

Exploring Bio-Actors of the Cities through Serious Games

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Abstract. This study focuses on the importance of biodiversity in protecting the urban ecosystem in urban planning. Considering cities as an ecosystem, city actors should communicate collaboratively within this ecosystem. Urban actors include not only humans but also other bio-based creatures. For the communication in the city through design, collecting information about bio-actors with their habitats, serious games can play an important role. Since serious games are useful for educating players, city inhabitants can be informed through these games. It was chosen as a method that provides a space to players for learning by entertaining. Therefore, the game 'My City Mate: Exploring Bio-actors of the City', developed on the Twine platform, offers players the opportunity to get to know the bio-actors of a fictional city environment with the visual, audio and text-based information it provides. Lastly, this research analyzes players' learning and interaction levels with this game through surveys.

Keywords: Biodiversity, Serious Games, Gamification, Bio-Actors, Urban Design

1 Introduction

Diversity of life (also called biological diversity or biodiversity) is the variety of living systems (Minelli&Bonato, 2020). The units of biodiversity can be anything from genes to ecosystems, but species tend to be the most common unit of measurement (Minelli, 2005). Tying biodiversity, or associated biodiversity metrics or proxies, irrefutably to ecosystem functioning in its various guises is an ongoing and highly valuable area of research (Anderson, 2020). All biodiversity is impacted by the urbanization process and ensuing urban form (Anderson, 2020). One of the most important topics that should be considered when discussing sustainable cities is the preservation of urban biodiversity and ecosystems. Cities cannot be only perfect systems that are designed by

designers and urban planners that need to be aesthetic or functional. Different parameters need to be calculated and organized together. This can be created in an efficient communication environment. Not only the communication of different disciplines in the planning and design process, but also the communication with the non-human living actors of the city are crucial. Urban open spaces are normally designed by landscape architects with a primary focus on plants, aesthetic design and functionality for human users (Weisser & Hauck, 2017). Addition to this, designers need to recognize other living species in the environments they design and have attitudes that consider their needs. If the inhabitants of the ecosystem dramatically decrease or increase, this can affect the diversity and sustainability of the system. Building sustainable futures requires the ability to deal with the complex dynamics that characterize the world in which we live (Fabricatore, 2011). Human beings, as part of this system, need to continually evaluate and collaboratively adapt to the environment. In this case, the Animal Aided Design research (Weisser & Hauck, 2017) proposal can be an example of a sustainable design method that basically focuses on biodiversity of a city. Cities are the most important places to increase biodiversity. The uncontrolled growth of the human population has changed biodiversity and the balance within the ecosystem. However, the human race needs other living things in the city in order to survive. With the development of the digital world, it can be thought that people are physically moving away from nature. However, it is possible to reverse and benefit from this situation. They can get closer again using digital tools. In addition to landscape design, architectural design or urban planning, game design can also be used to develop the sustainability approach and reach a large group of people. Games (and gaming approaches to other activities) are increasingly being used for serious or social purposes in a wide range of fields, including biodiversity conservation (Sandbrook et. al., 2014). However, not every type of game is suitable for an idea with such an informative mission. In this context, the concept of 'serious games' was thought to be a guide.

Serious games can be defined as those games that are designed with a purpose that goes beyond pure entertainment. These games are intended to convey ideas and values, facilitate learning, and practice skills. They have the purpose of influencing thoughts and actions in real-life contexts, therefore exceeding the scope of the game itself (Quariachi, Olvera-Lobo, Gutiérrez-Pérez, 2019). There are studies at the intersection between biodiversity conservation and digital games, however there is no study about the actors' communication in urban design in relation with the biodiversity concept. In this study it is aimed to use a serious game concept as a tool in order to raise awareness about increasing biodiversity in cities. "My Citymate: Discovering Bio-actors of City" is a game design experience developed on the Twine platform (Twine, 2024). The game aims to discover the non-human bio-actors whom we should share the city collaboratively. Survey was conducted with 30 people to measure the contribution and impact of this serious game on user

experience as city inhabitants. The data obtained as a result of the survey shows that people living in the big cities are not in contact with other bio-actors. It has been understood that serious games as in this case have the potential to create an informative and enjoyable learning environment about the preservation of biodiversity in city's ecosystems.

