (Medeiros et al., 2013). In the present study, other approaches were inserted that look for ways of developing the object in close connection with the community for which it was designed (Jornet & Roth, 2018). The context and agents intertwine in the materialization of the game.

Given the unique context of this research project and the unpredictability of out-of-scope aspects, we remained open and adaptable to change and made efforts to keep the community involved throughout the process, which gave us a degree of flexibility in the final result. Figure 5 is an illustration of the incremental phases of the GeoQuest prototype.

Figure 5. Incremental phases of prototyping.



Source: Elaborated by the authors.

### 3.2. The social context of the study: to develop the artifact in the community

Social contexts are open, dynamic, and particularly appealing systems for qualitative research because of the importance of the action settings (Neuman, 2013).

This research was conducted within a restricted military community stationed at McGuire-Dix-Lakehurst Joint Base (JBMDL), New Jersey, between August 2019 and February 2020. Military communities in the US represent only 1% of the population (U.S. Department of Defense, 2019), thus being a microculture that is simultaneously rich and complex and deserving of further research in social studies that focus on geolocation technologies' impact on leisure and education. Each microculture has a particular form of social organization, where the interaction between individuals and close connection with their socio-cultural paths creates cultural norms that develop the groups' social ecology (Geertz, 1963). It is important to understand three main aspects that characterize the military community: the general culture of the military structure, the microculture of the institution where the research takes place, and the people who participate in it. Like any organization or institution with historical value, the U.S. Armed Forces has its own culture, language, and code of conduct. It is a stratified and highly organized institution, ready to respond to any situations of possible conflict or natural or human disasters.

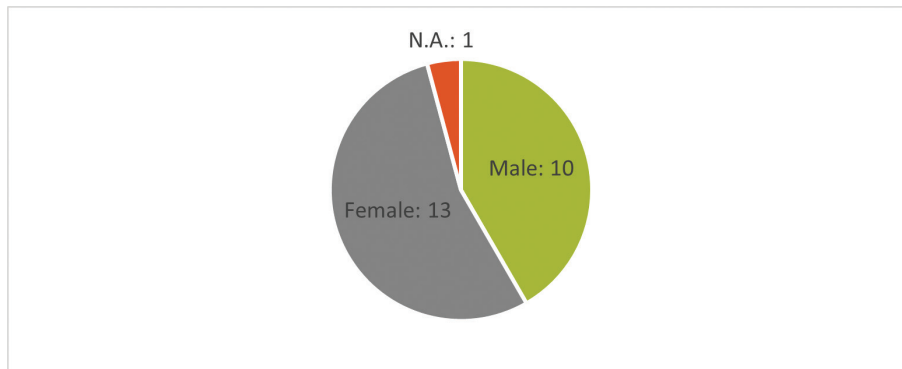
Military culture is also governed by a series of values appropriated by each individual, serving as a guide for reactions, decisions, and procedures that make the military culture unique. Although it is important to understand the organizational culture of this institution, it is even more important to understand the people who make up this community. Although strongly diverse in terms of demographics, geographics, and ethnographies, its members share a set of common values and beliefs that create a sense of mutual identity, and it is common to refer to the military community as a "family" that understands and supports each other. Due to the particularities and demands of military life, significant social support is created specifically for these communities. The military location where this study was conducted can be considered a microcity with all the services necessary

for daily life. Here, conditions are created for the military members and their families to feel truly at home by including services that become familiar and identical to each tour. A good example is the Outdoor Recreation services, created to promote positive, active, and intergenerational leisure opportunities.

Different groups in the community participated in the development of the game: the leaders who authorized and validated all the stages of the process, the librarians and leisure technicians, the inmates, and the individuals and families who took part in the last phase of the game and answered the questionnaire and participated in the interviews. The latter group represents an intentional sample of 24 individuals with the following features, considering gender and age categories:

