Investigating The Intersection of Wayfinding and Immersive Experience in Virtual Landscapes

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Abstract. The virtual landscape has been used as a tool to develop the real world; however, this domain itself also has a design value. Taking advantage of the unique affordances of such environments to allow the construction of spatial knowledge, virtual landscape designers need to incorporate wayfinding mechanisms into their designs to help the users' navigation in the space. However, the wayfinding efficiency of the virtual landscape bonds strongly with the designers' real-world skills and their transmission to the virtuality. Hence, the spatial features that consider user-space interactions in mental representation are more efficient in designing immersive wayfinding aids. Since the combination of various types of spatial knowledge leads to creating cognitive maps in people's minds, this paper adopted the cognitive mapping concept and Kevin Lynch's design approach to provide a framework for understanding players' spatial knowledge process. The research results were evaluated by understanding the benefits of landmark knowledge to create route information, map usage, and location determination features. Based on the player survey analyses and audio-interview data on selected virtual landscapes in World of Warcraft, the research provides an inclusive representation regarding five main characterizations: experience, abilities, strategies, motivation, and environmental features. With the research findings, virtual landscape designers can produce more inclusive and immersive game environments by focusing on spatial interactions and user experience in commercial and educational-oriented digital games.

Keywords: Digital Games, Virtual Landscape, Spatial Knowledge, Immersive Experience, Wayfinding, Landmark

1. Introduction

As in the real world, designing virtual landscapes requires the skill to design the space by considering the interactions between users and the space itself (Dondlinger & Lunce, 2009, pp. 562-569). Current studies on spatial interaction in virtual landscapes contributed to the development of player-centered techniques (Yannakakis & Hallam, 2007). To provide and maintain player satisfaction, digital game designers study players' behavior. Although spatial exploration is essential for digital games, player experience in performing exploration tasks is insufficiently understood. Investigating how players explore and navigate a virtual landscape can contribute to better game design, such as how natural or artificial objects are hidden and distributed in the map environment and believable non-player characters (NPCs) that use human-like exploration techniques (Si, et al., 2017).

An essential but elusive feature of the virtual landscape is involvement and enjoyment, often known as immersion. Immersion can be defined as a cognitive experience of players resulting from playing digital games.

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Cairns, Cox, and Nordin (2014) defined it as the degree to which players are involved in different aspects of the game that causes their attention, awareness, and thoughts to move from the real world around them to events occurring within the game (pp. 337-361). In the context of virtual landscapes, immersion is generally meant to signify the phenomenon of the player having a sense of observing and controlling the space but also actively present in the game environment and ceases to be aware of the surrounding physical world (Johan, 2020). If the game environment is rich enough in sensory data and consistently follows its aesthetic narrative and systemic logic, the player's mind and senses will favor the game's world depending on the expectations of the mental model (Witmer & Singer, 1998, pp. 225-240). Hence, when designing a virtual landscape, the designer assumes that players can construct reasonably coherent mental representations of these spaces (Verdine, 2011). Thus, while attempting to describe the relational elements that create a game-play experience, researchers developed the user-system-experience (USE) model (Cowley et al., 2006, June, pp. 419-424). The primary function of USE is to describe the player-game relationship, which it does in terms of constructs from the literature on personality types (Bateman & Boon, 2005), optimal psychology or Flow theory (Csikszentmihalyi, 2014), and human-computer interaction (HCI) (Steuer, 1992, pp. 73-93).

Numerous research has been conducted on immersion and navigation in digital games as separate phenomena, such as Immersion in Digital Games by Cairns, Cox, and Nordin (2014) and Xiao's study (2020) about Navigation Aids in Video Games. While only a few studies have focused on their intersections, such as Hellgren's research (2020), both have deep roots in spatial cognition. Therefore, this intersection presents itself as a potentially beneficial, and largely unexplored field of study. This research takes advantage of the gap in this field to demonstrate inclusive mental representations to players' by evaluating the effects of wayfinding aids on spatial cognition. Numerous virtual landscapes offer the opportunity for transportation and perceptual immersion and a very high degree of realism. Massively multiplayer online games (MMOG) require players to work together and provide a sense of social and spatial presence. NPCs in such games give the sense of the game having social actors and various spatial components that provide connection and interaction on specific virtual landscapes.

