

An educational leap of faith: Exploring the connections between instructional architectures and digital game spaces

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Abstract

The educational potential of games is nowadays widely accepted. Games, however, are multimodal artifacts, featuring many characteristics that can contribute to educational experiences in different ways. This paper engages one of these characteristics: that of the spatial organization in digital games. Digital game space has been examined over time from different perspectives (e.g., historical, semiotic, gameplay-based, environmental storytelling-based, etc.), but there is still a clear lack of studies concerning the connections between digital game spaces and their pedagogical value. This exploratory study aims to be the first step towards the establishment of a framework for the study and design of game space for educational purposes. To do so, we have decided to focus on two key elements – the instructional architectures and forms of gameplay afforded by different game spaces – and test them by conducting a case study of *Assassin's Creed Odyssey Discovery Tour*. This work aims to understand: a) what instructional architectures are fostered by *Assassin's Creed Odyssey Discovery Tour's* digital game space and how does this latter influence them; b) what synergies and contradictions emerge from the creation of a space that aims simultaneously to allow educational practices and play. The case study shows how the digital game title seems to mainly foster a receptive and, to a lesser extent, an exploratory type of instructional architecture. Furthermore, this study showed what synergies and contradictions emerge from a digital space that aims to create both playful and pedagogical experiences.

Keywords

Digital game space, game-based learning, instructional architectures, education, playful experiences

1. Introduction

The spatial dimension is a key feature of digital games. Their ability to create almost limitless virtual space, and the different ways in which players can navigate such space are major dimensions when it comes to game design. However, the design of game environments and spaces plays a crucial role also in terms of the educational experience that the game can afford. Game Based Learning is nowadays a well-established field, and the importance of digital games as educational tools is widely accepted and evidenced by the history of the meta-analyses [1, 2, 3, 4].


Over time, digital game space has been explored from different perspectives. Several studies have investigated its potential in the context of digital storytelling [5, 6, 7, 8]. Others analyze it from a historical perspective [9], or through a multidisciplinary perspective across philosophy, semiotics, and psychology [10]. Still others through a

holistic analytical approach [11] or from a semiotic-semantic perspective [12, 13]. However, there is a clear gap in the literature when it comes to investigating the connections between the features of digital space and the effects they can have in the pedagogical-educational sphere. This paper therefore proposes a preliminary exploration of digital game virtual space from an educational lens. In particular, we will draw some connections between the layouts, spaces, and morphologies of ludic environments and different instructional architectures. To do so, we will focus on the four architectures of instruction advanced by Clark [14] which sets out four types of instructional architecture, in combination with elements coming from the frameworks on instructional architectures and methodologies by Bonaiuti [15] and Bonaiuti, Calvani and Ranieri [16].

In order to explore these connections, we will engage a case study: *Assassin's Creed Odyssey Discovery Tour*. The Discovery Tour (DT) is a special instance, dedicated to educational purposes and to digital

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tourism, of the commercial game *Assassin's Creed Odyssey* – which is primarily aimed at entertainment. It is an emblematic case of a digital environment whose space (the represented architecture and game environment) not only benefits from an accurate work of historical reconstruction and a philological reconstruction of the architecture of several iconic monuments and cities of Classical Greece, (elements that have an intrinsic pedagogical potential), but also because it is a virtual environment that is designed to be explorable for primarily educational purposes. This case study, therefore, will allow us to look at the connections between the virtual space of the game and the educational architectures that it puts in place. Our research questions (RQs), hence are the following:

- RQ1: What instructional architectures are fostered by *Assassin's Creed Odyssey Discovery Tour's* digital game space and how does this latter influence them?
- RQ2: What synergies and contradictions emerge from the creation of a space that aims simultaneously to allow educational practices and play?

2. Background

That space is a crucial element of digital games is certainly not new, nor a recent discovery. As early as the 1990s, Murray [17] identifies space as a fundamental property of digital environments (along with the *procedural*, *participatory* and *encyclopedic* dimensions), pointing out that the navigability of spaces is the element that differentiates digital environments from other media. Cecilia Pearce [18] focuses on analyzing digital games as “spatial media” aimed at creating “experiences”. Wolf [19], concentrating on in-game and out-game spatial architectures, emphasizes how interaction and navigation make digital game space unique compared to other media. Aarseth [20], one of the pioneers of game studies, asserts that “the defining element in computer games is spatiality. Computer games are essentially concerned with spatial representation and negotiation, and therefore a classification of computer games can be based on how they represent or, perhaps, implement space.” (p. 44). Jenkins [7], looks at digital game space as a form of training for narrative design, and emphasizes the importance of space in digital game media, remarking that “Game designers don't simply tell stories; they design worlds and sculpt spaces.” (p. 121). In this regard, he speaks of evocative spaces, i.e., spaces capable of telling stories that engage with the user's prior narrative background. In the same vein, Nitsche [11], deepening the connections between space and the act of playing and digital games through a holistic approach, speaks of evocative narrative elements: elements designed to guide the player's understanding. Still on the subject of digital game spaces and storytelling, Fernández-Vara [6] refines the concept of environmental storytelling by introducing the concept of *indexical storytelling* according to which “Storytelling becomes a game of story-building, since the player has to piece together the story, or construct a story of her own interaction in the world by leaving a trace.” (p.1). Murray's