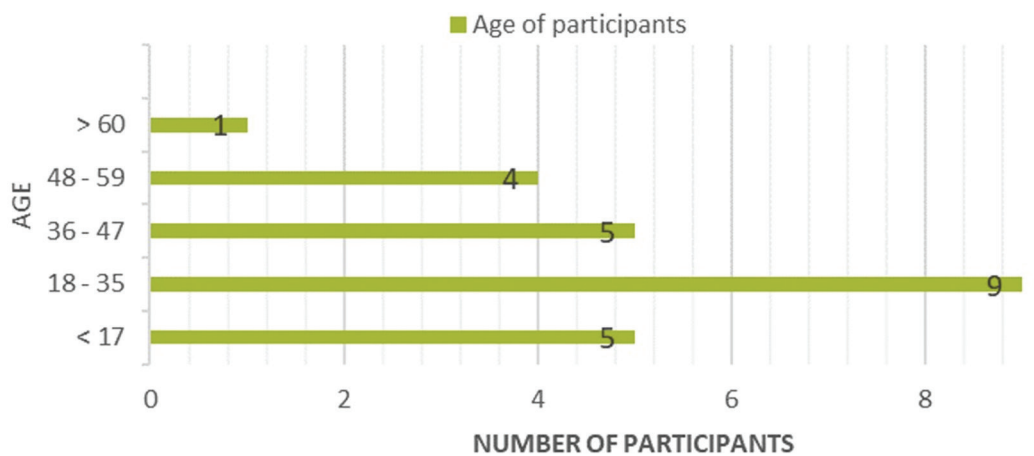
- Gender: 13 female, 10 male, and 1 of them did not answer this question (see Figure 6).

Figure 6. Gender.



- Age: The average is between 18 and 35 years old (see Figure 7).

Figure 7. Age of participants.



#### 4. GeoQuest design and implementation

In this section, we present our key findings and the most relevant aspects of the research in response to our primary objectives. We highlight the stages of design, trial launch, and implementation of the LBG GeoQuest, which involved the direct and active participation of the military community stationed at JBMDL. Finally, we share the implications of the results gathered in the (24) questionnaires and (5) in-person semi-structured interviews.

##### 4.1. The game and its main components

During this phase of the project, we designed the game's functionalities and the geocaches, the game's main components. The game included ten (10) geocaches located across several recreational, historical, and leisure areas within the perimeter of JBMDL and managed by Outdoor Recreation, as described in Table 1.



Table 1. Details of geocaches in the planning phase

| #   | Cache name                | Location                    | Description            | Notes  | Contents   |
|---|---------------------------|-----------------------------|------------------------|--|--|
| 1   | Hollow there              | Camp Dix                    | Black film canister    | Place the small cache inside a tree hollow near the outdoor amphitheater   | Small cache: Logbook   |
| 2   | Nest egg                  | Cranberry Pond              | Traditional cache      | Place the cache on the floating nest located at the pond which can be reeled in with a fishing pole              | Traditional cache: Logbook, pencil, FTF coin, exchange token |
| 3   | Lookout                   | Hipps Folly Park            | Hanging small geocache | Place the cache on the lookout of Hipps Folly area under the standing deck attached by a retractable cord        | Small cache: Logbook   |
| 4   | Starlifter                | Starlifter airplane exhibit | Magnet geocache        | Place cache under the bench directly under the right wing of the airplane  | Devious cache: Logbook, pencil, FTF coin                     |
| 5   | Screw it                  | John Mann Park              | Screw shaped geocache  | Hide the screw on the south gate of the mini golf course at John Mann Park area                                  | Devious cache: Logbook only                                  |
| 6   | Literally speaking        | Wacky World Park            | Small geocache         | Place the cache in the secret compartment under little free library  | Small cache: Logbook, pencil, FTF coin,                      |
| 7   | Off course                | Dogwood Pond                | Golf ball geocache     | Place the golf ball on a tree right off of the Fountain Green Golf course close to Dogwood Pond                  | Devious cache: Logbook                                       |
| 8   | Tank you for your service | Doughboy Field              | Micro geocache         | Place the micro cache in one of the military tanks and add to the description the history of the Fort Dix Museum | Micro cache: Logbook,  |
| 9   | The rock                  | Cannon display Fort Dix     | Rock shaped geocache   | Place the rock near in the crest of the big rock near one of the cannons on the display                          | Micro cache: logbook and pencil                              |
| 10  | Cast away                 | Laurel Pond                 | Large geocache         | Place the cache on the island in Laurel Pond. Will most likely need kayak to access cache                        | Large cache: Logbook, pencil, FTF coin, exchange tokens      |
| All the geocaches will be identified with the following logo:  |                           |                             |                        |  | April 2019   |

Source: Elaborated by the authors

The geocaches were designed to increase foot traffic in these areas, impart a spirit of adventure in the community while promoting contact with nature and effectively using mobile devices in a more interactive and educational manner. Considering the several types of geocaches, we opted for mostly “traditional” geocaches, although inherently different in dimensions and features, as shown in Figure 8.