Additionally, online digital games and online game communities allow players to play against or cooperatively with other players over the Internet. World of Warcraft (WoW) is known to have complex social and spatial dynamics (Ducheneaut et al., 2006, April, pp. 407-416; Chen & Duh, 2007, June, pp. 21-24). WoW presents a privilege to architecture as a spatial experience. As McGregor (2006, December) stated, his research moves through space by constructing architecture as solids and voids (pp. 69-76). As players interact with the space, spatial features channel and impede players. Also, to present an immersive spatial experience, landscape operates similarly to architecture, functions as an organizational system, and creates nodes of activity. The landscape of WoW closely simulates a personal experience of the environment. By examining the spatial features and dynamics presented in WoW, this research provides a framework that aims by considering the interactions of navigation mechanisms which is one of the essential tools of spatial cognition to increase the sense of immersion in virtual landscapes. Survey data analysis is presented to evaluate the effects of wayfinding aids for establishing various spatial relationships and improvements in the design of virtual landscapes in the digital game industry.

2. Spatial Cognition and Wayfinding

By following Bond (2020), wayfinding refers to all the stages of an individuals' interpretation and orientation within an environment to navigate between different locations. Lynch (1960) suggests that wayfinding includes stages involving sensory input, cognition, and memory. Hence, it processes

sensory information and uses it to create an environmental image based on previous experiences in familiar environments. These processes are known as components of the cognitive map and a fundamental part of wayfinding contains the development and use of a cognitive map (Darken & Sibert, 1996, April). A cognitive map includes a hierarchical structure based on how objects communicate with each other. Therefore, it is known as the type of information required to navigate an environment. It allows individuals to plan new routes in unfamiliar environments as long as they contain familiar spatial information (Elvins, 1997). Knowledge construction is also considered an essential element for exploration. Wayfinding was developed as a design practice for physical spaces and is vital in large public spaces that offer complex and varied navigation, especially in dense urban areas (Lynch, 1960). Representing spatial information in the real world requires a process that acquires and combines three different types of related spatial information developed to create a cognitive map. This process emerges as the Landmark, Route, and Survey (LRS) information model developed by Siegel and White (1975) (pp. 9-55).

By following Kim et al., (2018), virtual landscape shares different characteristics as a design domain such as perspective, interaction, aesthetic, and scale (pp. 458-473). Hence, precise information on the nature of spatial cognition in digital games has not been provided (Anagnostopoulou-Politou & Al-Sayed, 2016, July, pp. 195-202). Navigation in digital games tends to rely on user-experience components rather than communicating and interacting with the space. Despite this, essential research has been conducted focusing on navigation tools and mediators in virtual landscapes. Verdine (2011) rated the digital game types of ten routine players based on definitions for each of the skills used in different genres to examine how different skills are used in various digital game categories. Based on this research, massively multiplayer online (MMO) games allowing multiple players to interact over the internet enable free navigation to a much greater degree than standard games. The mentioned effect is particularly true about the MMO subgenre of role-playing games (RPGs) such as WoW, with its enormous virtual landscape of various natural and artificial elements. The game often features large, freely navigable environments with a specific location, item, etc. To an immersive gameplay experience, successful wayfinding is an essential component of the cognitive mapping process (Elvins, 1997) that is fundamental to build a mental model (Wirth et al., 2007, pp. 493-525) of the game world.

3. Methodology

This paper chooses WoW as a test-bed due to the above-average rating specified in the use of navigation skills (Verdine, 2011) and its simultaneous interaction, collaboration, and competition in simulated 3D realities. WoW, which was released in 2004, has more than 6 million players worldwide and is at the top of the U.S. charts. WoW closely simulates a personal experience of the environment. Its objects and spatial features are complementary to landscape and architecture and concerned with emphasizing a symbolic or experiential aspect (McGregor, 2006, December). Hence, understanding the use of wayfinding aids becomes an essential factor in gameplay. In this context, in the World of Warcraft Classic and World of Warcraft Shadowlands games, the character distributions based on race and the Avatar History dataset (Lee et al., 2011, February, pp. 123-128) were analyzed to select proper virtual landscapes for two races (Alliance and Horde). Along with that, familiar architecture from the real world and the perceptibility of spatial use create a harmony in selected virtual landscapes to which the player perceives their abilities and can perform the various activities. Its vast landscape and architecture immerse and saturate the player while striking the delicate balance between feeling the world small and allowing players to navigate through nodes.