observation on the *navigability* of digital game media is thus reformulated, since “the player can also manipulate the space, interacting with the objects in it” (Ibid.). Fernández-Vara [21, 6] also points out that digital game spaces can also have an effect on user behavior. For instance, in a first-person shooter, the digital game space may encourage the user to shoot and run or, in a platform, it may encourage the mechanics of jumping over obstacles in the game space [6]. On the other hand, a game such as *Assassin's Creed* can, for instance, stimulate certain actions such as jumping, climbing and practicing parkour [22]. Therefore, from the existing literature on the connections between digital games and space, it emerges that the latter assumes a fundamental significance from various gameplay and narrative perspectives.

The spatial organization of educational environments has often been recognized as a key feature well before digital spaces. So much so that pedagogical traditions such as the *Reggio Emilia Approach* look at space as a metaphorical “third teacher”, supporting a *delicate balance* between providing structures and the learner's agency in terms of free exploration [45] (see, especially, p. 41). This view of space as personal tutor/teacher might be easily extended to digital educational game realities, as the environment can play a similar role – potentially in an even stronger way, as it is often an interactive environment.

Therefore, while space is a key feature of any digital game (including those designed for fun/entertainment) it assumes a different form when we look at games for learning – that is, games that purposefully expose the player to intrinsically pedagogical content. Such games often offer a tutoring system to the learner, which is a key factor in the education/learning process (see, e.g., the discussion on the relevance of tutoring in the learning process of educational games [46]). The environment, then, can be thought of as part of this process: digital space can be seen as a “meta-tutor”, i.e., a “third-tutor” of an already “tutoring” environment. A feature, the latter, that often markedly distinguishes how games for learning approach the process of learning, compared to games for fun.

The new perspective we intend to investigate here, hence, is the connection between the digital game space and its ability to produce significant pedagogical effects. Thus, taking up Pearce's idea [18], according to which the design of spatial media (games) has as its aim the creation of “experiences”, we add here that these videogame spaces can have as a direct or indirect consequence the creation of more or less significant “pedagogical experiences”.

3. Methodology

The present study has an exploratory and qualitative nature. Our approach is articulated in four main steps. After setting the stage for this research with a narrative literature review, we selected a specific case study, formulated an analytical framework to approach it, and analyzed it (and reflected on the

analysis results). In this section we will provide the specifics of the methods we adopted.

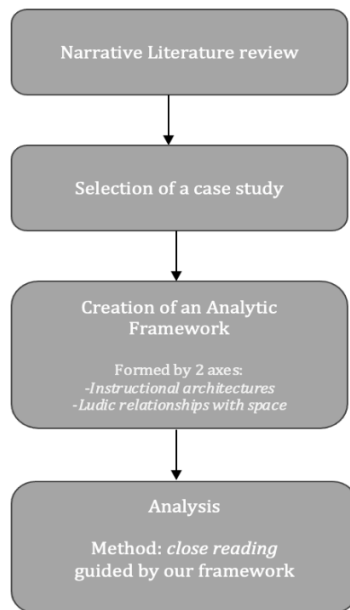


Figure 1: Workflow of the methodological process

3.1. Narrative Literature review

First, we have conducted a short narrative literature review [23] looking at the existing studies on the connections between space and digital games. The databases used for bibliographic research were ERIC, one of the main sources for educational research, and the search engines Google and Google Scholar. We searched for topics concerning the analysis of the digital/video game space. The bibliographical analysis was useful to outline several key dimensions of this relationship in terms of game design and gameplay. At the same time, the review revealed a clear research gap: despite many important studies on the spatial dimension of digital games [17, 18, 19, 20, 5, 6, 8, 7, 9, 10, 11, 12, 13] there is a lack of studies analyzing how virtual game spaces can impact pedagogical approaches in game-based learning. From a game-based learning perspective figuring out how the digital space encourages certain instructional architectures is crucial for understanding how the digital space can be projected and organized in order to improve educational experiences. Moreover, it is also important to understand the leeway of educators/teachers in using these games as game-based learning tools. A space that encourages too much exploration (and thus incentivizes an exploratory type of didactic architecture) may be dispersive for the learner, overloading the cognitive load excessively. This may require teaching interventions of briefing or debriefing respectively pre- or post-game session. On the other hand, a space that, for instance, encourages a receptive type of architecture (i.e., in which the learner is a passive receiver of information), may require an instructional design (post-game session) oriented towards experiential/active learning activities. This then led to the formulation of specific questions regarding the influence these spaces can have in

supporting pedagogical principles pertaining to different educational architectures.