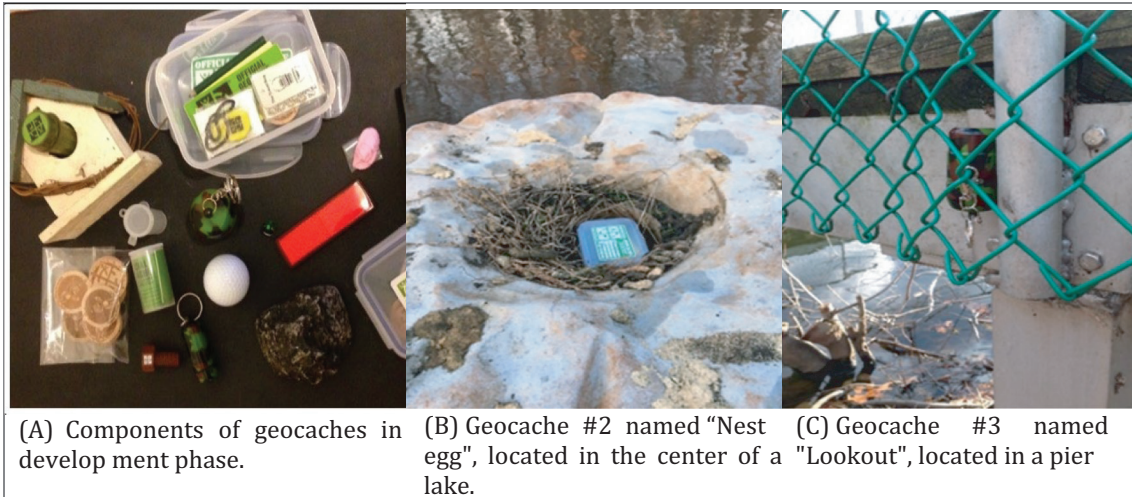
Parallel to the implementation of the GeoQuest, we also implemented an outdoor reading program entitled *Little Free Library*, which consisted of placing small self-service libraries in strategic outdoor areas to develop outdoor reading spaces and increase activities and time spent outdoors. This secondary project quickly became one of the highlights of this project because it was done in partnership with the Bureau of Prisons of Fort Dix and included the participation of members of a high-risk community who built three small wooden libraries. In fact, one of the planned geocaches was intentionally placed inside one of the little libraries, as shown in Figure 9.

#### 4.2. Implementation and evaluation of the LBG GeoQuest in the Community

The game has been made available to the military community. To assess the game experience game, participants were invited to fill in a questionnaire at the end of the game and, later, take part in an interview.

The questionnaire was developed to be responded to by all participants in the geolocation game to collect relevant data on GeoQuest uses. To support the design of the questionnaire, we followed these guidelines: the questionnaire has an introduction with (1) a request for cooperation in completing the questionnaire; (2) the main goal of the questionnaire; (3) a short description of its general features; (4) the name of the institution within which the research is being carried out; and (5) anonymized data on the participants. In terms of

Figure 8. Examples of geocaches placed on the ground as an integral part of the GeoQuest game.



(A) Components of geocaches in development phase.

(B) Geocache #2 named "Nest egg", located in the center of a "Lookout", located in a pier lake.

(C) Geocache #3 named "Lookout", located in a pier lake.

Source: Elaborated by the authors.

Figure 9. Little Free Library outdoor reading project.



Source: Elaborated by the authors.

structure, the questionnaire consists of predominantly closed-ended questions that are distributed in three blocks with homogeneous themes. The first section collects sociodemographic data that would allow us to identify the sample of participants. In the second section, questions were developed to understand the mediating role of technology in promoting contact with nature and to assess the type of use of the game application in practice. In the last section, we intend to gather information on the real perceptions and motivations of playing the game. Filling in the survey takes about 5 minutes.

The questionnaire matrix is as follows:

Table 2. Details of geocaches in the planning phase.

| Specific Goals                                       | Indicators             | Sections, Questions   |
|--|------------------------|---|
| To identify/ characterize the sample of participants | Socio-demographic data | Section I – Background Information<br>• Three multiple choice questions |

Table 2. Details of geocaches in the planning phase. (Continued)

| Specific Goals   | Indicators   | Sections, Questions   |
|--|--|---|
| To understand the mediating role of the game in promoting contact with nature.<br>To assess the type of use made of the Geocaching program for the personal development of the participants. | Sequence of solving the game<br>Types of use of Geocaching<br>Frequency of participation<br>Level of satisfaction                        | Section II – Geocaching<br>• Six multiple choice questions  |
| To understand the participants' perspectives on the geolocation program<br>To identify real motivations for connection with nature   | Level of satisfaction<br>Motivation for participating in the program<br>Importance of using technological resources (GPS or substitutes) | Section III – Feedback on the Geocaching program<br>• Two Multiple choice questions<br>• One Likert scale question<br>• One open question |

After participants had completed the questionnaire application, it was found that it was important to delve deeper into some of the responses through a semi-structured interview. This technique would allow us to obtain more specific data about individuals' experiences and perceptions regarding participation in the game.

