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THE STUDY OF IMMERSIVE EXPERIENCES IN CITY SIMULATION GAMES

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Abstract

This study investigates the immersive experiences in city simulation games, focusing on the game elements that impact player immersion. Utilizing a qualitative and quantitative method, the research analyzes popular city simulation games to identify key game elements and employs a questionnaire to assess their effect on immersion. Additionally, the study highlights the varying importance of these elements based on player preferences and gameplay styles. The findings aim to provide valuable advice for game developers to create immersive city simulation games. Results state that elements such as strategy, visuals & audio, ground-up and weather play key roles in enhancing immersion in city simulation games.

Keywords: Immersion, City Simulation Games, Game Elements, Player Experience

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1 Introduction

City simulation games engage players in city planning and management through interactive, immersive experiences. These games serve not only as entertainment but also as training tools, allowing players to explore city planning principles and strategies in a risk-free environment.

The motivation for this study comes from the increasing use of city simulation games in education and planning. Japanese government organising events for citizens to tour Cities: Skyline as a way of communicating their aspirations and visions for city planning shows city simulation games effectively convey city planning concepts and promote public participation in planning processes. However, the specific game elements contributing to player immersion in city simulation games are underexplored. This study addresses which game elements affect immersion in city simulation games. Understanding these elements enables developers to create more engaging games for educational and planning purposes. The research uses a mixed-method approach, starting with a qualitative analysis of popular city simulation games to identify common elements. This is followed by a quantitative study using a questionnaire to measure these elements' impact on player immersion. The research involved selecting fifteen popular city simulation games based on sales and player reviews. These games were analysed for their elements, which were then categorized and coded. A questionnaire was designed to evaluate how these elements influence player immersion, and data were collected from participants with varying levels of experience in city simulation games.

In conclusion, this study provides insights into the immersive qualities of city simulation games. The findings aim to benefit game developers and educators by informing the design of more immersive city simulation games.

2 Background

The background section firstly explores the background and theoretical foundations associated with serious games and their applications. Then it presents the definition of serious games and focuses on their practical and non-entertainment purposes. This is followed by a discussion of city planning and city simulation games, emphasising their use as tools for understanding and engaging with city development issues. The types and definitions of some of the game elements that make up games are also summarised later. Besides, the theoretical underpinnings of immersion in games are also discussed, with some key concepts such as flow theory, cognitive absorption and presence, as well as an analysis of how Jennett's Immersion Questionnaire applies these theories.

2.1 Serious Games

Serious games present a challenging concept to define. It was initially noticed and considered not to be developed for entertainment but with a clear and well-established educational purpose (Laamarti, Eid and El Saddik, 2014). Later on serious games were considered as innovative methods to solve some problems related to science education, career choices and even some planning in government and industry, so most people agree that serious games are digital games used for purposes other than pure entertainment (Susi, Johannesson and Backlund, 2007).

Serious games have two main characteristics. Firstly, they usually have a practical use for training or education and allow players to experience situations that are not usually realized in reality due to factors such as safety or cost (Susi, Johannesson and Backlund, 2007). Secondly, they are immersive and provide learners with a wide range of opportunities for practice and suitable training environments for participants to immerse themselves in (Poplin, 2012).

Based on the purpose served by serious games and the market in which the games are designed, serious game classification will generally use only one or two criteria (Laamarti, Eid and El Saddik, 2014).Laamarti, Eid and El Saddik (2014) propose a new classification criterion which incorporates Activity, Modality, Interaction Style, Environment and Application Area. The comprehensiveness of this categorization is due to its consideration of 5 aspects that are critical to the design, development and evaluation of serious games:

Activity: distinguishes the type of activity required by the player to enable the game to be targeted to achieve educational or therapeutic goals.

Modality: Designing games that enhance the learning experience by utilizing multiple sensory modalities.

Interaction: Include multiple modes of player interaction, such as motion tracking, to facilitate customization of games to suit different learning styles and abilities.

Environments: integrating virtual, physical and social environmental factors, with an emphasis on the impact of the environment on game design to enhance realism, immersion and social interaction.

Application Areas: categorizes games according to their application areas, demonstrating the potential of serious games in various fields.

Serious games are used in a wide range of fields (Susi, Johannesson and Backlund, 2007). In the medical field, serious games are training tools for the professional training of medical personnel, providing challenging simulation environments that match future surgical training (Graafland, Schraagen, and Schijven, 2012). In programming instruction, serious games provide programming learners with game content that includes adaptive gameplay to help learners of different abilities and knowledge levels master programming skills (Miljanovic and Bradbury, 2018)

In addition to the above aspects, the field of city planning has also seen the involvement of serious games. A study by (Poplin, 2012) explores the possibility of using online games to promote public participation in city planning. Taking the theoretical foundations of Public Participatory Geographic Information Systems (PP GIS) and serious games as a starting point, he developed a game called 'NextCampus', which uses entertainment games for serious gaming purposes. Students interact with the game environment and the physical model to understand the current situation and make decisions that affect stakeholder satisfaction and available budgets based on different action choices, and then learn about the possible consequences of different actions through the results of the game. The game aims to communicate to the public the current situation of the university campus site selection through an entertaining game and to show the impact of different decisions on the campus architects, students, local residents, government agencies and other stakeholders. City planning students and external experts evaluated the serious game and recognized the promotion of public participation in city planning by the serious game (Poplin, 2012).

2.2 City planning and city simulation games

City planning significantly impacts public life, and successful city planning processes worldwide have led to the effective execution of large-scale infrastructure projects within cities (Gibberd, 2017). In Western Europe, most major cities boast strategic long-term planning mechanisms alongside detailed land use and building regulations (Edgington, 2017). However, some cities still grapple with inadequate management systems, evident in poor building layouts and space allocation (Wiseli, Tanusetiawan and Purnomo, 2017).

Research by Wiseli, Tanusetiawan, and Purnomo (2017) demonstrates that simulating real-life conditions in games, such as sandbox simulation games, allows players to learn about city problems and their solutions without real-world consequences. This method enables players to gain knowledge related to city planning or revisit city management practices safely, particularly in environments with inherent risks (Wiseli, Tanusetiawan and Purnomo, 2017). For instance, the city simulation game SimCity 2013 serves as an effective educational tool, aiding students in comprehending the intricacies of city management and planning through interactive learning experiences (Vasuthanasub et al., 2019). By participating in activities such as city planning, land zoning, infrastructure construction, and resource management, SimCity 2013 allows players to experience a variety of decisions and challenges in real city management. Through hands-on learning and simulation experiences, students can learn to weigh the pros and cons, predict outcomes, and take responsibility for the development of their city.

Moreover, city simulation games foster systems and critical thinking skills among students, enhancing their understanding and application of city geography, politics, and planning knowledge (Bereitschaft, 2021). Using commercial city-building games (CBGs) like SimCity and Cities: Skylines as tools in the classroom, students design and build economically viable virtual cities in CGBs. By dealing with the layout of industries in a virtual city as well as the balance between economic, environmental, and demographic factors, and by acquiring and using knowledge about city geography, politics, and planning, students' understanding and application of geographical concepts as well as developing spatial reasoning and creativity are enhanced (Bereitschaft, 2021). Through the use of serious games in the classroom, students' skills in communication and problem solving can be enhanced while laying the foundation for their future careers in city planning (Vasuthanasub, et al., 2019).

It shows that the use of entertainment games for serious games demonstrates its value for application in the field of city planning, which is one of the important aspects for this thesis to investigate the game elements that influence the immersion of city simulation games.

A recent study by Raghothama, Baalsrud Hauge, and Meijer (2022) identified key factors influencing the effectiveness of city simulation games, including engagement, exploration, openness, complexity, and learning. Technology and modeling significantly impact these factors, thereby influencing game effectiveness. Games must strike a balance among these elements to aid players in understanding game mechanics, fostering expertise, stimulating imagination, and addressing design and planning challenges effectively (Raghothama, Baalsrud Hauge and Meijer, 2022). Furthermore, city simulation games' evolution towards deeply immersive experiences highlights their potential to impact individual and societal practices, underscoring the crucial role of technology and game design in gamification practices (Cavada and Rogers, 2019).

It can be concluded that city simulation games are not only entertaining in nature, but they also contain a lot of city planning knowledge that needs to be learnt, and certain city simulation games can be a very good type of serious game.

2.3 Theoretical foundations of immersion

The concept of immersion is a little bit ambiguous and can be interpreted in a number of ways (Jennett et al., 2008). When people find enjoyment in a game and are unaware of factors such as time and sound around them, it is an indication that they are fully absorbed in the game. The phenomenon that is often seen as a manifestation of immersion (Jennett et al., 2008). In this particular state, players may experience a sense of isolation from the real world due to changes in the level of attention (Agrawal et al., 2020).

Jennett et al. (2008) demonstrate that flow theory, cognitive absorption and presence are the three core concepts that describe the immersion experience. They will be explained next.