3.2. Selection of a case study

Second, we selected the *Assassin's Creed Odyssey Discovery Tour* as a relevant example of digital space that was specifically configured to create formative/educational experiences. Among many possible articulations of virtual space, this case has a few key characteristics that, as we shall see later, make it crucial for fostering our understanding of how game space can be designed, managed and actualized in an educational effort. We are dealing with a recent, triple-A, game (from 2018) which can therefore represent the state of the art and the full potential of the medium. It is the educational mode of an entertainment-oriented title, which has been explicitly designed for formative/educational purposes. The educational material is framed like a "tour" suggesting a strong spatial characteristic in the organization of the materials. The digital game features explorable, navigable spaces and possibilities for interaction with the surrounding environment. Additionally, the space of this Discovery Tour features a historical reconstruction of several culturally relevant spaces of Ancient Grece. While the reconstruction is adapted to the representational and ludic needs of the game [51] a considerable attention was given to the reconstruction of historical architectures, buildings, atmosphere and environments of Antiquity. Finally, while there are no studies on the relationship of its use of virtual space and its educational strategies, this game has been consistently analyzed in the literature through both experimental and argumentative studies. The presence of a corpus of academic literature related to this game, seems to support its relevance as an object of study.

The *Assassin's Creed* franchise, has been analyzed over time from different perspectives in academic literature [24, 25, 26, 27, 22, 28, 29]. Beyond the narrative elements that may entertain the gamer as a motivational drive, what is most striking about this series (and partially helps to motivate playing) is precisely the space and the game environment, since "Ubisoft's *Assassin's Creed* series has, since its very inception, been based on historical reconstructions" [22] (p. 48). Precisely by virtue of elements such as the period-specific environments, landscapes and architectures, in addition to the fact that the player can interact and converse with important characters from history (such as Herodotus, da Vinci, Plato, etc.), there are those who enthusiastically reported that "the *Assassin's Creed* franchise has gained a strong reputation with players interested in history around the world, systematically offering them the opportunity to learn while playing" [29] (p. 79). On the heels of this excitement, some have even spoken of this saga as an enticing virtual time machine [27]. Going beyond this enthusiasm, one can agree, however, that it must be acknowledged that there is a clear love of the past behind these games, especially by virtue of employing historians and consulting with experts [27] (p. 319).

Assassin's Creed Discovery Tours are additional stand-alone modes of some chapters of the famous digital game saga *Assassin's Creed* designed primarily for formative and educational purposes. Through these digital game environments, it is possible to explore places, iconic monuments within contexts such as Ancient Egypt, Ancient Greece and Viking-era Europe either freely (free-roaming) or by deciding to follow guided itineraries. Winners of awards such as *Best Learning Game*³, they stand out within the current educational game panorama for features such as: realism in graphical rendering, attention to the reconstruction of historical architectures and compartment, and great immersiveness.

The Discovery Tour of *Assassin's Creed Odyssey*, our case study, was introduced in 2019. It is set in Classical Greece. This type of mode, unlike the title that is part of the saga (*Odyssey*), does not feature any gameplay elements related to violence (no killing, no blood, no dying allowed) and does not follow the saga's narrative line. It does, however, retain the same characteristic mechanics of the franchise, such as those related to exploring, climbing, jumping, and experimenting with parkour.

3.3. Creation of an analytic framework

Third, we outlined a framework for the analysis of our case study. The framework focuses on two main axes: instructional architectures and ludic relationships with space.

The axis dedicated to instructional architectures is based on the key concepts presented in Clark [14] in relation to instructional architecture - in combination with later studies refining Clark's approach [15, 16]. Clark's work, although not exhaustive, has the merit of elaborating clearly a synthetic framework, within which the most frequently used instructional architectures were illustrated and described through systematic parameters. Clark [14] proposes a taxonomy that "can be used to consider different strategic approaches for meeting various human cognitive and performance task needs." (p. 32). She describes four types of instructional architecture: *receptive*, *behavioral*, *guided discovery*, and *exploratory*. These are analyzed systematically across four dimensions: *Cognitive Impact*, *Cognitive Overload*, *LTM Encoding Failures*, *Metacognitive Skills*. Furthermore, for each of them Clark introduces a historical overview and advice on when it is appropriate to use them. The following is a concise overview, designed to give an understanding of the characteristic elements.