3.1 Procedure and Participants

Participants were recruited via undergraduate and postgraduate university mailing lists and public social networks in the university groups. In total, ten participants signed up for the interview. All were recruited based on their questionnaire responses and had played WoW in the month before the experiment. In addition, the situation of reaching the level that contains the selected landscapes was also taken into account to examine the familiarity. In the first phase, because of the lack of available standard tools to evaluate WoW players' expertise, this research built an off-game Google Form questionnaire to collect basic information about gaming interests and gaming habits. In total, the questionnaire included 17 questions asking various details regarding familiarity with the digital game context and WoW particularly (Table 1 and 2). It was necessary to capture the complex multitasking capabilities that WoW requires. Because its 3D massive virtual landscape involves completing stages with varied and increasingly difficult challenges and quests as players navigate and evolve (Marzouki et al., 2017). The possible answers were given on a Likert scale: 1 lowest, 5 highest, open-ended and multiple choice.

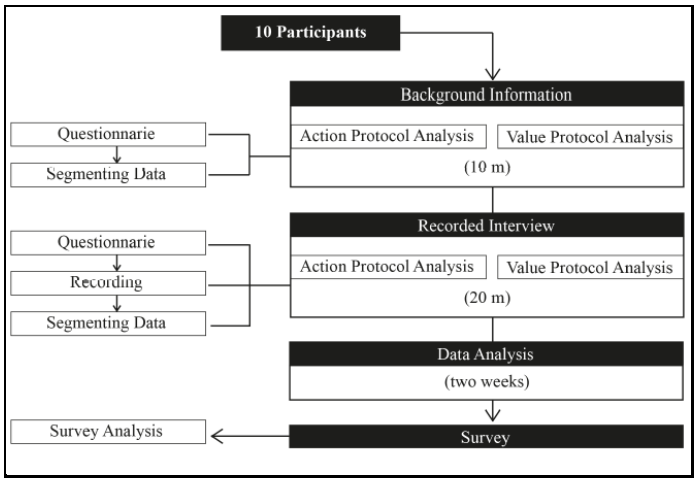

Figure 1: Designed experiment.

In the second phase of the study, the paper analyzes the social and spatial features data (Ducheneaut et al., 2006, April, pp. 407-416; Chen & Duh, 2007, June, pp. 21-24) that participants used while navigating virtual landscapes and the elements that allowed for immersive cognitive experience (Cairns et al., 2014, pp. 337-361). An audio-recorded interview was conducted and transcribed to reach practical and understandable data, consisting of 21 questions and lasting 20 minutes on average (Figure 1). The designed experiment covered four main areas: real-world navigation skills, virtual environment content information, virtual environment navigation skills, and virtual environment map usage skills.

3.2 Test Game Environments

In the first part of the interview, the questionnaires include open-ended questions to evaluate participants' navigation experience in real life. These questions serve to assess the three key aspects of spatial navigation abilities: distance estimation (Wilson et. al., 2003, pp. 297-305; Jeffery, 2007, pp. 684-691), spatial orientation (Iaria et. al., 2009, pp. 30-40; Hegarty et. al., 2002, pp. 425-447), and spatial memory (Montello, 1999, pp. 515-534). In the second stage, different data collection methods exist to examine player behaviors and movements in the literature. These can be analyzed by various mining algorithms such as regression models, in-game distribution of characters, and different