2.3.1 Flow Theory

When individuals fully concentrate on a challenge, they enter a state of ordered, fully engaged mental activity (Nakamura and Csikszentmihalyi, 2009). Similarly, (Tse, Nakamura and Csikszentmihalyi, 2022) describe the experience of flow theory as a mental state characterized by simultaneous absorption, concentration and enjoyment.

The two key conditions for entering the state of flow theory are: perceived challenges and opportunities that are no more difficult than existing skills, a clear immediate goal and timely feedback. It is often characterized by a combination of action and awareness, loss of reflective self-awareness, a sense of being in control of one's behavior, and a distorted experience of time (Nakamura and Csikszentmihalyi, 2009).

In fact, the state of flow theory is inherently beneficial, it leads to an increase in skill levels in dealing with a number of challenges (Nakamura and Csikszentmihalyi, 2009). Therefore some people have started to study the factors that have an effect on the state of flow theory. In game quizzes for learning genetics concepts, science outcome expectation beliefs have been found to have a direct impact on learners' experience of flow theory during the learning process. When students have positive expectations about the outcome of science learning, they are more likely to experience flow theory, which leads to deeper engagement and potentially better learning outcomes (Rachmatullah, et al., 2021).

2.3.2 Cognitive Absorption

Cognitive absorption, distinct from flow theory, refers to an individual's tendency or trait leading to complete attention, where the object of focus consumes their attentional resources (Leong, 2011). In contrast, researchers in another study (Webster and Hackley, 1997) described cognitive absorption as individuals' subjective experiences characterized by feelings of pleasure and engagement.

In early research (Webster and Hackley, 1997), cognitive absorption was then assessed as four dimensions: attention, concentration, curiosity, and intrinsic interest. Subsequently, cognitive absorption was slowly defined as five dimensions: temporal separation, focused immersion, pleasure enhancement, control, and curiosity (Agarwal and Karahanna, 2000). Balakrishnan and Dwivedi (2021) applied the same five assessment criteria and found that cognitive assimilation builds positive trust and has a positive impact on the user experience. Leong (2011) similarly referred to these five assessment dimensions in his study and applied them in a study of technology-mediated distance learning outcomes.

2.3.3 Presence

Presence in virtual environments refers to the subjective sensation of being in a location or environment, even when physically elsewhere (Witmer and Singer, 1998). Similarly, in human-computer interaction research (Riva et al., 2006), presence is described as the operator perceiving both a real physical environment and a virtual environment simultaneously, entering a state of presence. Notably, presence in virtual environments occurs when attention shifts from the physical to the virtual environment, without necessitating complete attention transfer, potentially resulting in an incomplete state (Witmer and Singer, 1998).

De Barcelona et al. (2009) argue that presence is a response to immersion, with varying levels of presence observed among individuals in the same immersion mode. Additionally, different immersion modes may elicit similar levels of presence in different individuals, highlighting the logical separation between the sense of presence and immersion (De Barcelona et al., 2009).

Witmer and Singer (1998) developed a questionnaire to measure presence in virtual environments, identifying factors such as control over events, environment responsiveness, and natural interactions as contributing to a heightened sense of presence. They posit that presence hinges on attention to the continuity and connectivity of stimulus flow, with virtual environment features and stimuli consistency directing attention without imposing it on the experiencer (Witmer and Singer, 1998).

2.3.4 Jennett's immersion questionnaire

Flow theory, cognitive absorption and presence were all used in Jennett et al.'s (2008) study in the development of an immersion questionnaire, an immersion questionnaire designed to quantitatively define and measure the immersion experience in games, they defined immersion as a multifaceted concept that includes the player's deep engagement with and absorption in the game, which leads to a loss of perception of the real world, a temporal perceptual distortion, and a high level of engagement with the game environment. The significance of an immersion questionnaire is that it can provide both subjective and objective measures of immersion, combining aspects of Flow Theory, Cognitive Absorption, and Presence in order to understand how players interact with and immerse themselves in video games.

Furthermore, the importance of the immersion questionnaire lies in its ability to dissect the components of the gaming experience that contribute to immersion. By identifying barriers to immersion and understanding the level of player engagement, game developers can create more engaging and immersive games. The main method of measuring immersion is through questionnaires. Specifically, Jennett et al. (2008) investigated how immersion affects the player's ability to switch from immersive to non-immersive tasks as well as the effect of externally imposed interaction rhythms on immersion. Jennett et al. (2008) emphasized that immersion can be experienced at varying levels, from engagement and full attention to total immersion, and is influenced by the game design, factors such as player preference and game environment. In the method section, the immersive questionnaire will provide a reference for the questionnaire design in the method part.

2.4 The game elements of the game

Game elements are the basic components that make up a game. Avedon(2013) delineates game elements from a syntactical viewpoint into ten categories: the purpose of the game, the sequence of actions, the rules governing those actions, the number of participants, the roles assumed by these participants, the outcomes or rewards, the abilities or skills necessary for the actions, the modes of interaction, the physical setup and the environmental requirements, required equipment (man-made or natural in game). The latter two of these elements may not exist in every game. Similarly, Prensky (2001) in his study on the architecture of game elements, classified the fundamental elements constituting a game into six categories: rules, goals and objectives, outcomes and feedback, conflict and challenge, interaction, and story. In a study investigating what constitutes a quality game, Bond and Beale (2009) divided the factors into positive and negative categories, with thirteen positive factors including: engaging gameplay, immersive environments, compelling storytelling, robust user

interaction, customization options, rich social interaction, diversity, solid technical execution, cohesion, ease of maintenance, value for money, legacy of the franchise, and a substantial quantity, with the absence of customization and ease of maintenance noted in the negatives. Wikipedia (2022) suggests that the term "gameplay" is somewhat vaguely defined, with a preference for specifying the aspects of a game's interactive elements. Consequently, in this study, "gameplay" refers to a concept more closely aligned with game mechanics within the game experience.

Plass et al., (2019) in their study observed that the use of visuals and colors can positively impact emotional arousal in games, while Byun and Loh (2015) demonstrated that players engaged with games featuring voice acting show higher engagement levels than those playing games without. Concerning serious games, rather than games in general, Rahimabad and Rezvani (2020) proposed a model with six factors, i.e., game elements that influence the immersion in serious games, and ranked them from high to low as follows: Game Design & Challenges (GDC), Game Credibility (GC), Attitude towards the Game, Perceived Enjoyment, Concentration & Immersion, and Awareness of the Game, indicating that design and challenges are paramount in affecting immersion in serious games, followed by the game's credibility and the player's attitude towards it.

It can be learned from the above content's explanation of the basic elements of the game that it is possible to analyze the elements of the game by defining different contents and that they have different levels of influence. In the methodology section, a set of game elements of a simulation game will be redefined based on the above categorization as a reference.

3 Problem

In 2019, the City Planning Department of Takahama City Hall in Aichi Prefecture, Japan, used Cities: Skylines to allow citizens to express their views on the future planning of their city and build the city of the future that they have in mind for the 50th anniversary of the city's construction. This shows that city simulation games are very realistic and have a certain reference value. At the same time, the idea of using city simulation games for city planning and learning to build cities has become commonplace, with Bereitschaft (2021) finding in a study that city simulation games have a positive impact on improving students' access to and application of city geography, politics and planning knowledge, and suggesting that city simulation games should be integrated into educational curricula. Furthermore, the Swedes used the game My World to create a charitable project called Block by Block, which helped young people in different regions to plan their hometowns while presenting their ideas to local politicians, architects and businessmen, resulting in a successful city-building project (Tianmei Miaowu, 2021).

For players of city simulation games, their needs for games are mainly highly realistic city building and management and immersive experiences (Schalbetter et al., 2023). Schalbetter et al. (2023) point out that the highly realistic city models and management tasks in the games enable players to gain insights into the functioning of the city system, including the interconnectivity of various infrastructure interconnections and impacts on residents' lives, giving players a sense of realism. And immersive experiences can enhance players' emotional engagement and connection, with every decision the player makes in the game and its outcome bringing a strong emotional response through feedback, reaping a sense of fulfilment. Therefore, immersive experience is a very important need for city simulation games.

In summary, city simulation game is a good type of serious game. At the same time, to create a good serious game, the experience of immersion is the focus of attention. Combined with the game elements section explored in the background section, the research questions derived are as follow:

What are the most important game elements of the city simulation game that affect immersion?

Subq1: What are the most important game elements in city simulation games?

Subq2: How do the identified game elements affect immersion?

This research hopes to provide some inspiration for city simulation games in the market while solving the problem, help game developers better understand how game elements affect immersion, and motivate future city simulation games to do better in terms of immersion.