- **Receptive Architecture:** this is the oldest instructional architecture and the most widely used in the training/educational field. It is characterized by a lack of interaction with the outside world and presents a strong control from the didactic source (be it a digital game medium, teacher, tutor, etc.). It therefore requires students to already have well-developed metacognitive skills and a pre-knowledge of the content, enabling

them to link Working Memory (WM) to Long-Term Memory (LTM). The risk is a strong cognitive overload, it can be used as a briefing to introduce concepts, especially if supported by written (and audiovisual) materials. An example is the typical and well-established *lectio* (e.g., university lecture).

- **Behavioral Architecture:** it is a fairly well-established architecture in education. It is characterized by a procedure in which knowledge acquisition proceeds gradually bottom-up, through a constant stimulus-response process. Although this architecture keeps the cognitive load at bay (useful for novice learners), the risks are that it does not allow deep development of metacognitive skills and easily demotivates more advanced learners. Clark suggests using for beginner learners.

- **Situated Guided Discovery Architecture:** lending itself to more constructivist approaches "compared to the behavioral architectures, the guided discovery approaches emphasize the building of unique knowledge bases versus consistent acquisition of predetermined knowledge and skill hierarchies" (p. 34). It is characterized by higher learner control, as well as high interactivity with the outside world, and a problem solving or discovery approach (which may be more or less facilitated). Unlike the behavioral-transmissive architecture, feedback is not tied to the "right-wrong" dichotomy but is *multisourced* and *naturalistic* and the learning process is more global than bottom-up. It also provides the learner with ways of finding solutions. This architecture could, however, stress the learner's cognitive abilities.

- **Exploratory Architecture:** it "is designed on a premise of high learner control" (p. 35). It requires good metacognitive skills and prior knowledge. This also suggests when it is appropriate to use it. It also allows one to control the rhythm of information transmission. Several phases of "optional practice" (or even de-briefings) might be appropriate.

Although Clark is mostly referring to the use of IT instruments in his architectures (Clark's was writing when e-learning was in its infancy), the assumptions and principles of each architecture are still valid. For instance, the risk of getting "lost-in-hyperspace" in exploratory architectures, is just as applicable in the digital game experience as it is for other mediated environments (metaverse, XR, etc.). Clark's work is a point of reference for instructional design, as evidenced by its impact in supporting numerous follow up studies that developed its contents and structure or used it as a basis for the creation of methodological instructional taxonomies to concretely guide educators/teachers in their teaching activities [30, 31, 32, 15, 16].

The work of Bonaiuti [15] and Bonaiuti, Calvani and Ranieri [16], in addition to introducing new instructional architectures, link these to precise teaching strategies and clearly articulate the factors that characterize each architecture: degree of

³ https://g4cawards.secure-platform.com/a/page/past_winners

system/learner control, level of information pre-structuring, degree of learner/system interaction. We will refer to these factors, together with Clark's model, to understand which instructional architectures are supported by the digital game space.

The axis dedicated to ludic relationships to space is grounded on the long tradition of research on the topic. There is an intrinsic and intimate relationship between play and games and space. The famous concept of "magic circle", from Huizinga [33] describes, among other things, how play delimitates space, and reshapes it according to its needs (for example in tracks, pitches, courts, if we look at sports). Games, however, often escape spatial delimitations, and pervades the spaces of everyday life [34], "coloring" them in playful ways. There is a long tradition of playful exploration and engagement with urban spaces, that ranges from the idea of *flânerie* as a free careless movement in the city [35] and of *derive*, a playful abandon to the currents of urban life, all the way to the playful valorizations of the e-scooters that populate many contemporary cities [36], and focus more on speed, risk and swiftness. Practices such as skateboarding and *parkour*, which reinterpret urban furniture and architecture as supports for playful acrobatic movement, have been described as forms of urban gamification [37] – and have been imitated promptly in digital games. The Assassin's Creed franchise relies strongly on the parkour-like movement of its characters. David Belle, the founder of the discipline of *parkour*, notes in an interview⁴ how this form of acrobatic movement has a similar dimension both in the game and in real life: it distracts from the expected behavior of the space and allows free and pleasurable exploration.

The fundamental relationship between urban space and game has also been theories in a systematic way, both in creative projects such as Constant Nieuwenhuys "New Babylon", a city of eternal exploration designed for the *homo ludens* [38] and in frameworks such as that of the Ludic City [39] or the Playable City [40]. All these perspectives seem to highlight the ability of play and games to give meaning to the space and therefore to orient the behavior of people within them – often in ways that go against norms, and sometime the law. Similar engagements with space emerge also clearly in digital games, for example when spaces are explored for glitches and exploits while doing a "speed run" [41] i.e., trying to complete the game as fast as possible, disregarding the rules.