Regarding the pre-script, the structure created by the researchers was as follows:

Table 3. Interview script.

| General Objectives  |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. Develop and deepen the perceptions gathered through the questionnaire survey regarding the geolocation experience that combines elements of nature and locative means.</li> <li>2. Triangulate the results obtained to verify the accuracy of the collected information.</li> </ol> |  |
| Specific Objectives   | Dimensions   |
| <ul style="list-style-type: none"> <li>• Present the interview methodology to the informant, specifically requesting consent for its recording</li> </ul>   | <ul style="list-style-type: none"> <li>• Informant Consent</li> <li>• Ensure confidentiality/privacy, in accordance with the current legal requirements on Personal Data Protection</li> </ul>   |
| <ul style="list-style-type: none"> <li>• Understand the opinions of GeoQuest program participants</li> </ul>  | <ul style="list-style-type: none"> <li>• Opinions about the game</li> <li>• Technology impact in outdoors games.</li> <li>• Game strengths and weaknesses</li> <li>• Technology and the pleasure to contact with nature</li> <li>• Digital devices to contact with nature</li> </ul> |
| <ul style="list-style-type: none"> <li>• Identify areas for improvement in the program</li> </ul>   | <ul style="list-style-type: none"> <li>• Changes to improve the GeoQuest game</li> <li>• Best and worst parts of the game</li> <li>• Recommendations for improvement</li> </ul>  |

## 5. Discussion: Key findings and implications

Most of the participants did not answer the questionnaire, and only 24 participants took part in sharing feedback on the experience. Five of these participants were invited to participate in a semi-structured interview.

Regarding socio-demographic variables, we analyzed a sample from 24 questionnaires that indicated a balanced gender percentage, with 57% females and 43% males and ages mostly between 18 and 35. Similar studies (Melo, 2014) have also suggested that nature activities are primarily performed by individuals between 18 and 30 years old.

Regarding user experience, the element most valued during and after the LBG was *Nature*, as reported by 17 of the 24 participants in answers obtained through the questionnaires. The same trend was noticeable during interviews, as contact with Nature was predominantly suggested, as follows:

*I enjoyed being outside and going through nature (E03)*

*I really like that it took me out of my comfort zone. I tried kayaking for the first time. (E01)*

*I really enjoyed the historical aspect and the research that went into learning about the areas (E02)*

*See how it affected other families where young kids put their phones down and go out and enjoy nature. (E05)*

The impact of *Family/Community* was also pointed out as a significant aspect by 6 participants. Mobile digital technologies per se, although used by all participants during the game mainly in the form of a personal smartphone, were not highlighted as a positive and transformative element during this experience. It was clear that the participants valued technology but were acutely aware of the effects of its over-dependence.

*Use technology in your favor (E01)*

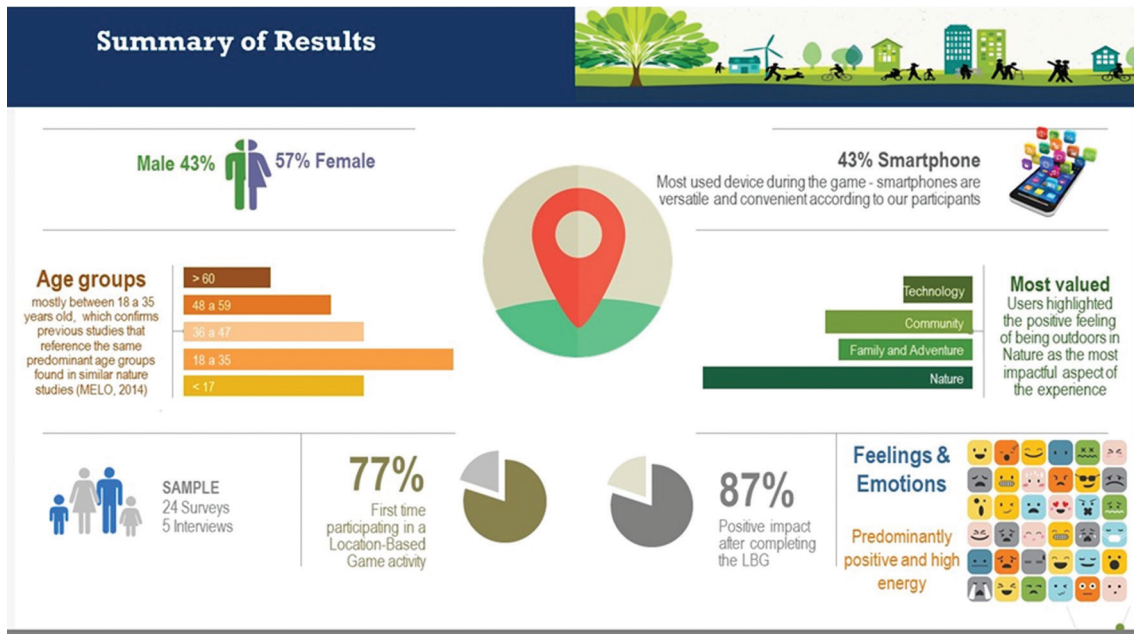
*Technology can help you find locations, but at the same time, it can take away your focus while in nature (E04)*