websites where players participate. Considering the character distributions based on race and the Avatar History DataSet (Lee et al., 2011, February, pp. 123-128), two diverse virtual landscapes were selected for the Alliance and Horde races present in the game. The game world consists of the opposing races Alliance and Horde. However, due to the different abilities and capabilities of races, it is impossible to navigate freely in the territory of the opposite race or perform tasks. The study took the spatial elements that allow different route creations into account in these spaces. This gives an understanding of the elements that are involved in the spatial cognition process. Hence, applied strategies, decisions making, and cognitive mapping processes are evaluated in virtual landscapes. Stormwind City has been chosen for Alliance players, located north of Elwynn Forest on the Azeroth region's northwest coast, is the capital city of the kingdom of Stormwind and the largest human city in Azeroth. Participants were asked to describe in detail their route from the Old Town to the Harbor District. Old Town is a location right next to the entrance of Stormwind City. Players have the opportunity to experience the entire map on their way to the Harbor District. Tirisfal Glades is chosen for Horde players. It uses real-world-like urban elements with its squares, tall and distinctive buildings, and paths that allow passage between them. Tirisfal Glades is located in northern Lordaeron in Eastern Kingdoms. Participants were asked to describe in detail their route from Agamand Mills to Undercity. Agamand Mills is the starting point for players in this zone. By reaching the Undercity, an area of vast architectural density in which several critical related events take place, players both take advantage of the natural elements in the environment and follow instructions from NPCs.

4. Results

Investigating the players' responses to the questionnaire, it was assessed that all of the participants stated that they had average and above-average familiarity with the digital game. In addition, the average weekly gameplay hours and game types they usually played were considered to evaluate gaming habits (Table 1). Hence, the study assessed the participants' maximum level, character race, favorite, and most visited places to understand their familiarity with the game content (Table 2).

Table 1: Participant's basic information and the digital game content information

ID	Real-World route (m)	Familiarity with the digital game concepts (Likert scale 1-5)	Average weekly gameplay (h)	Game types usually played
P_01	45	3	4	RPG
P_02	85	3	4	RPG
P_03	90	4	1	NONE
P_04	25	4	12	MMO
P_05	45	4	2	RPG
P_06	10	5	20	Indie
P_07	40	5	20	RPG
P_08	45	4	4	MMORPG
P_09	25	4	2	Sports, Strategy
P_10	30	3	6	RPG

RPG: Role Playing Game

MMO: Massively Multiplayer Online

MMORPG: Massively Multiplayer Online Role-Playing

Table 2: Participant's recognition of WoW

ID	Level	Game hours	Character race	Favorite place ingame	Most visited ingame
P_01	52	5	Blood elf	Bastion	Azeroth/Great Seal
P_02	10	4	Horde	Darkmaul	Darkmaul
P_03	20	5	Gnome	Stormwind	Stormwind
P_04	40	5	Night elf	Ironforge	Stormwind
P_05	41	5	Blood elf	Feralas	Orgrimmar
P_06	53	5	Orc	Bastion	Bastion
P_07	70	5	Blood elf	Undercity	Undercity
P_08	50	3	Worgen	Stormsong valley	Stormsong valley
P_09	45	4	Human	Orgrimmar	Orgrimmar
P_10	30	3	Elf	Azeroth	Azeroth

Despite the different starting points that the players selected, they followed a similar pedestrian path. Hence, starting from this point, the common route and the three most representative landmarks identified on the route to reach the campus are presented (Figure 2).

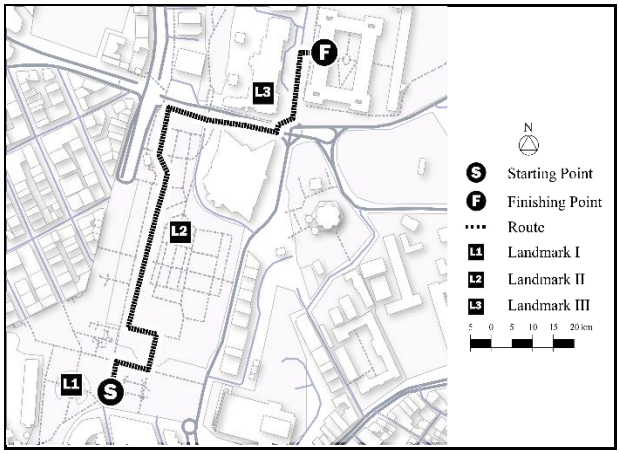

Figure 2: The most representative route and the three representative landmarks in the real world.