All in all, it seems that the relationship between games and space is twofold: on the one hand, the design of (digital) game spaces enable, support, and direct gameplay. On the other hand, however, a playful behavior tends to disrupt expectations, and favor free exploration and the enjoyment of speed and risk taking. From these perspectives we derived two main aspects for our analysis:

- Spatial Affordances for Play – focusing on how the design of virtual space has been oriented to invite specific forms of play actions.

- Playful Use of Space – focusing on how play can reimagine space and the expectations connected to its use.

Our framework, therefore, allow to look, at the same time, at both the instructional architecture that is implicitly supported by the virtual space of a game, and how (and in what measure) that same space supports gameplay and, simultaneously, can be renegotiated by playful behavior.

In the table below (Table 1), we summarize the main metrics used, connected to the respective two axes of our analytic framework, for the case study analysis. The assignment of these metrics was based on personal evaluations by both authors, based on common criteria, that where then discussed until we reached an agreement. The metrics for the axis of instructional architectures largely correspond to the main characterizing factors/variables featured in the works of Clark [14], Bonaiuti [15] and Bonaiuti, Calvani and Ranieri [16] to categorize various instructional architectures. Here, they are adapted and translated to the field of digital games, whereby:

- The *teacher* corresponds to the *instructional source* (system)
- The *learner* corresponds to the *player*

Table 1
Analytic Framework Overview

Analytic Framework	
Instructional architectures - <i>metrics</i>	Degree of player (learner)/instructional source (system) control: low to high
<i>Translation and adaptation from</i> [14, 15, 16]	Level of Information pre-structuring: low to high
	Pace and mode of information transmission
Ludic relationships with space - <i>metrics</i>	Degree of interaction between player (learner) and instructional source (system): from absent/poor to high
	Spatial Affordances for Play: elements related to how the design of virtual space has been oriented to invite specific forms of play actions
	Playful Use of Space: elements related to how play can reimagine space and the expectations connected to its use

3.4. Analysis

Fourth, we have used our framework to guide our analysis of the selected case study: *Assassin's Creed Odyssey Discovery Tour*. The analysis aims to answer our research questions.

Our analysis takes the form of a *close reading* [42] where the game is played and experienced by the researchers, who unpack the game content and systematize it. While being necessarily a form of situated research – based in some measure on the

⁴ <https://www.youtube.com/watch?v=9LS2Ewe8FTI&t=144s>

personal interpretation of the researchers – our close reading was guided by our framework. During play, we have kept a “gameplay diary” [43, 44] where we have annotated our impressions, collected screenshots and wrote down anything that seemed relevant for our analysis.

During play, we focused primarily on the aspects of the game related to the exploration of digital space and connections between spatial and pedagogical elements. The device used to run the game was the *PlayStation Five*. The analysis involved two main phases:

- First, we familiarized ourselves with the game, its controls and the main game elements.
- Second, we played the game. Due to the vastness of the open-world area (38 regions) of the game, we concentrated on exploring the tours and the environment within the boundaries of a specific region of the map (Attika), as it is not only one of the most representative of Classical Greece, but also because it seems to be the richest in game activities. During this phase we realized our gameplay diaries.

Finally, we organized and compared our diaries and observations of the game, systematizing them according to our framework and highlighting the synergies and contradictions between the two axes: the instructional architecture and the ludic relationship with the game space.

4. Results

1. The first phase was used to familiarize ourselves with the gameplay and game mechanics



Figure 2: A portion of the vast map. The cursor indicates the region of Attika. The borders are marked with a white line - *In-game screenshot*

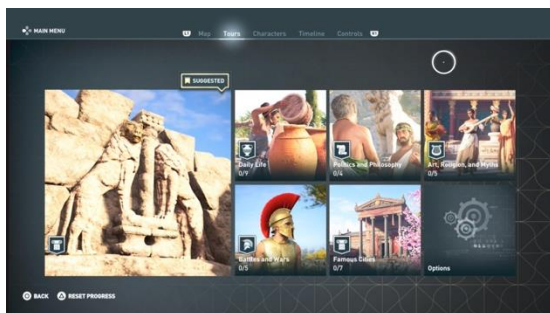


Figure 3: The Tours menu, with the different discovery tours divided into themes - *In-game screenshot*