According to the data collected during the interviews, we concluded that the participants greatly value natural leisure experiences. The LBG was, in fact, a constructive leisure experience where the positive impact of using mobile digital technology when applied to concrete objectives was attested, making what would be a simple walk outdoors into a playful and interactive learning experience. Participants also report that technology can amplify an experience, but overuse of technology can be distracting.

In this case, using digital GPS locative media was key for the activity’s success, in which the location played a vital part in the action. This technology allowed the users to locate geocaches in an accessible way, demonstrating a ratio of time and effort that enabled the development of feelings of motivation necessary in the progression of learning processes and active leisure processes such as serious games.

Figure 10 presents a summary of results correlating to the research goals.

Figure 10. Results overview infographic.



Source: Elaborated by the authors.

## 6. Final considerations

This paper studied leisure and location-based games and their contribution to non-formal education and situated learning. We studied the power of leisure for human development, considering Cuenca Cabeza et al.'s (2010) perspective and its importance in generating creativity, interaction, and initiative. We highlighted the use of digital media daily and its strong impact on leisure and education, bringing about new forms of learning. We discussed Louv's (2008) *Nature-Deficit Disorder*, which argues that technology should not be a source of leisure itself but should be used as a tool in conjunction with other forms of leisure to create new leisure approaches.

By exploring this topic, we hope to have contributed to implementing studies and ideas that promote non-formal outdoor learning experiences that combine elements of digital technology in a positive and complementary way. In this sense, we highlighted the concept of ubiquitous learning, a new educational paradigm that,

through the use of locative media, can offer alternatives for interaction and access to diverse learning content in a non-formal environment, based on the theory of Vázquez-Cano & Sevillano García (2015).

Based on these premises, we dug deeper into finding available apps to promote contact with nature and provide multisensory educational and recreational experiences. We highlight Geocaching, a world-renowned activity that inspired the pilot GeoQuest. This LBG was aimed at promoting outdoor leisure experiences by using locative media. The development of this location-based game allowed us to explore the objectives planned at the beginning of the research.

In the second part of the research, we outlined the planned objectives, presented our preferred methodology for this project as Design-Based Research along with several development iterative cycles, described the launch and maintenance processes of the LBG, and finally, the procedures for data collection and analysis.

The iterative development process of the program was long and intense due to the many fundamental components to consider, namely the strong theoretical and bureaucratic component that preceded the LBG deployment, the practical component that consisted in the development of the game in an active and participatory way, having involved many hours of land recognition work and subsequent placement and maintenance of geocaches; the action of dissemination of the program according to the directives of JBMDL's marketing section, as well as the maintenance of the prototype.

Once the program was launched in August 2019, it was possible to know the perspectives of community members who participated in this game development phase through questionnaires and semi-structured interviews that allowed us to collect elements to respond to the objectives initially outlined for the research.

Alongside the LBG, which was the main focus of the research, a secondary project was also created with a robust social scope that involved different entities: the Little Free Library at JBMDL project. This outdoor library project was carried out in partnership with the Fort Dix Bureau of Prisons and provided the installation of 3 libraries.

We concluded, from the data analysis, that the design of the LBG was not a closed process; on the contrary, it expanded with the involvement of the community. The study of the narratives of the participants in the first phase of the application of the game in a real context allowed us to observe that the use of locative media can enrich non-formal educational experiences and greatly enhance outdoor adventure experiences, not containing negative connotations or negatively impacting the outdoor leisure experience. It also made it possible to obtain a first assessment of the LBG at this stage of its design.