4 Method

To answer the question posed above, the method will be conducted in two studies. Study1 attempts to answer sub-question 1 by analyzing the popular city simulation games on the market through a qualitative study and investigating what game elements are contained in them through coding. The conclusions about the game elements of city simulation games drawn from study1 will be used in study2. Study2 will design a questionnaire based on the results of study1 and distribute it to players of city simulation games to recover players' responses to question 2 by quantitatively investigating the impact of these game elements on the overall game immersion. At the same time, considering that the city simulation game will appear as a serious game, the questionnaire will also cover a small portion of questions related to serious games.

4.1 Game elements in city simulation games

In their study, Jansz and Martis (2007) demonstrated that experienced gamers typically invest around 20 hours in exploring a contemporary video game. This becomes particularly significant for city simulation games, where players devote considerable time to constructing and enhancing their cities and unlocking new achievements. Given this, researching the game elements of city simulation games by playing each one individually proves to be a time-consuming endeavor, posing challenges in recruiting willing participants.

So when analyzing multiple games within a category, the selection criteria becomes crucial. Sampling video games from the market offers a convenient research method, effectively narrowing down the pool of games for analysis, as noted by Jansz and Martis (2007). Historically, researchers have often selected games based on popularity, typically choosing those with high sales figures. Study1 adopts this method as well, drawing inspiration from both Jansz and Martis (2007) and Brand, Knight, and Majewski (2003). In their analysis, Brand, Knight, and Majewski (2003) utilized game videos and film sequences, among other sources, to examine 130 computer and video games, coding the gathered data for their research. Similarly, Jansz and Martis (2007) employed coding to analyze 12 video games, focusing on the representation of female power in video games. Study1 will also utilize video gameplay videos as a primary data collection source and utilize coding as a method of study1.

4.1.1 Game selection

The games sampled in this study were chosen from the top 15 best-selling city simulation games on Steam's sales charts, each bearing the "city construction" tag. Steam(2003) has a huge impact on the gaming industry. It not only has it changed the way games are sold and distributed, but it has also supported players to create and share self-produced content through features such as Workshop, which provides a platform for game developers to show and sell their games. Steam, as one of the world's leading digital distribution platforms, offers game charts that provide valuable insights, showcasing games that align with player interests and have succeeded in the marketplace. For the purposes of this study, source videos for these games were sourced from the Bilibili (2009) website, with each game being observed for over forty minutes. The reason for choosing Bilibili(2009) is that it is a community and video sharing website mainly for young people, and the game section is an important part of its cultural community. In the game section, users can share game

strategies, reviews, videos, and game-related discussion content. This board brings together a large number of game players and enthusiasts, and becomes an important place for them to share strategies, discuss games and watch game-related videos, playing an important role in the promotion and discussion of the game industry.

Below are the fifteen city simulation games selected for this study:

Table 1 Selected Games

Game Name	**Tag**
ANNO 1800	City Construction
Cities:Skylines	City Construction
Frostpunk	City Construction
Cities:Skylines II	City Construction
Against the Storm	City Construction
The Wild Ancient Tribes（translated）	City Construction
Planet Zoo	City Construction
Rail Route	City Construction
Farthest frontier	City Construction
New Circle	City Construction
Blossoms in the Courtyard	City Construction
Two Point Campus	City Construction
Let's School	City Construction
Pioneers of Pagonia	City Construction
Workers & Resources: Soviet Republic	City Construction

4.1.2 Coding

The variables of game elements in the coding study are primarily derived from the initial research question. These variables will, in part, reference definitions from earlier studies mentioned in the background section. Additionally, they will reflect specific characteristics of city simulation games and incorporate insights from discussions between the programmer and the researcher, thus becoming more refined.

The following game element variables are included in the codebook for this study:

Background：The background of the game gives players full and basic information about themselves regarding Who, When, What, Where, Why, and How.

Production progression：The process by which low-level products are transformed to higher-level products and continue to be utilized.

Realistic: The game setting and experience is close to real life and gives the player a sense of authenticity.

Visuals & Audio: The game's visual and audio fit well with its setting.

Strategy: Game requires a considerable amount of strategic thinking and planning.

Resource layout: Resource diversity and layout in the beginning influence player's construction layout.

Perspective: Perspective switching. Player can choose first-person or third-person perspectives.

Stage: The game has different stages where different variations and limitations are.

Demand: Non-playable characters in the game will have some non-compulsory needs.

Objectives: Have a clear objective to achieve.

Module: Player can choose a number of styles of each building module to build, such as different styles of fences.

Ground-up: This game was built completely from scratch. The game system does not provide any initial buildings.

Animation: This game has transition animation which maybe tell a story or introduce something.

Weather: Weather systems are available. The weather system may affect constructions positively or negatively.

Indirect construction: Player needs to allocate suitable number and type of workers to build constructions instead of finishing building directly.

Customization: Players can choose their own game character image.

Specialized: The game involves a lot of expertise. Players would play better if they learn about knowledge in some specific fields.

The coding process was jointly conducted by a programmer highly experienced in city simulation games and myself. The process was that she and I sat together in front of the computer, and the computer played the gameplay videos of each selected game one by one. The total viewing time of each game was more than 40 minutes. In the process of watching the whole video, we summarized what game elements were in the city simulation game based on all the game-related contents presented in the video, and how to describe and define these game elements with concise words. We will refer to the definitions of the game elements in the background section. For example, if game elements of weather systems and perspective shifts appeared in a gameplay video, the programmer would note and discuss with me at the end of the viewing: Did these two elements appear? How should they be defined and interpreted? How many games did they appear in? In this way, game elements in 15 games were studied and coded. Once we have consolidated the definitions from each city simulation game, the next step is to count how often these game elements appear in these games. The results of the coding will record the frequency with which each game element variable appears in each of the 15 games, with occurrences in one game being recorded as frequency plus one, and repeated occurrences not being counted additionally.

Due to these definitions and interpretations were discussed and modified several times during the process and the whole process was dynamic, so there is no clear line of demarcation between versions, and the above definitions and interpretations of game element variables are the final versions. These findings will directly inform the development of the questionnaire for the subsequent study. Therefore, the coding results will be detailed in the Methods section, while other analyses will be discussed as usual in the Results and Analysis section.

Below is a table summarizing the coding study results:

Table 2 Overview of Study 1 Result

Game Elements Variables	Frequency
Background	9
Production progression	4
Realistic	9
Visuals & Audio	11
Strategy	12
Resource layout	10
Perspective	4
Stage	12
Demand	6
Objectives	11
Module	5
Ground-up	11
Animation	4
Weather	12
Indirect construction	6
Customization	2
Specialized	5

4.2 Study of immersion in city simulation games

4.2.1 Design of questionnaires

To examine how identified game elements impact immersion, this study adopts a questionnaire-based research method, guided by the design principles and recommendations of Jennett et al. (2008). Jennett and colleagues developed two immersion-related questionnaires for their study, utilizing a Likert scale for evaluation. Likert scales, often employed in social science research, typically feature a four to seven-point structure, with Wu and Leung (2017) noting their frequent use. Leung (2011) analyzed the efficacy of 4, 5, 6, and 11-point Likert scales, finding that increased scale points might

reduce error, though their effect on predictive validity remained inconclusive. Hall, Hume, and Tazzyman (2016) also applied a Likert scale to assess children's well-being on five levels, concluding that a five-point scale is preferable for large-scale summative assessments in serious play contexts. Accordingly, this study's questionnaire will utilize a 5-point Likert scale for scoring, applying the game element variables identified in the preliminary study following a detailed interpretation.

To avoid overly empty study objects, Cities: Skylines was chosen from the 15 games analyzed in the initial study to explore how game elements influence game immersion. Below is a description of the game and why it was chosen:

Cities: Skylines, selected for this study, is a city simulation game on Steam, boasting a rating of over 92% based on more than 250,000 ratings, according to third-party website SteamDB (n.d.). Players assume the role of mayor, overseeing all aspects of a fictional city's development, including road layout, traffic management, and utility services. With its strong reputation and nine years of success, Cities: Skylines is widely recognized for its immersive gameplay, making it an ideal criteria to examine the impact of game elements on immersion.

Here's a selection of reviews taken from Steam (2003) that indicate Cities: Skylines is immersive, and there are many more like this one:

As soon as I turn it on, I don't want anything.

Cut the crap and watch my hours.

Gouxi(2024)

I once played it for 12 hour straight and it felt like 30 minutes.

jNewton182(2022)

The questionnaire was divided into two chapters; the reason for dividing it into two chapters instead of two questionnaires was to ensure that participating players would fill out both questionnaires and to increase the completion rate of the questionnaire. Chapter 1 primarily created questions based on the effects of the 17 game element variables from the first study on immersion in Cities: Skylines, while chapter 2 was designed to assess immersion in the game Cities: Skylines and establish a standard for subsequent analyses.