Participants stated that they identified Landmark I after getting off at the Starting Point. Afterward, they passed through Landmark II, recognized Landmark III right across the campus, and reached the Finishing Point. The results indicate that the participants created a specific cognitive map and a route using landmarks in the environment. Due to the outcomes, participants find their way through a target-oriented manner, using meaningful paths and places. In addition, all ten participants demonstrated clear distance and direction during this spatial process, were not easily disoriented in an unfamiliar environment, and had a solid spatial memory of places.

As mentioned above, different social and spatial features are influential in the cognitive mapping process in virtual landscapes. Therefore, in this analysis, the features that were effective in the route knowledge process of the participants were evaluated. The three most usual routes were selected on the map by Alliance players (Figure 3 (a), (b), (c)), and by Horde players (Figure 4 (a), (b), (c)). Figures 6 and 7 provide an overview of the use of landmark knowledge.

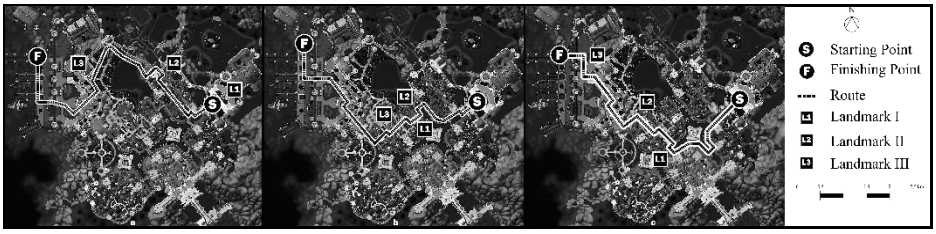

Figure 3: Common routes used by the Alliance players.

In Figure 3 (a), participants stated that they used crossing and inter-regional features, large and striking structures, flamboyant and interesting natural elements near the harbor. In Figure 3 (b), participants stated that they used certain elements as landmarks for their importance in the game or their interesting designs to investigate their similarity with the real world. In Figure 3 (c), the participants created a route using the square in the middle of the map. After the participants reached this area, they spent time here to examine the structures they were curious about and used landmarks as wayfinding features.

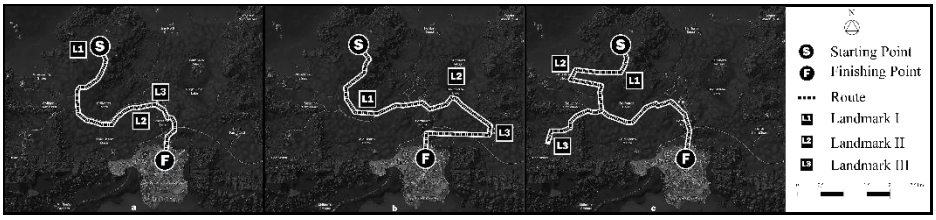

Figure 4: Common routes used by the Horde players.

In Figure 4 (a), participants chose the shortest, target-oriented route and used environmental features. In Figure 4 (b), the participants did not select the fixed paths and proceeded by exploring the environment. In Figure 4 (c), participants tried to find directions without being tied to a specific road or code, but they used certain environmental elements for guiding purposes.

Figure 5 shows a comparative view of Figures 2, 3, and 4. The results suggest that more landmarks are identified in the real world than in a virtual landscape. Hence, different navigation mechanisms used by the participants are presented as a result of the analysis, considering various factors such as time and user-system-experience affecting their cognitive process.

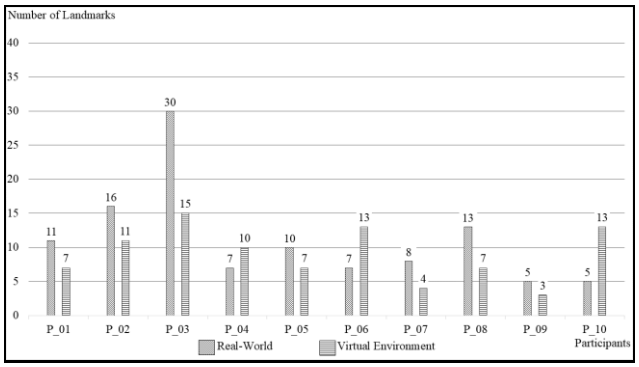

Figure 5: The number of landmarks identified in the real world and a virtual environment.