Through the game menu, one accesses a quite large and representative map of a fairly accurate Classical Greece [27] (p. 319). Iconic ancient regions are represented (Figure 2), e.g., the island of Kefalonia, the region of Boeotia, Attika, Achaia, Lakonia, Arcadia, Elis, parts of Makedonia, Crete, the Aegean islands, etc. The regions are full of fast travel points (marked by the green eagle icon) and “tour” points (marked by a black and white flag symbol). The game features a total of 228 *Discovery Tour sites* and 30 *Behind the Scenes*, points of interest with informative captions, marked by a purple light in game space, and represented with a black circle indicating a compass/cross on the map (Figure 2), scattered throughout the game world. Also, within the menu, by switching to the *Tours* section (Figure 3), tours are presented divided by different themes (*Daily Life; Politics and Philosophy; Art, Religion, and Myths; Battles and Wars; Famous Cities*) for a total of 30 tours. Each tour reports an estimated time for completion and is led by a guide (there are 5 tour guides, historical or fictional characters: *Aspasia, Leonidas, Markos, Herodotus and Barnabas*). Each guide conducts the tour that is most appropriate to his or her historical background (e.g., *Leonidas* is in charge of conducting the tours on the theme *Battles and Wars*). Still within the menu it is possible to consult the *Character* section, where there are characters to unlock and a Mount selection (rides to unlock). The release of these characters is the vaguely gamified game-design element to encourage exploration (unlocking depends on how many discovery sites/tours one has visited). Finally, there are sections for controls and a section called *Timeline* that allows one to diachronically retrace the best-known events in Greek history, from those situated in the Minoan Civilization (2700-1350 BCE) to those relating to the period of the Battle of Thermopylae (480 BCE) and the Peloponnese (431-404 BCE).



Figure 4: The player suspended above the statue of Athena, located in the Acropolis of Athens. In the background the Parthenon - *In-game screenshot*

2. At this second phase, we concentrated on exploring the digital game spaces offered by the digital game. We therefore started with the introductory tour *The Acropolis of Athens* and continued with others, such as *Battle of Marathon, School of Greece – Music, School of Greece - Theatre*, etc. Exploring the tours, what is most striking is the feeling of immersiveness, this is due to multiple elements in the space. First of all, the photorealism: it actually feels like living spaces very close to reality. The graphical rendering is truly remarkable. This realism can be seen, for instance, in the reproduction of elements that are notoriously difficult to reproduce, such as the fire and smoke from

the braziers scattered around the game space or the reproduction of the water surface with its waves near the port of *Piraeus*. Subsequently, the liveliness of the environment, given by a large quantity of NPCs in period clothing moving and talking, singing and praying (in Ancient Greek) in front of monuments. Furthermore, the majesty of the buildings and monuments, such as the imposing statue of Athena (Figure 4).

This feeling of immersiveness and the desire to know more about the places prompted more exploration of the play spaces and parkour experiments. We have seen a philological attention to detail, such as the interior of the Parthenon, which is full of treasures, as it must have been at the time. In addition, we noticed a considerable abundance of elements in the urban space: places filled with statues, temples, columns, vases of different sizes and kinds, flags or curtains depicting the symbols of cities, and other architectural elements typical of the period (each environmental decoration is extremely detailed). Experiencing parkour, we felt a great sense of freedom. In fact, it is possible to climb almost any building, jump from rooftop to rooftop, overcome obstacles along the way, grab onto ledges and scale any wall. This feeling of freedom was then amplified by experiencing the thrill of doing what is not allowed in the real world, such as climbing over monuments like the Parthenon or jumping off the Acropolis in Athens.

As regards the tour, we noticed that a linear route must be followed to complete it. Each stop on the tour (corresponding to a monument/historical place) is accompanied by a narrator explaining its history or curiosities. In addition, immediately after discovering a monument/place, there is a caption that shows real images of different existing museums, so that comparisons with the real world can also be made. Each tour has a final quiz to measure the knowledge acquired. The environment therefore offers many opportunities to get to know and learn about the culture of Classical Greece. In exploration, we made use of game elements such as mounts and teleportation through fast travels on the game map. We then selected tours such as *Battle of Marathon* directly from the *Timeline* Menu. We used also the *Tours* menu (Figure 3), where we selected *Democracy in Athens*. Finally, we noticed that characters and mounts are unlocked based on how many sites and discovery tours are completed.

5. Discussion

To answer the first question (RQ1). The game space seems to lend itself to two main types of educational architecture: the *receptive* one, which is predominant, and, to a lesser extent, the *exploratory* one.

The game is mainly based on guided tours; once a tour is undertaken, the game space pushes for its completion, indicating to the player the direction to follow through yellow lines. The player thus stays in the shoes of a visitor who step by step follows a predetermined itinerary. The pre-structuring of information is therefore high, interaction is limited to experiencing parkour (i.e., climbing, jumping and scrambling over monuments or buildings), a mechanic

not particularly demanded by tours, almost always optional, which mostly serves to enrich the experience and playfulness of the game. Therefore, these are elements (pre-structuring of info, limited interaction and control of information by the system) that characterize *receptive-transmissive* architectures [14, 15, 16].