Locative media technologies like GPS can enable ubiquitous learning and, when associated with play, create new forms of knowledge that are not restricted to formal education. In the case of the game proposed here, it would be difficult to complete the game without using locative media, such as GPS. Thus, besides being beneficial, using this digital technology is almost crucial, without prejudice to the interactions and play experiences.

### 6.1. Limitations

This study has two main limitations: 1) A small number of participants and its limited impact on recognizing more diverse experiences in the community; 2) In addition to the questionnaire (with closed questions) and the limited number of interviews, it would have been essential to carry out participant observation while playing. Observation would have made it possible to obtain more in-depth information on the meanings of the experiences lived throughout the game and in contact with nature.

### 6.2. Future research

We believe this investigation contributes positively to the dissemination of location-based gaming activities and showcases the potential of locative media technologies in contact with nature. The participants' narratives indicate positive experiences and clarify that nature and technology are mutually beneficial and not mutually exclusive.

We suggest the continuation of research projects that shed light on nature and digital technology and the direct positive impact of learning and education in non-formal contexts. We have seen that the ongoing growth of mobile applications and resources alone does not guarantee richer learning experiences, but rather, the mediated use in the right learning environments does.

In a context mediated by digital technologies, mobile and ubiquitous learning is an emerging field in which the educator will have the last word in ensuring the appropriate use of the technology for practical learning purposes (Vázquez-Cano & Sevillano García, 2015).

In this sense, we draw attention to the European project Horizonte 2020 BEACONING (Breaking Educational Barriers with Contextualized, Pervasive, and Gameful Learning), whose approach can potentially reach alternative learning activities. This platform, winner of the 2019 Gamification Software Awards, is a project that, in addition to games, aims to explore and expand its approach to normalize active learning processes mediated by locative media in immersive and outdoor environments (Cardoso et al., 2020).

Considering the knowledge acquired throughout this research project, we would like to present a new question for future research: How can technology be adapted to the great outdoors to enhance accessibility to individuals with special needs?

In this research, we noted that the focus around location-based games is mainly on the technologies used to develop these interactive games or on the results of user experiences. Thus, a gap has been visible in terms of current research and discussions that study the accessibility issues in location-based games so that we can ensure that everyone is fully able to take part in these enriching outdoor experiences.

## Authors' Contribution

**Anabela Pimentel da Silva Jenkins:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing-original draft, Writing-review and editing.

**Maria Luísa Lebres Aires:** Conceptualization, Formal analysis, Methodology, Supervision, Validation, Writing-original draft, Writing-review and editing.

## References

- Alha, K., Leorke, D., Koskinen, E., & Paavilainen, J. (2023). Augmented play: An analysis of augmented reality features in location-based games. *Convergence: The International Journal of Research into New Media Technologies*, 135485652311564. <https://doi.org/10.1177/13548565231156495>.
- Anderson, T. (2005). Design-Based-Research and its Application to a Call Centre: Innovation in Distance Education. *Canadian Journal of Learning and Technology*, 31(2). <https://doi.org/10.21432/T26K60>.
- Barab, S., & Squire, B. (2004). Design-based research: Putting a stake in the ground. *Journal of the Learning Sciences*, 13(1), 1–14. [https://doi.org/10.1207/s15327809jls1301\\_1](https://doi.org/10.1207/s15327809jls1301_1).
- Cardoso, P., Morgado, L., & Coelho, A. (2020). Authoring Game-Based Learning Activities that are Manageable by Teachers. *ERCIM News*. <http://hdl.handle.net/10400.2/8951>.
- Creswell, J. (2007). *Qualitative inquiry and research design: Choosing among five approaches* (2<sup>nd</sup> ed). Sage.
- Cuenca Cabeza, M., Aguilar Gutiérrez, E., & Ortega Nuere, C. (2010). La fuerza transformadora del ocio. In E. Aguilar Gutiérrez, & C. Ortega Nuere C. (Eds.), *Ocio para innovar*. Universidad de Deusto.
- De Lima, K., Da Cunha, S., & Moreira, S. (2019). Comensalidade em bares como opção de lazer entre jovens da Zona Norte de Natal/RN. *Cenário: Revista Interdisciplinar em Turismo e Território*, 7(13), 103-116. <https://doi.org/10.26512/revistacenario.v7i13.27061>.
- Dumazedier, J. (1974). *Sociologie empirique du loisir: Critique et contre-critique de la civilisation du loisir*. Éditions du Seuil.
- Duvall, J., & Kaplan, R. (2014). Enhancing the well-being of veterans using extended group-based nature recreation experiences. *Journal of Rehabilitation Research & Development*, 51(5), 685-696. <https://doi.org/10.1682/jrrd.2013.08.0190>.
- Filho, N., & Veloso, A. (2019). Location-based games on active aging: A systematic review. *2019 14th Iberian Conference on Information Systems and Technologies: 19-22 June 2019, Coimbra, Portugal*. IEEE. <https://doi.org/10.23919/CISTI.2019.8760640>.
- Fonseca, X., Lukosch, S., & Brazier, F. (2022). Design Framework for Social Interaction with Location Based Games. *International Journal of Serious Games*, 9(1), 59-81. <https://doi.org/10.17083/ijsg.v9i1.481>.
- Francis, J., Gilles-Corti, B., Wood, L., & Knuiman, M. (2012). Creating a sense of community: The role of public space. *Journal of Environmental Psychology*, 32, 401-409. <https://doi.org/10.1016/j.jenvp.2012.07.002>.
- Fränti, P., & Fazal, N. (2023). Design Principles for Content Creation in Location-Based Games. *ACM Transactions on Multimedia Computing, Communications and Applications*, 19(5s), 165. <https://doi.org/10.1145/3583689>.
- Gee, J. (2006). Are Video Games Good for Learning? *Nordic Journal of Digital Literacy*, 1(3), 172–183. <https://doi.org/10.18261/ISSN1891-943X-2006-03-02>.