Immersive experience increases as in-game involvement and use of different skills factors (Csikszentmihalyi, 2014, pp. 135-153). Hence, the participants answered the main activities they performed in-game to examine gameplay involvement and evaluate their skills (Figure 6). It has been observed that mostly the quests and various exploration activities are performed in the environment. In addition, these activities require certain navigation features and help the players to prepare a mental presentation of the environment.

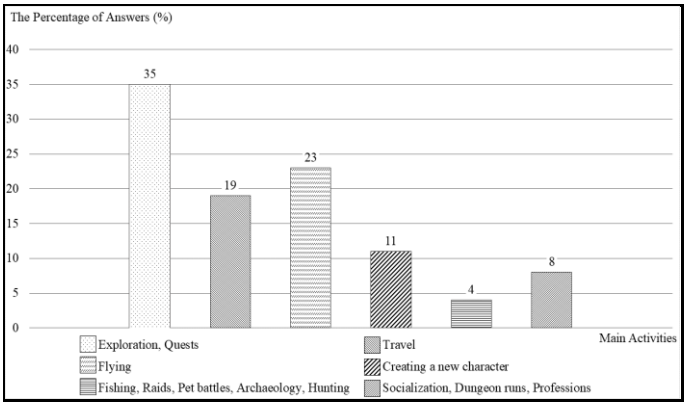

Figure 6: Main activities in WoW.

Figure 7 shows the different items they use to reach the targeted place shown in Figures 3 and 4. According to the analysis results, the participants benefited the most from the minimap and environmental features in this process.

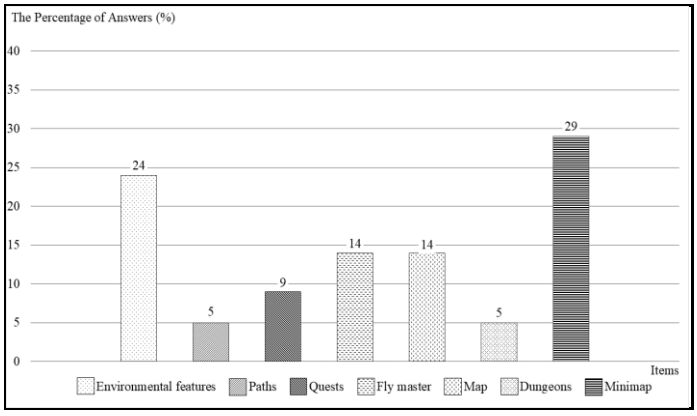

Figure 7: The items used to reach the targeted place in a virtual environment.

Based on Figure 7, the capability of the participants to find the way to target the destination without using a minimap or map has become an essential factor.

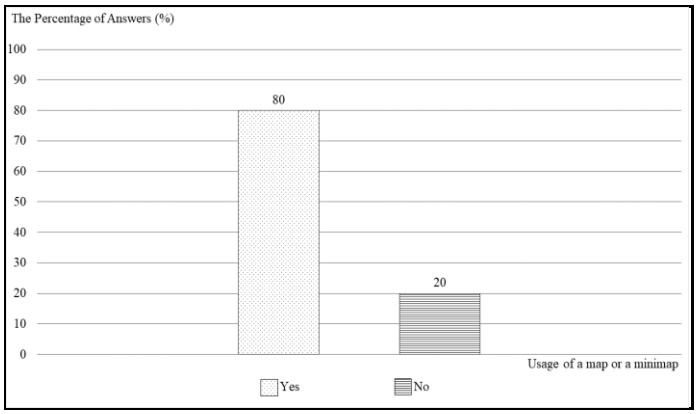

Figure 8: Players' preference of a map or a minimap in the game.

In figure 8, while 80% of participants stated that they could find the way without a minimap or a map, 20% of them claimed they needed it due to the content of the question.