In the original version of the questionnaire, the 5-point scale used in the chapter 1 was 1: Not at all 2: Less 3: Fairly 4: More 5: Very much, and the 5-point scale used in the chapter 2 was 1: Very negative 2: Negative 3: No impact 4: Positive 5: Very positive. However, the description of the criteria did not match the questions posed very well, and it did not fit the general response criteria of the Likert scale, so I modified it for the second version. The modifications were as follows: the criteria for the 5 points used in chapter 1 were modified to read 1. very unaware 2. unaware 3. neither aware or unaware 4. ware 5. very aware. whereas in chapter 2 the way the questions were asked was modified, the way the questions were asked about the degree was modified to rate the How, which would allow the interviewees to choose more accurate words for their answers.

4.2.2 Ethical considerations

This section explains the ethical considerations involved in the questionnaire used in the study2 project. This questionnaire was designed to analyze the immersive experience in a city simulation game, therefore only numerical data was collected regarding the evaluation and feelings of the game. This study does not involve the collection of personal information about the participants, such as name, age or email address. All data will be kept strictly confidential and will only be used to analyze how game elements affect player immersion and will not be used in any way unrelated to the study.

In order to protect the rights and privacy of the participants, I have created a detailed consent form that includes the purpose of the study, how the data will be used, and my contact information. Consent can be viewed in the Appendix C. The questionnaire and consent form will be sent to the respondents together and will only be filled once they have read and agreed to the terms of the study.

4.2.3 Distribution of questionnaires

Once the survey is completed it is expected to be released on the web, with the target for placement being the Discord gaming community at Cities: Skylines. The questionnaire will also be looking for offline respondents who have gaming experience and are willing to participate in the survey.

However, I encountered some difficulties with the survey and made adjustments. Members of the Cities: Skylines community on Discord showed little interest in the questionnaire, and I realized finding willing respondents might be more challenging than anticipated. However, after some time with the survey, I found some difficulties and made adjustments. Firstly, members of the Cities: Skylines community in Discord did not show interest in the questionnaire, and I realised that finding respondents willing to participate in the study might not be as easy as I thought. Therefore, I adjusted my goals and I placed the questionnaire in Discord's channel for university gaming majors, as well as contacting various people offline who were enrolled in gaming majors as well as those who had extensive experience with city simulation games to fill out the questionnaire, all of whom were in the 20-30 age range. In order to collect data in a uniform way, I created a Google form, everyone filled out the questionnaire online, and as a researcher I did not observe the respondents filling out the questionnaire offline.

To gain more in-depth experience data and insights, I also conducted a one-on-one interview with a Game User Experience major. As he did not want to disclose his personal name, I referred to him as Y in the thesis.

4.3 Pilot Study

4.3.1 Summary of the pilot study

The purpose of this pilot study was to test and evaluate the game immersion questionnaire developed for the study of immersion in city simulation games. To simulate a real-life testing environment, I used the first version of the questionnaire (see Appendix A - Questionnaire - Vesrion1) and filled it out offline on a one-to-one basis so that I can test the validity of the questions and the players' feedback experience. In the pilot study, the data results were less important than the evaluation of the questionnaire. Therefore this report will focus on the initial feedback on the questionnaire design and suggestions for improvement.

The design of the pilot study used the full experimental structure, but was small in size and included only 2 participants. both participants were classmates I knew. One comes from the Game User Experience major and another comes from the Game Development major, who had extensive experience with city simulation games. The focus of this pilot study was to initially assess the comprehension and completeness of the questionnaire and to provide specific recommendations and guidance for the full-scale distribution of subsequent questionnaire.

4.3.2 Questionnaire and data collection

The questionnaire used in this pilot study contains several questions designed to assess player immersion in the game. The questionnaire was divided into two chapters covering various aspects of the gaming experience, such as attention maintenance, emotional engagement, and loss of real-world perception. In the design of the questionnaire, I paid particular attention to whether the formulation of the questions accurately reflected the player's gaming experience and checked whether there were any repetitive or irrelevant questions, questions that could not be understood, or aspects of the survey that were missing. I spoke to 2 respondents offline on a one-to-one basis, and the questionnaire was filled out online through Google Forms, in addition to which I compiled the content and suggestions into a document for ease of analyzing.

4.3.3 Result

Feedback from the two participants indicated that they found the questionnaire to be relatively well developed and the questions understandable, but some questions were asked in different ways, resulting in a mismatch between the response criteria and the way in which they were asked. For example, the questions ‘13. To what extent did you feel emotionally attached to the game?’ and ‘17. Would you like to play the game again?’ required a different response standard. With these two questions, the way they were asked needed to be modified to ensure that they did not confuse respondents, while uniformity would facilitate subsequent analysis of the data.

Participant feedback also pointed out that it would be useful to ask whether the participant had played the game in question and for how long, as this might help the study to get data from different perspectives. The questionnaire also needs to be simplified and optimized to avoid player tired during the response process.

4.3.4 Suggestions for questionnaire adjustments

Based on the results of the pilot study, I have summarized the following suggestions for questionnaire revision:

Optimization of question formulation: Rewrite the questions that are not clear or have inconsistent response standards to increase the comprehensibility of the questionnaire.

Adding questions from different perspectives: Add questions outside the game content to view the survey data from different perspectives. It was also ensured that all questions were relevant to the game to increase the relevance of the questionnaire and the motivation of the participants to answer.

After discussions with two of the respondents, I took on board their suggestions and produced the final version of the questionnaire. Despite the small sample size of this pilot study, the feedback received has given an initial indication of the problems and challenges that may be encountered in the practical application of the questionnaire. By adapting the questionnaire, I anticipate being able to collect more accurate and meaningful data in future studies, leading to a deeper understanding of the multiple dimensions of game immersion. This pilot study provided me with valuable upfront feedback that was integral to the optimization of the questionnaire design. The full version of the questionnaire is detailed in the Appendix A-Questionnaire – Version 2.

5 Result and Analysis

5.1 Results Display

In this paragraph, I will show the situation of collection of data from the questionnaire and also analyze the results of the data of the two pre-questions outside of the game. Since the results of the data from the Game elements in city simulation games study were already presented in the Method section to create the questionnaire, I will not repeat them here. Given the formatting issues, I had to place the data from the questionnaire in two sections including three tables in the appendix, see Appendix B-Tables.

After a period of completing the questionnaire, I collected 16 pieces of data and created a chart. Distributing the questionnaire on the internet was definitely difficult, so I got the data from my offline contacts who have a lot of gaming experience and friends. However, because the questionnaire was filled out online using Google Forms and no personal data was collected, I do not know which specific data each person answered. Firstly, I will explain what the data represents in each row and column of the data tables. The first row of each of the three tables is the serial number of the question in the questionnaire, and the corresponding serial number is used here instead of the specific question for ease of viewing. The first column is the pronouns of the 16 participants, whose personal information was not collected to protect privacy. The data in the middle are the answers given by each participant to each question.

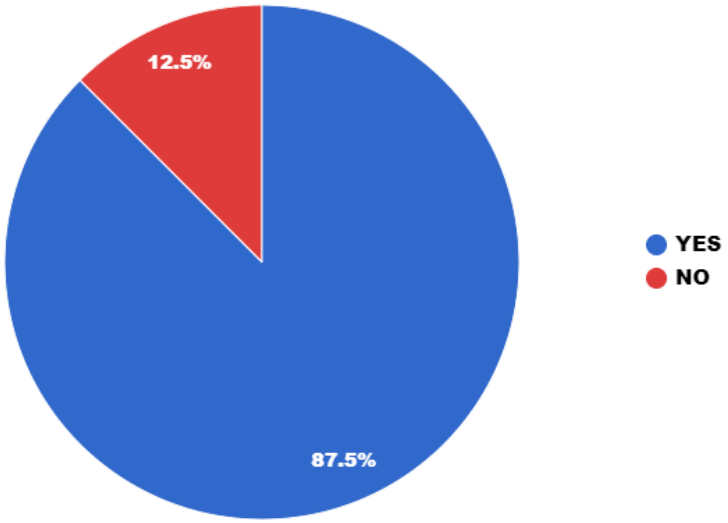

Figure 1 Percentage of participants who have played Cities: Skylines

In table4 in Appendix B and Figure1, we can see the response data for the two pre-set questions outside of the game. 2 out of 16 respondents indicated that they had not played the game Cities: Skylines, and both of these participants contacted me when completing the questionnaire to ask if the questions in Chapter 2 about Cities: Skylines could be filled in without having played the game. After some discussion, they agreed to watch a live video of the game on the internet before answering the questions.