2 Literature Review

Modern technologies have a significant impact on every industry, including gaming and education; it is crucial to see how science education has improved under its shadow and how it relates to gaming (Ullah et al., 2022). Many games offer a particular view of nature, ranging from the dystopian urban landscapes of *Fallout 3*, to the perfect imaginary meadows of *Flower* (Sandbrook et. al., 2014). There have always been efforts to draw attention to the issue of future city scenarios with different approaches in games. For instance, '*Fallout 3*' is an action role-playing game. This game is the third part of the series giving tasks to players on conducting field research for the *Wasteland Survival Guide* in which role they are rewarded for avoiding violent encounters with animals (Wallin, 2022). The game '*Civilization*' can be another example regarding the drawing attention to the unconscious collection of resources. Consumption of resources in the game can lead to deforestation and desertification (Golebiewski 2013). Although it does not directly address the issue of protecting biodiversity, it is an example game to raise awareness on this issue. Digital games can be used to raise awareness of a problem, improve understanding and change attitudes (Sandbrook et al., 2015).

Regarding biodiversity, there are different games that intend to create attention to the issue of conservation. Within the context of biodiversity, there are some digital game examples that aim to inform players such as *WhyReef* or *Congo Jones and the Loggers of Doom*. The *Why Reef* game creates a virtual world of coral reefs which aims to increase coral reef attention and appreciation (Jolin, 2014). *Zoo Tycoon* (2001), provides a chance for players to manage a zoo with creatures of different species. In *My Conservation Park* case, gamers build their own park and can help to save endangered species around the world. In the case of *Team Wild*, a 2D platform game in which the gamer plays a scientist trying to save species and habitats (Sandbrook et. al., 2014). In *Simpark* (1996), it targets more children players with the attempts to show the importance of ecological balance. Moreover, there are many examples of games developed to date based on urban planning and construction. *SimCity*, *Civilization VI*, *Caesar III* are some examples of games based on building cities and civilizations. For cities, the design of 'green infrastructures' or 'nature-based solutions' has been proposed to maintain the provisioning of these services and the preservation of biodiversity (Weisser & Hauck, 2017). Besides

urban design, games such as those highlighted above can be developed to draw attention to urban planning and to protect the urban ecosystem and increase biodiversity. Over the years, research studies on the impact of games on educational purposes have grown (Ullah et al., 2022). In this research, the 'My City Mate: Exploring Bio-actors of the City' game, which has not only entertainment-based but also educational purposes, offers an alternative for games that can be developed at this intersection.

3 Methodology

To preserve urban ecosystems and communicate with urban actors, the concept of a serious game has been selected as a tool in this study. Initially, a literature review was conducted on game examples related to biodiversity and urban design. Later, a game was developed specifically for this study using the Twine platform, featuring a fictional city called 'Pierock' along with its bio-actors, their diets, and habitats. The goal was to facilitate communication between city actors through gamification, integrate it into the urban design process, and raise awareness. The fictional city example developed in this study is intended to serve as a base for future studies. Each city can adapt its own database of bio-actors to this game. After the design of the game 'My City Mate: Exploring Bio-actors of the City' was completed, a game test and survey were conducted with 30 people. The informative and interactive impact of the game on users was analyzed through a questionnaire.

3.1 Data Management

This study involves the development of a game set in a fictional city named 'Pierock.' This fictional city example is designed as a template applicable to existing cities. It can be integrated by creating data for species in existing cities or by collecting data from platforms like Map of Life (MOL, 2023). The game, titled 'My City Mate: Exploring Bio-actors of the City,' features the fictional city of Pierock, which is divided into three main regions: Region Flory, Region Seavy and Region Deseary (Figure 1). Each region is further divided into 9 sub-regions, making a total of 27 sub-regions in the game. Each sub-region hosts a unique species. The images within the game are designed according to the themes of these regions. The game scenario includes 3 part for each bio-actor. These are general information about the sub-regions where the bio-actors live, along with content regarding their diet and habitat. For these stages, AI-based visualization tools were preferred to achieve visual consistency and rapid production. All visuals used in the game were produced using an AI interface called Imagine Art (Vyro AI, 2024). While generating the game visuals using an AI tool (Imagine Art), the prompts were iteratively refined until the most suitable visual was achieved (Figure 2). When players start the game, they see