Within the tour, one may come across discovery sites, points of interest marked with a purple light and, by clicking on the triangle command, discover additional information about the game environment (information caption). The player can clearly decide not to follow the tour and explore on his own. However, once the tour is activated, by straying too far from the tour area, the game warns that if one decides to continue the exploration, one will lose the progress of the tour and, consequently, also the final quiz aimed at finding out whether knowledge has been gained.

Nonetheless, on the side of exploratory architecture, the player does not remain totally passive. Already the mere fact of being able to decide whether to explore the tours through the game map (by teleporting close to or directly onto the relevant tour), through the selection of the various themes directly from the *Tours section* of the menu, to follow a temporal approach from the *Timeline section* of the menu, decide to rely on walking exploration of the game world, or even decide to implement several approaches, is a game-design mechanic that in itself indirectly contributes to a certain freedom in the exploration of the game world. The exploration of the spaces can also make use of two other elements; the *eagle call*, a mechanic that is activated with the up arrow of the gamepad and that shifts the character's view to that of an eagle, giving you a bird's-eye view of the surrounding area, in order to orient yourself, so as to decide to map a site or a tour one intends to explore; the use of a mount, which helps in reaching the designated places faster and partially contributes to the user's enjoyment during the exploration. The player is, of course, free to explore any place on the vast map of Ancient Greece. This contributes, together with the parkour mechanics and the different approaches that can be used to explore the world, to a feeling of full control and freedom in exploration; the high degree of freedom and the strong control by the player/learner (in this case: deciding autonomously where to go, what to visit, how and when to explore) are in fact the defining factors of exploratory architectures [14, 15, 16].

It should be noted, however, that the vaguely gamified mechanics of unlocking new playing characters or mounts do not seem to be fully sufficient in motivating exploration of the game environment. Even if this is an additional mode of the title (for which there are no elements such as storytelling, stealth, etc.) it would certainly have been useful to add other mechanics/dynamics in the Discovery Tour, such as other non-plot-related mini-challenges, or a clear system of progress bars, badges, scores, etc. The excellent graphical rendering, the care for the reconstruction of the environment, understanding the history, art and culture of the ancient world, talking to iconic characters and understanding their historical background, together with being able to experience parkour in a vast open-world world, constitute

elements that certainly contribute overall in the process of discovering the digital game space. Yet, this is something that may depend on the gamer's inclinations or passions. A user not too fascinated by the architecture or history of the Greek world may not find sufficient stimulation to explore the game world.

As regards spatial organization, there seems to be an imbalance between the enormous vastness of the explorable game space and the distribution of tours/points of interest. The player can also randomly discover the various points of interest (*discovery sites* and *behind the scene*) scattered throughout the game space without activating any tours. Nevertheless, discovery sites are mostly concentrated in areas where a tour is present. In addition, there are areas very dense with activities such as Attika or Lakonia and quite empty areas such as the island of Crete (with only one tour), Boeotia (no tour) or, even more conspicuously, the various Aegean islands (some with neither tours nor points of interest). Finally, there are many repetitive spaces and many empty natural landscapes. This clearly has an impact on exploration. In fact, one can run the risk of exploring for a long time without finding points of interest (in the event that one does not use tools such as the map, teleportation, eagle call and mount).

In relation to the second research question (RQ2), The synergies and contradictions of space can be explained through the two perspectives connected to the axis related to ludic relationships with space of our framework: **Spatial Affordances for Play** and **Playful Use of Space**.

1. As regards Spatial Affordances for Play, we can say that these are given by a combination of several factors:

- **Linearity of tour spaces:** elements in the space, such as the yellow line that indicate the player which way to follow to complete the tour, or the alert message that warns, once the tour is activated, that you are straying too far from the path and may lose progress, induce the player to choose to follow a predetermined itinerary.
- **Limited interaction with environment:** the ability to interact with the setting is limited to parkour, an almost always optional component. This, unlike the saga from which the tour is derived, lacks a pragmatic function (e.g., climbing, running away or running across rooftops to avoid being seen by enemies). This clearly induces the player to follow rule-based gameplay.
- **Unbalanced space layout:** the points of interest (*discovery sites*), while scattered across the vast game map, are mostly concentrated in the surroundings of the tours. Furthermore, outside the urban areas, there are many empty spaces. This not only causes the player to concentrate more on gameplay in the proximity of the tours (to the detriment of free exploration), but also causes the player to run the risk of exploring for a long time without finding any points of interest (in case that he does not use mechanics such as fast travel, eagle call and mount).

The combination of these elements, in addition to explaining how the design of the virtual space was geared towards inviting specific forms of playful actions, encourages a *receptive type* of instructional

architecture. The linearity of tour spaces is in fact connected to: **strong control** and **pre-structuring of information by the system**; elements that characterize *receptive type architectures* [14, 15, 16]. Limited interaction with the environment is related to: **scarce interaction with the system**; also a characterizing factor of this architecture [14, 15, 16].