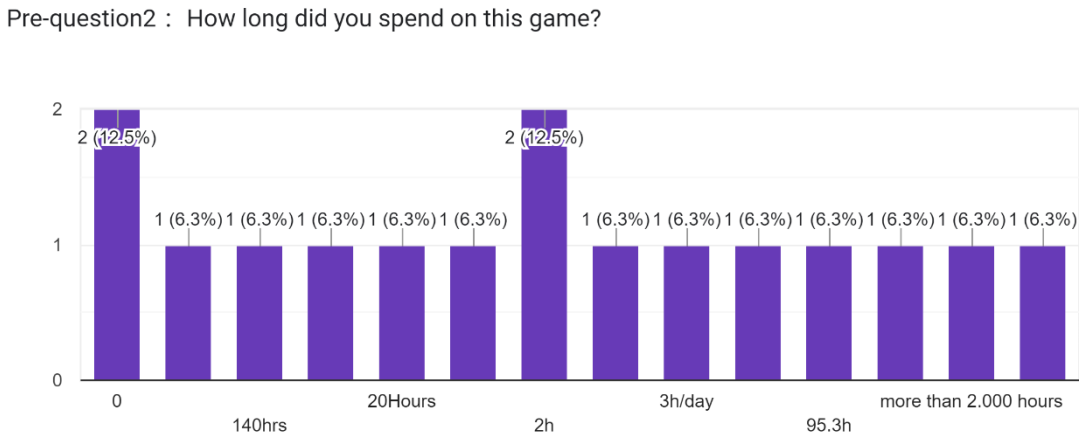

Figure 2 Participant play time

The data from the responses to the other pre-question is also interesting in that there is a huge difference in the amount of time participants spend playing the game, with some spending more than 2,000h and some just less than 2h. So it is worth thinking about whether or not different weights need to be given to the responses of participants with different playing times in the subsequent analysis of the data results. The above is the data for the participant-related questions, and the rest of the in-game data results will be listed along with the analysis in the following analyses.

5.2 Game elements in city simulation games Data Analysis

In this paragraph, I will present and analyse the data results of the two studies 'Game elements in city simulation games' and 'Study of immersion in city simulation games'. Because the results of this study are not very numerous and complex, direct observation and comparison is the most effective approach. I will use the average value in maths (Wikipedia Contributors, 2019) to make comparisons so that a clear standard can be drawn for the comparison of different data.

5.2.1 Preliminary data Analysis

Based on the table2 derived from the coding, I created the Figure3. This allows for a more intuitive look at the comparisons between each piece of data.

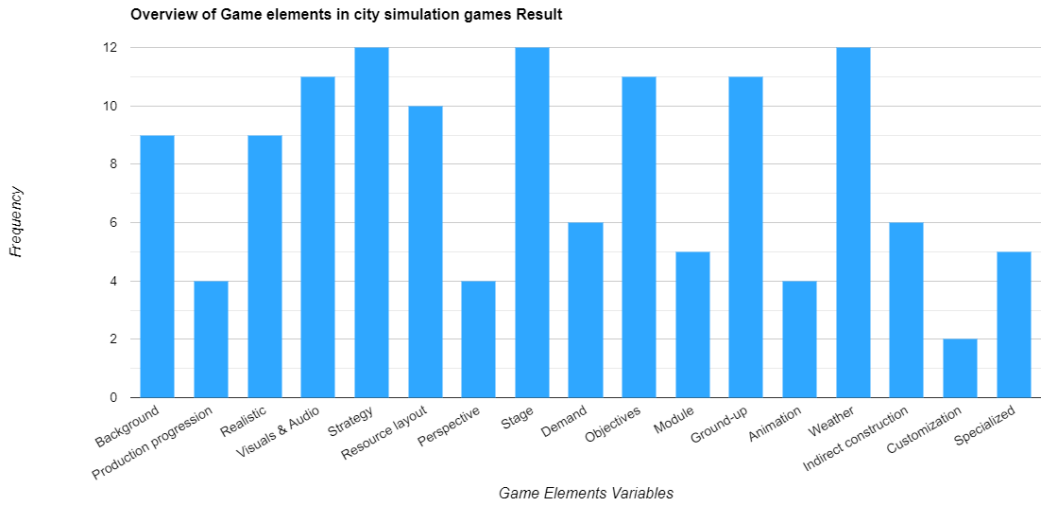

Figure 3 Game Elements Variables

Background is a common game element in city simulation games, with a Frequency of 9 indicating that it plays an important role in the production of city simulation games, and that many city simulation games consider the importance of this game element. Production progression and Animation have lower Frequencies, both only 4, indicating their relative less importance in city simulation games. Realistic has a high Frequency of 9, indicating that it is an important element to be considered in city simulation games, along with Background. Visuals & Audio, Objectives and Ground-up are mentioned frequently, with a Frequency of11, indicating that they are a very important game element in city simulation games. Strategy, Stage and Weather are the most frequently mentioned game elements with a Frequency of 12, indicating that they are crucial in city simulation games and are the main drivers of player engagement and challenge. Similarly, Resource layout has a Frequency of 10, showing its importance in this type of game, and Demand has a moderate Frequency, indicating that it has some influence in the game, but is not the most important factor. Module, Specialised, and Indirect Construction have a low Frequency of 5, 5 and 6 respectively, which may mean that Modularisation and Indirect construction are not the most central elements in city simulation games, and also that players do not have a high demand for specific game features or characters. Customization has the lowest Frequency of Only 2, which may mean that customisation of roles or elements is not a major concern in city simulation games.

5.2.2 Comparison with the average value

Part 5.2.1 is the preliminary analysis for each game element, we have selected a total of 15 city simulation games, which means that the upper limit of Frequency is 15. Through the calculation can be concluded that among all the game elements, the average number of times it is mentioned is about 7.8 times, which can be called the average value. Average value is usually defined as the sum of all values in a set of data divided by the number of values. It is a basic statistic that measures the trend in a data set. By analysing the average value, it is possible to understand the importance of each game element in the surveyed. Among the 17 game elements, the game elements with Frequency greater than 7.8 times are Background, Realistic, Visuals & Audio, Strategy, Resource layout, Stage, Objectives, Ground-up, Weather, which are the existing These are the game elements that appear more frequently in existing city simulation games and reflect their importance and appeal to players. Among them, Strategy, Stage and Weather are the three game elements with the highest frequency of 12 times, while Visuals & Audio, Objectives and Ground-up also have a frequency of 11 times,

which shows that Visuals & Audio is an important element in city simulation games. an important element in city simulation games and is valued in most such games, while Strategy may be an important driver of player interaction and challenge and is therefore also valued. At the same time, the phased design of the game progression and the weather system have a significant impact on the game experience and are therefore also emphasised. Finally, clear game objectives and the process of building a city from scratch are equally appealing to players and have a propulsive effect on game progression. In summary, Visuals & Audio, Objectives, Ground-up, Strategy, Stage and Weather are some of the most important game elements in city simulation games.

In addition to this, I would like to talk about some of the game elements that had a lower Frequency than the average value of 7.8. As a researcher, I had some discussions with the programmer about the results of the coding process, and the game elements Production progression, Perspective, Animation and Customisation were all used with a low Frequency of less than 5 times in the city simulation game. To some extent this means that most existing city simulation games don't pay much attention to these game elements, but both the programmer and I think they have potential. For example, Animation, good transitions can enhance the detail and visual richness of the game, and have an impact on the player's immersion. At the same time, transitions to different viewpoints, which allow players to get a closer look at the city they've built as well as the buildings, can similarly increase the gaming experience. They have not been adopted by popular city simulation games nowadays, but there is value in continuing to explore the potential. Therefore, we have placed questions related to these game elements in the questionnaire, hoping to discuss them further after collecting more data.

5.3 Data Analysis of study of immersion in city simulation games

After collecting the data results from the 16 questionnaires, I created three tables relating to the questionnaire and placed them in the Appendix B to present my data results. The most intuitive way to analyze the results of questionnaires that include Likert scales is to look at how the participants scored each question and compare it to the total score. However, in addition to this, I read up on some of Scribbr (2023) methods of analysis and decided to use some mathematical methods to analyze the data alongside the direct analysis of the data.

In the analyses that follow, in addition to the analysis of the data and average values for each question, I will also use standard deviation for my analyses. The standard deviation (Wikipedia Contributors, 2019) is a statistical measure of the dispersion of a data set. It indicates the distribution of data points relative to the average value. The larger the standard deviation, the wider the distribution of data, indicating that participants rated the importance of the element more differently; the smaller the standard deviation, the more concentrated the distribution of data, indicating that participants rated the importance of the element more consistently. See Wikipedia Contributors (2019) for details on how standard deviation is calculated. Often the standard deviation is compared to 1 to help determine how discrete the data is. If the standard deviation is greater than 1, the data is more discrete; if the standard deviation is less than 1 or even further from 1, the data is more concentrated.

5.3.1 Impact of 17 Game Element Variables on Immersion

In the data analysis in Chapter 1, I divided the 17 questions into 8 categories so that the differences in data between the different types could be visualized and easily analyzed.