team members tasked with constructing a structure in the city. Before building the structure, two team members responsible for analyzing the city context start exploring the city with their strategies. During the exploration, they meet bio-actors, which are the important factors in urban design. Each sub-region has a unique species with a three-phase data set. The first phase provides general information about the species, the second phase covers the basic needs for the species to grow and survive (such as sunlight, water, soil, or other living beings), and the final phase includes data about the species' habitat. The information, compiled from the literature, is presented as short texts in the game. In some parts of the game, sound data referring to the relevant species or habitat is also included. The game uses images, GIFs, audio, and text formats for its content. The game has fundamental rules. Players can move to adjacent cells from any cell they are in. They must complete the three-phase learning process (general info, nutrition and habitat) in each cell before moving to the next. Players should not revisit cells they have already visited, for which a scoring system is used. The more species the players encounter, the more points they earn. This way, players can finish the game with the highest score in the shortest time using their strategies. The game rules essentially reference strategies for collaborating with bio-actors during urban planning. This game can be customized with a database specific to different cities.

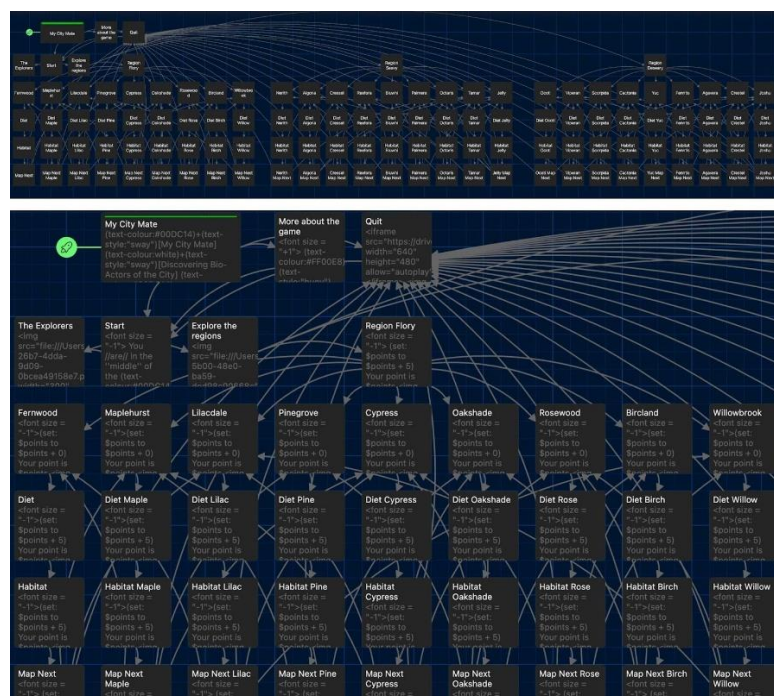


Figure 1. Game development in Twine 2.8.1. Platform. Source: Twine, 2024.



Figure 2. The game scenes visuals generated through Imagine Art. Source: Vyro AI, 2024.

3.2 Game Design

In this study, the focus is on the preservation and enhancement of biodiversity in cities in relation with the design of sustainable cities. The collective consciousness and the recognition of each other by city inhabitants, or in other words, communication of the bio-actors, are significant factors. Cities are not merely static entities that produce solutions aesthetically or functionally. Cities are dynamic structures that gain meaning with their inhabitants and are in constant change. Therefore, it is believed that there can be a benefit provided through design in the mutual recognition of non-human actors within this dynamic structure. Serious games are types of games that do not solely focus on entertainment but have an informative purpose at their core. In this study, the concept of serious games was intended to be used as a tool for recognizing bio-actors in the city. Firstly, urban design examples were examined under the headings of cities and the living beings sharing the city. Examples of serious games that might be suitable for these examples were reviewed. Following the literature review, the process of designing a game that can be adapted to all cities began. This study specifically did not choose a particular city but focused on a groundwork study that can be adapted to all cities. Each city can follow the steps applied in this study with its unique data and develop games that can help them learn about their bio-actors.