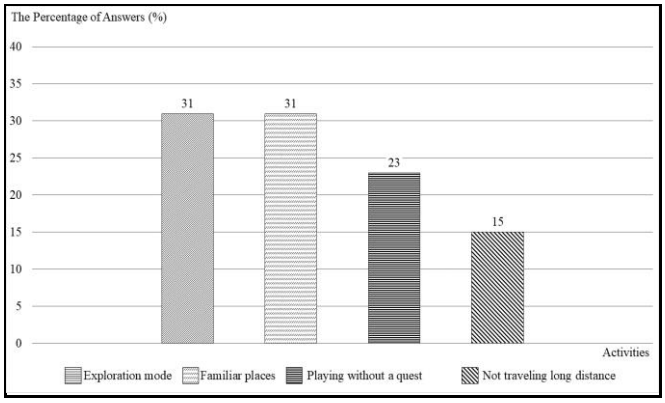

Figure 9: Activities not using a map or a minimap in the game.

These results necessitated analysis to understand in which situations they did not monitor a minimap or a map. The results are given in Figure 9; the participants stated that they did not monitor while playing in exploration mode and in familiar environments the most.

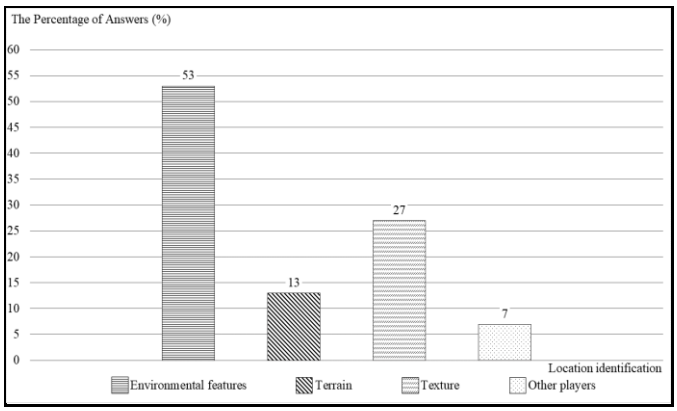

Figure 10: Information using between players without a map or a minimap.

In addition, the paper analyzed the used location determination features based on the results in Figure 6 (Figure 10). The outcomes demonstrate the environmental elements as the most used ones by the participants. Considering Figures 3,4,5, 7, and 10, the outputs indicate the undeniable prominent role of environmental elements.

5. Discussion

While this research analyses the spatial features that create a sense of immersion in virtual landscapes, it considers that examining the real-world route information process will be helpful in the analysis. Thus, it offers a comparative view of landmark information. The results showed that the participants considered various factors in the spatial orientation process. Participants find their way target-oriented, using the given paths and using places that are meaningful for them. Therefore, Figure 2 demonstrates that the participants followed a standard route after a certain point and identified familiar landmarks on the way to the target.

This research proposes a framework based on survey analysis of the most influential factors analyzed in the player's cognitive mapping, decision making, and decision-making process (Darken & Sibert, 1996, April, pp. 142-149; Thorndyke & Goldin, 1981) in selected virtual landscapes. The player's experience, abilities, strategies applied during spatial exploration, motivation, and environmental features formed sub-themes.

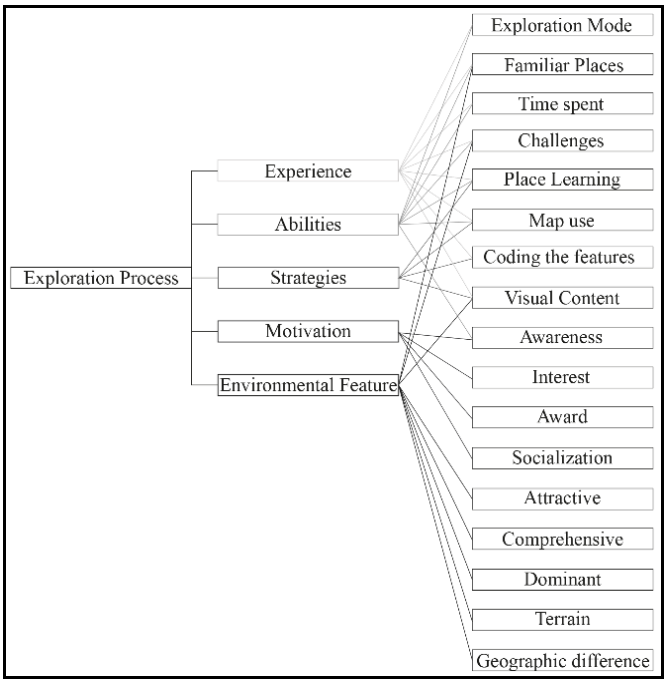

Figure11: Decoding map for spatial exploration in a virtual environment.