1. Attention and concentration

To what extent did the game hold your attention? (question1)

To what extent did you feel you were focused on the game? (question2)

2. Commitment and sense of time

To what extent did you put into playing the game? (question3)

To what extent did you lose track of time? (question4)

3.Perception of reality

To what extent did you feel consciously aware of being in the real world while playing? (question 5)

To what extent did you notice events taking place around you? (question 6)

To what extent did you feel as though you were separated from your real-world environment? (question 7)

4. Interact with the game

To what extent did you feel that you were interacting with the game environment? (question8)

To what extent was your sense of being in the game environment stronger than your sense of being in the real world? (question9)

To what extent did you feel as though you were moving through the game according to your own will? (question10)

5. Challenges and frustration

To what extent did you find the game challenging? (question11)

To what extent did you just want to give up during the game? (question12)

6. Emotion and enjoyment

To what extent did you feel emotionally attached to the game? (question13)

To what extent did you think you enjoy playing the game? (question14)

7. Changes in immersion

How immersed do you feel at the start of the game? (question15)

How immersed do you feel at the end of the game? (question16)

8. Willingness to replay

To what extent did you want to play the game again? (question17)

Combining the data in table6 in Appendix B, it can be found that in the part of attention and concentration, the average value of question 1 is 4.18, and the standard deviation is 0.91; the average value of question 2 is 4.12, and the standard deviation is 0.89, which means that the participants mostly think that the game can attract their attention to a large extent, and they are very concentrated during playing, and the data are less dispersed, which means that the majority of the players are more consistent with their evaluation of this. consistent.

In the Engagement and Sense of Time section, questions 3 and 4 both had a average value of 4.13, and their standard deviations were 0.96 and 0.81, respectively. this means that the participants mostly felt that they lost their sense of time during play, and the data dispersion was small, indicating that most players were consistent in this evaluation.

In the perception of reality section, the average values for questions 5, 6 and 7 were 3.38, 3.25 and 3.56 with standard deviations of 1.20, 1.34 and 0.96. This indicates that a portion of the participants still perceive what is happening in the real world even when they are in a state of engagement in the game, but the data dispersions are large and the individual differences are significant.

In the section of interaction with the game, the average values of questions 8,9 and 10 are 3.88, 3.44 and 3.69 respectively, but the standard deviations are all greater than 1, which means that most participants think they feel strongly in the game, there is more interaction, and they are able to act in accordance with their own desires, but the data dispersions are all very high, and there is a large disparity in the individual experiences.

In the Challenge and frustration section, Question 11 had a average value of 3.56 and a standard deviation of 0.89, which suggests that participants found the game challenging, with a low level of data dispersion, and that the majority of players felt similarly challenged. Question 12 had a average value of 2.38 and a standard deviation of 1.02, which suggests that participants were less likely to give up on the game, but there was a greater dispersion of data and significant individual differences.

In the Emotion and Enjoyment section, Question 13 had a average value of 3.63 and a standard deviation of 0.96, indicating that participants felt they had some emotional attachment to the game, and the data was moderately dispersed, indicating slightly different individual experiences. Whereas question 14 had a average value of 4.38 and a standard deviation of 0.62, which means that participants felt they enjoyed the game a great deal, with a small degree of dispersion in the data, indicating that the majority of the participants had more consistent feelings.

In the variation in immersion section, question 15 had a average value of 3.13, which indicates that participants perceived a lower average value of immersion at the start of the game, however, question 16 had a average value of 4.06, which indicates that the majority of participants had a higher average value of immersion at the end of the game. The standard deviation of these two questions is 1.29 and 1.09 respectively, which shows a greater dispersion of data, indicating a greater variation in players' final experiences.

In question 17, the average value was 3.56 and the standard deviation was 1.41, which indicates that most of the participants expressed a willingness to play the game again, but the data dispersion was large, indicating that there was a large variation in players' willingness.

Based on the analysis of the above question-by-question response data, the following preliminary results can be obtained:

Attention and Focus section:

The majority of participants felt that the game was able to greatly attract their attention and were very focused during play, indicating that players were more consistent in their evaluation of this, and that there was no polarisation in each participant's scoring.

Involvement and sense of time: Most participants felt that they put a lot of effort into the game and lost their sense of time while playing, which was rated consistently by the participants and did not show a great deal of individual variation.

Perception of reality: some participants reported that they would still perceive the real world even when they were engaged in the game; however, the rest of the participants gave data indicating that they would be fully engaged in the game and would be less aware of the outside world. Some individual differences in this section were significant.

Interaction with the game section: most participants felt that they had strong feelings in the game, that there was more interaction, and that they were able to act as they wished.

Challenge and frustration: Participants perceived the game as challenging and were more consistent in their perceptions of challenge; most had fewer thoughts of giving up the game, but there were significant individual differences, with a few having very strong thoughts of giving up when they did.

Emotion and enjoyment: Participants mostly felt that they had some emotional attachment to the game, and enjoyed the game very much, with more consistent feelings.

Change in immersion component: participants mostly felt less immersed at the beginning of the game, but more immersed at the end of the game. Because of the large dispersion of data, there was a large variation in players' final experiences.

Willingness to replay section: the majority of participants expressed a willingness to play again. However, there was some variation in players' willingness, with those who showed a tendency not to play again usually scoring very low and hardly having any thoughts of replaying the game.

5.3.2 Assessing Immersion in the Game of Cities: Skylines

In the analysis of the data in Chapter 2, as it relates to specific games and specific game elements, I will be using a combination of tables, pictures, results and analysis from the Game elements in city simulation games study and the interview. Similarly sometimes I will still use the mathematical methods of average value and standard deviation in analysing the data from the responses to some of the questions to give multiple perspectives.

We can see from the analysis of the data in chapter1 that almost all the participants felt immersed while playing the game. The attention and concentration section shows that they

completely devoted their attention to the game and entered a mental state of full operation-flow. In the Engagement and Sense of Time and Perception of Reality sections, it was clear that participants would lose their sense of time and lose their sense of reality. The separation of time and the immersion of concentration, which is an indication of the cognitive absorption that was created, also indicates that the participant enters into a sense of presence. This is very helpful in the analysis of this paragraph as it shows that participants play the game with a strong sense of immersion and that they do experience immersion. It is then their impact on immersion when evaluating specific game elements of a specific game that is real, whether that impact is positive or negative.

As can be seen in Table 7, the scores for all questions in Chapter 2, have a average value of 3 or higher, indicating that participants mostly felt that all 17 game elements had a positive impact on immersion in the selected games, but to varying degrees. The average of these values was calculated to be 3.5.

The results of the data in Table 7 show that the following 10 game elements were considered by most participants to have a greater positive effect on immersion: Production progression, Realistic, Visuals & Audio, Strategy, Objectives, Module, Ground-up, Weather, Indirect construction and Specialised. Weather, Indirect construction, and Specialised, all of which had a average score of 3.5 or greater, and participants could clearly feel the positive effects of these elements on immersion after experiencing the game. However, the standard deviations of Realistic, Objectives, Module, Ground-up, and Specialised were all greater than 1, which means that the participants' scores on these game elements were less focused and more discrete. This phenomenon was included in the interview session I conducted with respondent Y, who believed that this phenomenon was closely related to personal preference. In Y's response, Y prefers more authenticity in game content, yet there is no denying that in an empty world such as a game, there are players who prefer more exaggerated game content, or even want to have nothing to do with authenticity in order to bring a more refreshing experience. He said that he prefers to waste time in games without a purpose, he doesn't like to have clear goals and missions, which makes him feel less free. At the same time, Y really liked having a wide variety of building Modules to choose from, allowing him to try out more interesting ideas. He also likes Ground-up as a game element, and Y thinks he really enjoys the process of building buildings from scratch, rather than the existence of ready-made templates. On the other hand, Y did not think that having too many Specialised game elements in the game was a fun thing to do, and he thought that too much expertise in a particular area would make the threshold for playing a city simulation game higher, and when players encountered difficulties in the game that involved specialist knowledge, they might not be able to solve them, and this was the reason why he thought that participants might have scored more differently on this game element is one of the reasons why there is a wide variation in scoring. Therefore, it is normal for participants to vary their scores according to their preferences for the game content.

Next I will analyse the remaining 7 game elements one by one. Their data results show that they have some positive impact on the immersion of the game, but the results also show that there exists a part of the participants who do not think so, and the difference between the two percentages is not very big.