The game design was prepared using the platform named Twine. Twine is an open-source game development platform where simple coding tools can be used to add visuals, short videos in GIF format, and sounds. Essentially, the game starts in a city divided into three regions (Figure 3). Players sequentially learn about the habitats and diets of the living beings in these regions. As they gather information about these creatures, they also collect points. The points they collect at the end of the game depend on how much they have learned. The types of points vary based on parameters such as the name of the creatures, their habitats (Figure 4), diets, and their relationships with urban inhabitants (humans). At the end of the game, they reach the score based on the points they have gained. After this game design, a game test and survey was conducted with 30 participants. The participants' learning and gaming experience with the game was analyzed.



Figure 3. There are three different regions in the game as Region Flory, Region Seavy and Region Deseary. Plans of the regions with nine sub-region cells. Source: Vyro AI, 2024.

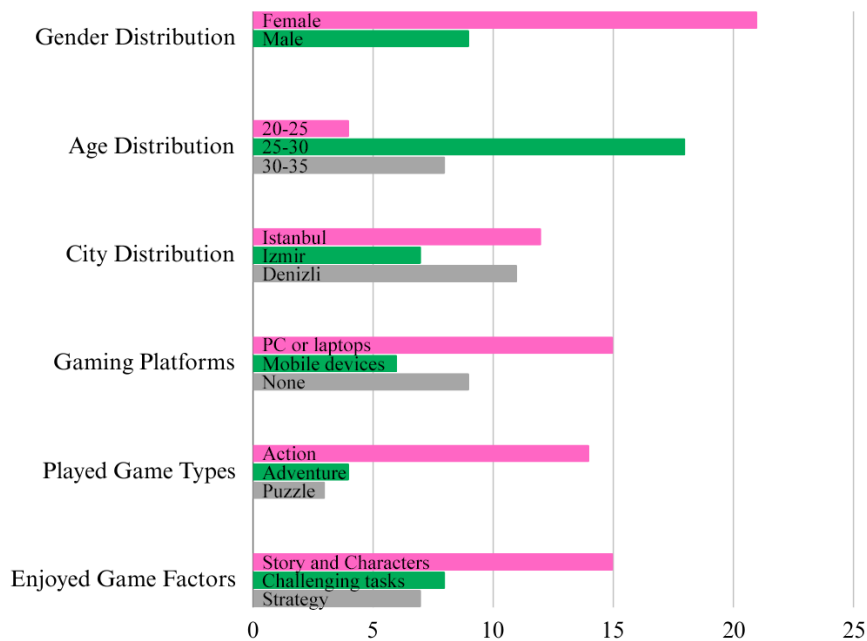


Figure 4. The example of Lilacdale Habitat with different types of bio-actors in Region Flory. Source: Vyro AI, 2024.