2. As concerns the Playful Use of Space, that is given by a combination of different aspects:

- **Parkour mechanics:** elements such as jumping, climbing and clinging everywhere enrich and gamify the play experience, allowing to break the linearity of the tours and stimulating more exploration of the play spaces. It also allows one to experience the thrill of performing actions that one cannot do in the real world (playful forms similar to the *Ilinix* described by Callois), such as climbing over statues and monuments such as the Parthenon, jumping from one monument to another, or even throwing oneself down into the void from the acropolis of Athens.
- **Exploratory mechanics:** elements such as the *eagle call*, or the use of mounts allow for a playful use of space and help facilitate/support exploration.
- **Urban furniture:** the digital spaces teem with elements, such as NPCs living in the city (*polis*) simulating real attitudes (they move, sing, talk to each other) or buildings, colored statues, amphorae, vases of the period. All this leads to letting oneself be carried away by exploration and playing more with urban space.
- **Photorealism:** the high level of detail in the reconstruction of the environments gives the player the sensation of experiencing places very similar to the real thing, thus soliciting immersiveness and exploration free from the schemes of discovery tours.

The combination of these elements, as well as increasing the playfulness of the space, help to support an *exploratory instructional architecture*. The mechanics of parkour and exploration are in fact linked to: **strong control and freedom of the learner**, factors characterizing the *exploratory architecture* [14, 15, 16].

6. Conclusion and future perspectives

This study has shown how the digital game space of *Assassin's Creed Odyssey Discovery Tour* seems to encourage more a *receptive instructional architecture* and, to a minor extent, an *exploratory instructional architecture*. Furthermore, our study showed what synergies and contradictions emerge from a digital space that aims to create both playful and pedagogical experiences.

We have, in fact, identified specific main factors relating to the axis of the ludic relationship with the game space (linearity of tour spaces, limited interaction with environment, unbalanced space layout, parkour mechanics, exploratory mechanics, urban furniture, photorealism) that, in relation to the

pedagogical axis, evoke, intertwine and connect with characterizing factors of instructional architectures.

In conclusion, research results may indirectly provide useful insights into the use of the digital environment as a Game-Based Learning tool. Different instructional architectures can indeed lead to different forms of learning. The *transmissive-receptive* architecture, the oldest and still used today, through features such as linearity (and unilaterality) of the transmission of information, low interaction with the learner (player in this case) and strong control by the teacher (in this case the instructional source) can lead to "knowledge-based", mechanical, by reception, or often "mnemonic" forms of learning. It could therefore be ideal, e.g., for briefing and de-briefing situations.

On the other hand, an *exploratory architecture*, assuming a more active role of the student (learner-centered), through features such as strong control (and freedom) of the learner (player), poor pre-structuring of information, can lead to forms of *meaningful learning* [48] (which often occurs through the experience of personal exploration/experimentation that leads to forming associations with the learner's cognitive background) and *discovery learning* [47].

It must be said, however, that existing literature establishes that approaches involving "pure" (too free) exploration (or pure discovery approach) could lead to disadvantages for the learner's (especially novice) cognitive load in the learning process (see, e.g., [49, 50, 14]). Therefore, this should be strongly taken into consideration by teachers or educators, alternating, for instance, constant tutoring phases such as briefings or de-briefings, or anyway trying to implement exploratory models/systems in well-designed and monitored instructional paths by the teacher/tutor.

Our study is exploratory in nature and, as such, has several limitations. We focused here on a single case study, and within it we played primarily within the confines of the region of Attika. While we believe that our findings could apply to other spaces in the game – and to similar games – our results so far are not generalizable. Furthermore, the motivational drive for exploration could change depending on the player's interest in the culture of the classical Hellenic world. Finally, the play experience may change depending on the approach chosen: explore by walking, make use of tools for orientation, or simply select tours from the game menu and play more passively.

Nevertheless, we think that our study can work as a first step in the direction towards an applicable framework on how to use digital game space as a game-based learning tool. While gamification in education has often focused on game design elements, we believe that a space-centered approach, when informed from the right educational perspectives, can have a lot to offer in the creation of engaging, immersive and effective game-based learning products.

This exploratory study, then, will be followed by a controlled experiment focusing on assessing its pedagogical value and the tangible effects of following certain instructional architectures (fostered by the digital game space).

Future studies will also have to expand our perspective by including different forms of game (that,

for example, are not Triple-A, or feature different representations of space such as God-games, or even analogue games). A systematic engagement with different ways of articulating game space, afford playful actions and support educational outcomes could pave the way to a new set of strategies that would enrich the existing approaches to Game Based Learning.

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