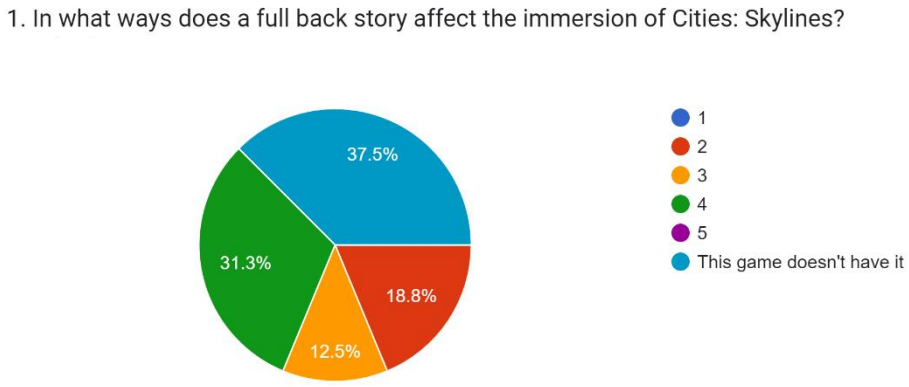

Figure 4 Background

For Background, 31.3 per cent of participants, five persons in total, thought it had a positive impact on immersion, while three, or 18.8%, thought it had a negative impact on immersion, and the rest of the participants did not make a clear statement. Background usually gives the player a description of the game world and gives the player an identity in the game, and a good background usually contributes to the immersive experience. But this common sense may not be true in city simulation games. Even though more participants responded that it had a positive impact, it was only 12.5 per cent more, which is not overwhelming. Meanwhile in my interaction with respondent Y, he stated that city simulation games focus more on in-game construction, and narratives such as background are rather not the focus of the player's attention. Thus even 37.5% of the participants as many as 6, thought that Background as a game element does not exist in Cities: Skylines. It is clear that Background has a positive impact on immersion, but does not play a key role.

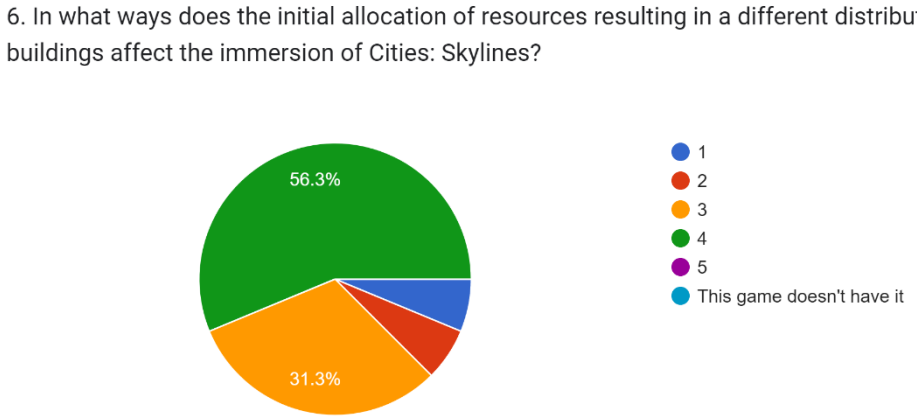

Figure 5 Resource layout

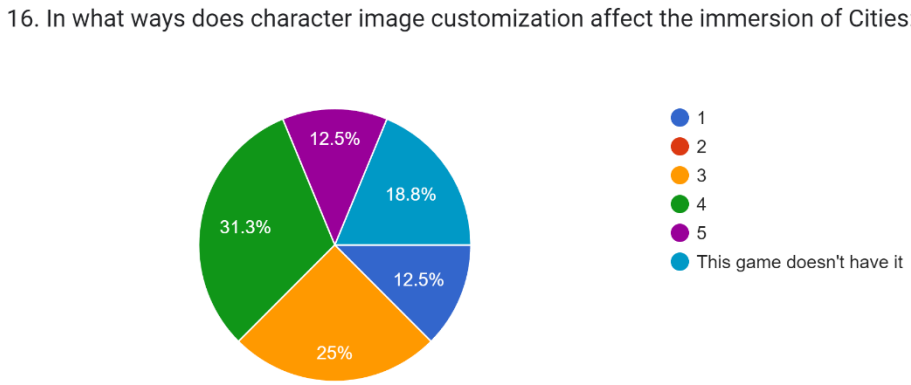

Figure 6 Customization

Resource layout and Customisation both have a average score of 3.38, which is very close to 3.5, so they are discussed together. Resource layout usually determines where in the game the player will build, as building facilities in resource-rich areas will greatly reduce the economic consumption in the early stages, making the player's experience smoother. smooth, so a good Resource layout will have a positive impact on immersion. In Figure5, it is clear that 56.3% of the participants believe that Resource layout positively affects immersion in the game, 31.3% are neutral, and 12.4% hold the opposite opinion. The average value is still a little bit away from 3.5 because the participants with the opposite opinion scored lower. However, the Figure5 shows more than half of the ratings of 4, which indicates that although a very small number of people rated it very low, for the majority of people Resource layout is a game element that has a positive impact on immersion, and the average value does not fully reflect its importance. The situation is similar for Customisation, with 37.5% of participants being neutral, and still 43.8% believing it has a positive or even very positive impact on immersion. However, it is worth noting that in the data results of the Game elements in city simulation games study, Customization appeared only 2 times in the Frequency of the 15 popular city simulation games on the market, which is the least among the 17 game elements, reflecting that the popular games on the market are actually not yet value the help that Customization brings to game immersion.

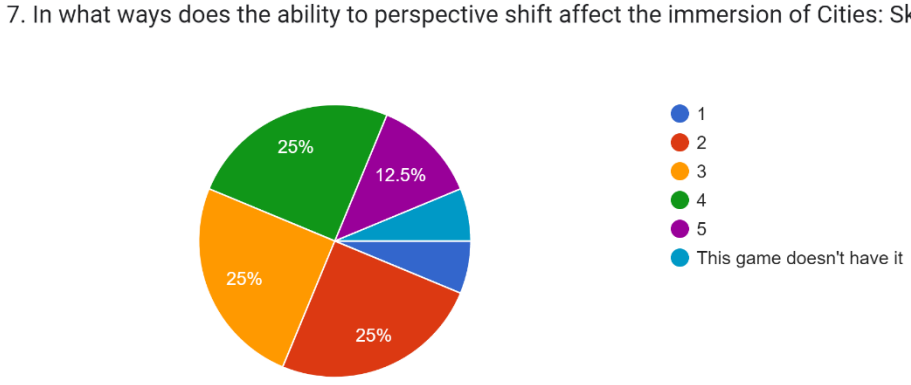

Figure 7 Perspective

The results of Perspective's data show that 6.25 per cent of participants felt that the element was not present in the game, with 25 per cent giving a score of 2, 3 and 4 respectively, and 12.5 per cent giving a score of 5. The data suggests that the ability to shift perspectives is an important immersion element for some participants, as it allows players to view and manage the city from different angles. However, the high standard deviation of 1.19 suggests that there is a wide difference in player perceptions of this feature. Some players perceived this feature to have a significant positive impact on immersion (5 points), while others perceived it to have negative impact (1 and 2 points). This suggests that the ability to switch perspectives appeals differently to different players, with Y stating that he cares more about the overall layout of the building and does not care about being able to switch perspectives to look at an already constructed building. Even though the data showed that this game element presented more positive impacts, he still considered it as an optional game element that did not significantly positively or negatively affect the immersion of the game.

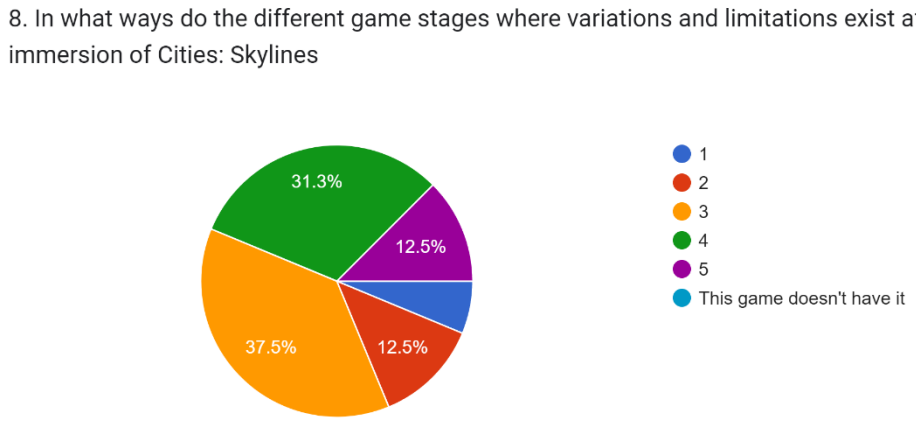

Figure 8 Stage

In the Figure8, 12.5% of the participants gave a score of 2 and 5, 6.2% gave a score of 1, 31.3% gave a score of 4, and 37.5% gave a score of 3. As can be seen from the data, most players felt that the changes had a positive impact on the gaming experience, but a few felt that they had less of an impact. This difference may reflect players' different responses to the challenges and strategic demands of different stages. Respondent Y felt that as the stages of the game changed, the game became more in-depth and players were able to control more of the game as a result, and this was reflected accordingly in Cities: Skylines. Thus for most people this game element has a positive impact on immersion.