- Geertz, C. (1963). *Agricultural involution*. University of California Press.
- Gillin, P. (2010). *The Joy of Geocaching: how to find health, happiness and creative energy through a worldwide treasure hunt*. Quill Driver Books.
- Groundspeak. (2012). *The Complete Idiots Guide to Geocaching*. Alpha Books.
- Hallnäs, L., & Redström, J. (2001). Slow Technology—Designing for Reflection. *Personal and ubiquitous computing*, 5(3), 201-212. <https://doi.org/10.1007/PL00000019>.
- Hutchby, L., & Moran-Ellis, J. (2001). *Children, Technology and Culture: The Impacts of Technologies in Children's Everyday Lives*. Routledge. <https://doi.org/10.4324/9781315011387>.
- Jornet, A., & Roth, W.-M. (2018). Imagining design: Transitive and intransitive dimensions. *Design Studies*, 56, 28–53. <https://doi.org/10.1016/j.destud.2018.02.002>.
- Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology*, 15(3), 169-182 [https://doi.org/10.1016/0272-4944\(95\)90001-2](https://doi.org/10.1016/0272-4944(95)90001-2).
- Leorke, D. (2019). *Location-Based Gaming: Play in Public Space*. Palgrave Macmillan. <https://doi.org/10.1007/978-981-13-0683-9>.
- Louv, R. (2008). *Last Child in the Woods: saving our children from nature-deficit disorder*. Algonquin Books of Chapel Hill.
- Lundberg, N., Taniguchi, S., & McGovern, R. (2016). Female veterans' involvement in outdoor sports and recreation: A theoretical sample of recreation opportunities structures. *Journal of Leisure Research*, 48(5), 413-430. <https://doi.org/10.18666/JLR-2016-V48-I5-6897>.
- Maia, L. F., Viana, W., & Trinta, F. (2021). Transposition of Location-based Games: Using Procedural Content Generation to deploy balanced game maps to multiple locations. *Pervasive and Mobile Computing*, 70, 101302. <https://doi.org/10.1016/j.pmcj.2020.101302>.
- Mazzardo, M., Nobre, A., Mallmann, E., & Martin-Fernandes, I. (2016). Design-Based Research: desafios nos contextos escolares. *Atas CIAIQ2016*, <https://d66z.short.gy/Ldg2VU>.
- McCullough, M. (2006). On the Urbanism of Locative Media: Media and the City. *Places*, 18(2).
- McLean, D., & Hurd, A. M. (2012). *Kraus' Recreation and Leisure in Modern Society* (9th ed.). Jones and Bartlett Publishers.
- Medeiros Filho, M., Campos, F., Benicio, I., & André, N. (2013). A importância da prototipação no design de games. *SBC - Proceedings of SBGames, Art & Design Track - Full Papers*, (pp.1-7).
- Melo, R. (2014). *Desportos de Natureza e desenvolvimento local sustentável: Análise dos praticantes e das organizações promotoras dos desportos de natureza* (Tese de Doutorado). Universidade de Coimbra. <https://hdl.handle.net/10316/24141>.
- Merriam, S. B. (1998). *Qualitative Research and Case Study Applications in Education: Revised and Expanded from Case Study Research in Education*. Jossey-Bass Publishers.
- Monteagudo, M. J., & Cuenca, M. (2012). Los itinerarios de ocio desde la investigación: tendencias, retos y aportaciones. *Revista Interuniversitaria Pedagogía Social*, (20), 103-135. [https://doi.org/10.7179/PSRI\\_2012.20.03](https://doi.org/10.7179/PSRI_2012.20.03).
- Moura, A., & Santos, I. (2020). Escape Room Educativo: reinventar ambientes de aprendizagem. *Aplicações para dispositivos móveis e estratégias inovadoras na educação*. Ministério da Educação, DGE.
- Neto, C. (2020). *Libertem as crianças: A urgência de brincar e ser ativo*. Contraponto Editores.
- Neto, F. M., & Sales, A. (2015). A Recommendation System for Ubiquitous Learning in the Context of Formal and Informal Education. *IEEE Latin America Transactions*, 13(4), 1061-1067. <https://doi.org/10.1109/TLA.2015.7106358>.
- Neuman, W. L. (2013). *Social Research Methods: Qualitative and Quantitative Approaches* (7th ed.). Pearson Education Limited.
- Oliveira, A. R. (2014). *Desenvolvimento da leitura e da escrita, em contexto de lazer* (Master Thesis. Master of Arts in Applied Health Sciences (Leisure Studies)), Instituto Politécnico de Coimbra. <https://d66z.short.gy/EbRUvV>.
- Pereira, A., Cardoso, T., Monteiro, V., & Pombo, C. (2021). Observação e Design-Based Research em contextos online. A prática na Investigação Qualitativa. *New Trends in Qualitative Research, NTQR* 5, 57-70. <https://doi.org/10.36367/ntqr.5.2021.57-70>.
- Peterson, R., & Herrington, J. (2005). The state of the art of design-based research. University of Wollongong. <https://ro.uow.edu.au/edupapers/59>.
- Pollock, H. (2018). *Exploring recreation and sense of community in the Canadian military*. (Dissertação de mestrado em Educação e Lazer), Faculty of Applied Health Sciences Brock University. <https://d66z.short.gy/4HYz62>.