4 Survey and play test

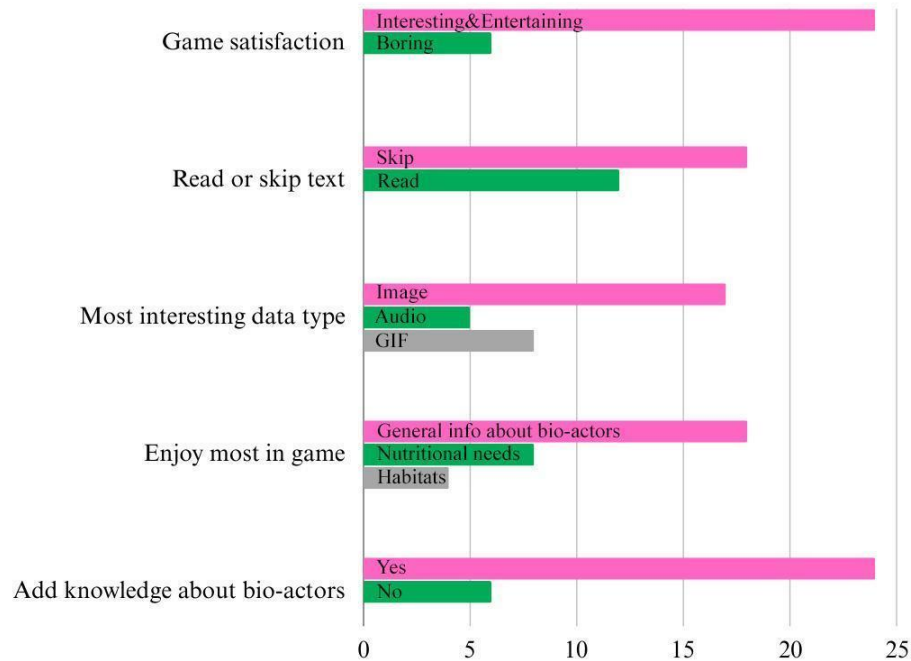
After the game design process was completed, the game was played by a group of 30 people, and surveys were conducted via Google Forms to understand the users' experience. Initially, participants were asked questions about their information, their previous gaming experiences, whether the city they lived in was a big city, and their experiences with other bio-actors living in that city before playing the game. Then, participants were asked to play the game. After the game, they were asked about their experiences, how long it took them to finish the game and what score they achieved, their interactions with the game, and their criticisms. The survey population was 30 in total, 21 females and 9 males. Their age range was divided into three groups: 20-25, 25-30, and 30-35, including 4, 18, and 8 target subjects, respectively. The population includes people living in different big cities in Turkey. The group was divided into three groups: Istanbul, Izmir, and Denizli, including 12, 7, and 11 target subjects, respectively. The reason behind this classification was to understand the impact of the game on people of different age groups and people living in big cities. In the pre-game survey, 15 out of 30 people stated that they played games on PCs and laptops, 6 played games on mobile devices, and 9 people stated that they did not play games regularly. Among the 21 people who played games regularly, 14 preferred action games, 4 preferred adventure games, and 3 preferred puzzle games. From the participants, 15 people stated the story and character designs, 8 people mentioned challenging tasks, and 7 people highlighted strategy development as factors that made the game enjoyable. The responses mainly emphasize the importance of the story and characters in a game and the usefulness of completing tasks on a certain challenge (Table 1).

Table 1. Background questionnaire graph before playing the game



In the second survey conducted after the game, 24 out of 30 people stated that the game was attention-grabbing and enjoyable due to its visuals, while others found the informational texts about the creatures boring. Additionally, 18 participants stated that they focused more on the visuals rather than reading the texts. Among the types of data presented in the game, 17 people found the visuals effective, 5 people preferred the audio elements, and 8 people found the animated images (GIFs) effective. Of the participants, 18 people chose the section providing general information about the creatures as the most interesting part, 8 people found the section with elixir visuals and learning about the nutritional needs of the creatures most interesting, and the remaining 4 chose the section where they learned about the habitats of the creatures. Finally, when asked how much they had learned about the creatures in the game, 24 people stated that they had gained extensive knowledge, while the others did not feel they had learned much. Based on this data, it was concluded that general information about the creatures and visuals were the most captivating elements of the game. Researchers inferred from these findings that to increase players' interest in reading, it would be beneficial to use shorter and more effective texts and to enhance the visual and audio elements to support biodiversity (Table 2).

Table 2. Game review questionnaire graph after playing the game



5 Results

This study has shown that if current urban planning is developed using a strategy similar to the game mechanics proposed in this research, it can raise awareness among urban actors about each other and the habitat of their city. Additionally, with an encounter and collaboration strategy suitable for this game mechanic in urban design, biodiversity in cities can be preserved and increased. This study can be an alternative for urban design process with the aspect of preservation ecological balance in sustainable cities.

6 Discussion

The contribution of this study to the literature is to draw attention to the issue of conservation biodiversity and urban ecosystem in cities through the learning-based game concept 'serious games', from a designer's perspective. This study provides a basis for urban actors (bio-actors) to get to know each other in a

general framework. For further studies, this base can be used to match a city-specific database. It can be integrated with the database of living things belonging to the selected city and used for each city. Lastly, this concept can be customized according to the appropriate city scales.

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