Experience; most gain is when playing in the exploration mode, and the players are more experienced in familiar places. Hence, spent time, the challenges of the game, the excess of visual content, use of map, and making a certain coding between the elements affect the gameplay experience. Abilities; Players can use the most when playing in exploration mode and decision-making in familiar places. Therefore, spending time, the game's challenges, learning the visited areas, using the map, and awareness of their situation affects their abilities. Different strategies are applied during spatial exploration to create a route. The game's challenges, the excess of visual content, learning the places

visited, using the map, and making a specific coding between the elements affect strategies. Motivation; participants have different motivations to play and present in the game. Participants' awareness, interest, the desire to receive awards, and socialization affect motivation. Environmental features; participants used different environmental elements to navigate and locate. The use of familiar places, game challenges, visual content, the interesting, comprehensive, dominant, specific terrain of the elements, and geographical differences affect the use of environmental features. Here, it can be seen that some factors overlap when wayfinding and locating in a virtual environment.

6. Conclusion

Virtual environments cannot provide the type and number of real-world navigation aids to help users unless designers plan and provide them. Hence, environmental elements, navigation tools, and exploratory impulses have a guiding role. Accordingly, to function successfully and efficiently in virtual environments, designers must ensure adequate navigation mechanisms. This conception enlarges the opportunity of virtual landscape design approaches that project the real-world environment. Experience, abilities, strategies, motivation, and environmental features are divided into sub-layers in the virtual landscape and contribute to the spatial exploration and cognitive mapping process. Players benefit from the similarities brought by the real world while navigating the virtual landscapes. However, a significant difference in reaching the target place in the real world and a virtual environment is time. In the real world, time was evaluated to reach the target point and the time spent on the route accordingly. In WoW, time was considered as players' time spent in the gameplay more than their plan. Thus, the results indicate that participants spent enough time to allow the mental presentation process with the above-average score (Table 1 and 2). With the survey carried out depending on the found variables and literature review, navigation in the virtual environment was examined from various aspects. In this context, the recorded observation is that the navigation tools' exploration plays an essential role in designing inclusive and immersive games. In addition, the virtual landscapes developed by the feeding of design disciplines such as urban planners, landscape architects, and architects offer a fundamental approach to the gameplay experience. How effectively virtual landscapes are designed and used will depend on how well researchers understand the transfer of real-world skills to these constructed worlds.

This research collected and analyzed the questionnaires, interviews, and in-game data to assess the immersive experience. However, the gameplay evaluation process of the participants is a limitation for future researchers wishing to repeat this research in different virtual landscapes. It requires players to meticulously observe and read their behavior and expressions in the context of an immersive experience through the data set. Thus, analyzing the in-game and out-of-game movements of the players by video recording can provide more precise results. The research indicates that it is challenging to encode data measurably due to the complexity and variability of behaviors and responses. The research needs future work to explore better methods of collecting and encoding such data.

The future work of this paper will address the development of this research from several angles. Firstly, further work will be done to produce quantitative evidence of the effects of player behaviors on navigation by correlating them with gamer personalities. Secondly, based on Bartle's study (1996), the navigation processes of four different player types will be evaluated by video recording players' movements in the virtual environment prototype designed with Unreal Engine 4.

Despite the limitations of the research, it still delivers value to the academic field by presenting the importance of working compactly with different disciplines by applying design methodologies and approaches approved in the real world to the virtual landscape design. The findings support current navigation models while allowing new research opportunities to the gaming industry with an analytical framework that can guide future research. Furthermore, for the industrial level, game designers can design wayfinding aids that enhance the immersive experience and gameplay by focusing on the player-environment interaction relationship in a virtual environment.

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