- Saaty, M., Haqq, D., Beyki, M., Hassan, T., & McCrickard, D. S. (2022). Pokémon GO with Social Distancing: Social Media Analysis of Players' Experiences with Location-based Games. *Proceedings of the ACM on Human-Computer Interaction*, 6(CHI PLAY), 249. <https://doi.org/10.1145/3549512>.
- Silva, C., Palmer, L., Nisi, V., & Straubhaar, J. (2019). Teaching Social History through Locative Media: A Case Study in Austin, Texas. *Anuario Electrónico de Estudios en Comunicación Social "Disertaciones,"* 12(1), 59-74. <https://doi.org/10.12804/revistas.urosario.edu.co/disertaciones/a.6066>.
- Silverstone, R. (1993). Time, Information and Communication Technologies and the Household. *Time & Society*, 2(3), 283-311. <https://doi.org/10.1177/0961463X93002003001>.
- Spiers, A., & Walker, G. (2009). The Effects of Ethnicity and Leisure Satisfaction on Happiness, Peacefulness, and Quality of Life. *Leisure Sciences*, 31(1), 84-99. <https://doi.org/10.1080/01490400802558277>.
- Thielman, T. (2010). Locative Media and Mediated Localities: An Introduction to Media Geography. *Locative Media and Mediated Localities [Aether. The Journal of Media Geography]*, 5, 1-17.
- U.S. Department of Defense. (2019). *2019 Demographics. Profile of the Military Community*. Department of Defense (DoD), USA. <https://d66z.short.gy/31QcKT>.
- Vázquez-Cano, E., & Sevillano García, M. L. (2015). *Dispositivos digitales móviles en Educación*. Narcea.
- Wilken, R. (2012). Locative media: From specialized preoccupation to mainstream fascination. *Convergence*, 18(3), 243-247. <https://doi.org/10.1177/1354856512444375>.
- Xanthopoulos, S., & Xinogalos, S. (2018). Opportunities and challenges of mobile location-based games in education: Exploring the integration of authoring and analytics tools. In 2018 IEEE Global Engineering Education Conference (EDUCON) (Santa Cruz de Tenerife, Spain, 17-20 April 2018) (pp. 1797-1805). <https://doi.org/10.1109/EDUCON.2018.8363452>.
- Zain, Z., Jasmani, F., Haris, N., & Nurudin, Z. (2022). Gadgets and Their Impact on Child Development. *Proceedings 2022*, 82(1), 6. *International Academic Symposium of Social Science 2022*. <https://doi.org/10.3390/proceedings2022082006>.