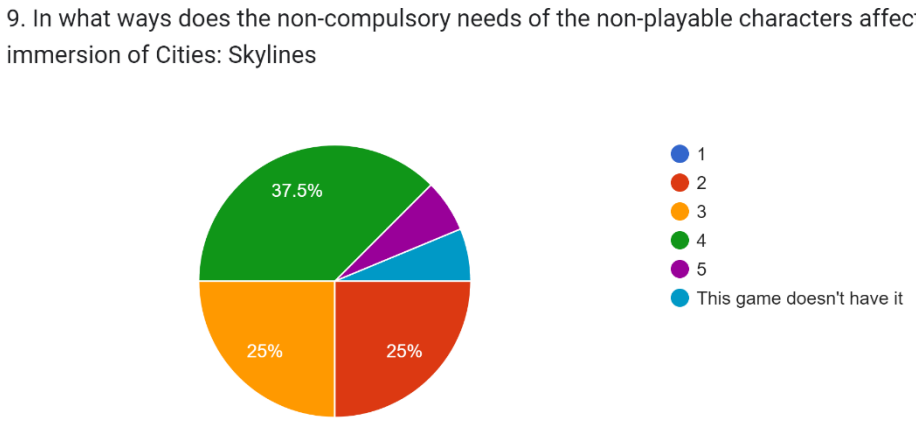

Figure 9 Demand

In the results of question 9, 25 per cent of the participants gave a score of 2 and 3 respectively, 37.5 per cent gave a score of 4 and 6.25 per cent gave a score of 5. The non-mandatory needs of the non-player characters involved simulating various types of real-life needs that could make the city seem more vivid and realistic. 37.5% of participants felt that these needs had a positive impact on immersion, but the same 25% felt that they had a negative impact. This suggests that whilst this element appeals to some players, not all players agree with its contribution to immersion. Respondent Y spoke highly of this game element in his interview, believing that this detail of NPC characters' needs best reflects the quality of a city simulation game, and that the inhabitants of the settlements in Cities: Skylines often had different status displays telling the player what their current state was and what their needs looked like, which made it seem as though he was actually interacting with a world of his own creation, which Y felt greatly increased the immersion of the game.

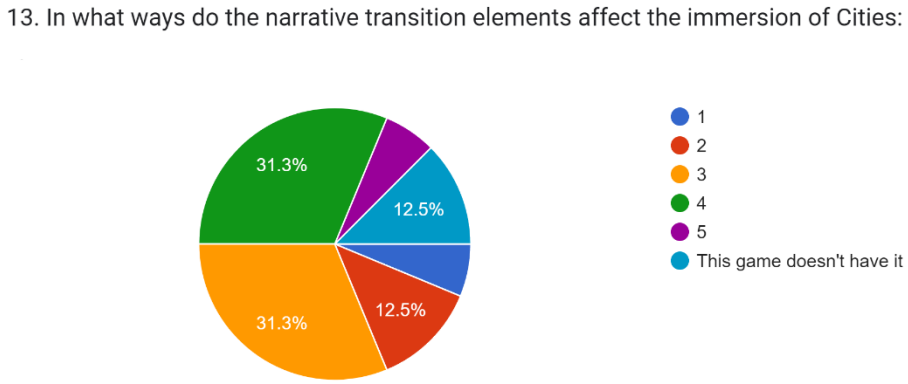

Figure 10 Animation

Animation is a game element that is actually not used much in existing popular city simulation games, with a Frequency of only 4, second only to Customisation, which is at the bottom of the list. It has some similarities with Background's position to help players better understand the background and development of the game, but it seems to be less important than the other elements in a city simulation game. less important than the other elements.

31.3% of the participants thought that this element had no impact on immersion, 12.5% had a negative view and 37.5% thought that it was a positive or even very positive impact on immersion. Overall more people thought it had a positive impact on immersion, but the role of the Animation element is still somewhat controversial, and not all players think it significantly improves immersion.

6 Conclusions

6.1 Summary

In summary, for Subq1: What are the most important game elements in city simulation games? The coding study shows that strategy, weather and stage have the highest frequency of 12. Visuals & Audio, Objectives and Ground-up have a frequency of 11, which is also very close to 12. These six game elements are the most important game elements in city simulation games.

For Subq2: How do the identified game elements affect immersion? I'll summarise some of the specific ways in which they affect immersion. Strategy: Providing challenge and decision space for players adds complexity and interest to the game, making players more engaged. Stage: The staged design of the game progression provides a gradual development experience that maintains player interest and engagement. Weather: Dynamic weather system enhances the realism of the game and makes it easier for players to feel the impact of environmental changes. Visual and Audio: High-quality visual effects and sound effects enhance the player's sensory experience and make the player more immersed in the game world. Objectives: Clear objective settings help players focus and provide a sense of achievement, enhancing the goal-oriented nature of the game. Ground-up: The process of building a city from scratch allows players to experience the fun of creation and development, enhancing the game's sense of achievement and belonging.

So for the main research question: What are the most important game elements of the city simulation game that affect immersion? From the coding study I got 6 important game elements summarized above. Among the identified game elements, the ones that have the most positive impact on immersion are Visuals & Audio, Ground-up, Realistic, Strategy, Weather, Module, Indirect construction, Production progression, Specialized, Objectives, and so on, in descending order. Combining these results of the data and rankings, the four most important game elements that affect immersion in city simulation games are Strategy, Visuals & Audio, Ground-up, and Weather. These four game elements are not only widely used in existing popular city simulation games, but also in the specific game Cities: Skylines also had a large positive impact on player immersion, and participants' evaluations were relatively consistent and not very divergent.

6.2 Discussion

The first study analysed and coded videos of hot-selling city simulation games to identify the key elements that influence the gaming experience. Then I verified the impact of these elements on player immersion through a questionnaire. The studies found that Strategy, Visuals & Audio, Ground-up, and Weather are the core elements that positively influence player immersion. These findings not only help to understand players' immersion experience in city simulation games, but also provide game designers with references to optimise the game experience.

Regarding the coding study, I worked on it with a programmer who is experienced in city simulation games. Coding study allows the researcher the flexibility to define and adapt coding categories to find the key to the data, which applies to qualitative as well as quantitative data types. However, managing and analysing the coding results becomes more

complex with the amount of data and coding categories increasing, which becomes a challenge. The collaboration between programmer and me brought significant advantages, such as the programmer's deep understanding of city simulation games, which contributed to the accuracy of the coding of game elements as well as a reasonable summary of the concepts of the game elements. The researcher's experience with city simulation games helps us to quickly identify and define key game elements, creating a more comprehensive code table.

However, there is some doubts as to whether this model is perfect. It is worth considering whether the number of people in the study has an impact on the research. The results of the coding study relied to some extent on the programmers' definitions and interpretations of the game elements. Therefore, if the number of programmers increases, for example another programmer, it is possible to have an impact on the results of the outcome coding study. On the one hand, another programmer means that perspectives become diverse. Each person's gaming experience will result in a different interpretation of the information presented in the game video, which may increase or decrease the number of game elements. At the same time, each person will have their own gaming preferences, or even biases based on their gaming experience. Additional programmer will make this section larger and may affect the definition and interpretation of game elements. This could be positive, or it could make them more subjective and less universal. This can't be approved what the results of increasing another programmer will be until making the experiment.

I choose two persons rather than more. On the one hand, a smaller number of participants makes it easier for the researchers to agree with each other, reduces conflict between different viewpoints, and facilitates uniformity in the coding results. At the same time, a smaller number of people means that communication costs are lower. The decision-making process is faster and more efficient so that we can discuss the definition and interpretation of each game element as much as possible.

There are some limitations in the questionnaire, too. Firstly, the sample size of the questionnaire was small; the original sample size was expected to be 50 or even more, but it was much more difficult to collect responses than expected, and thus may affect the generalisability of the data. So secondly, the participants of the questionnaire were mainly from the 20-30 age group of gamers, so it is still debatable whether the results of this study are applicable to other age groups. Furthermore, the design of the questionnaire was informed by Jennett et al. (2008) who not only designed the questionnaire, but also observed participants completing the questionnaire offline, and even utilised eye-tracking technology to see if the participants were actually staying focused throughout the process. This method could not be replicated in this study due to technical and time issues.

In contrast to Jennett's questionnaire study, I made the study more intuitive and easier to understand by writing specific questions for a game that is recognised in the market: Cities: Skylines in addition to general questions just about immersion into the questionnaire.

6.3 Future Work

Future study could be expanded in several ways. Firstly, Jennett, et al., (2008) have stated that there are limitations with questionnaires. The questionnaire they designed may be somewhat repetitive and limited in its coverage of all areas of immersion. Although I tried

my best to avoid similar repetitions at the beginning of designing the questionnaire, it still could not be perfect.

In order to obtain more accurate data, I would like to be able to take the lead in completing the questionnaires and watch the participants play the games, given sufficient resources, so that data can be collected through controlled environments and the use of additional measurements, such as eye-tracking technology. In addition to this, I would like to expand the scope of the interviews to allow all participants to express their thoughts and ask them how they experienced some of the technologies tested, such as eye-tracking, and if there are any areas that need to be improved.

Secondly, future study could also consider introducing new technologies such as VR into the experiment, while collecting physical and mental responses, such as heartbeats, from players during actual gameplay in the virtual world. Through these technologies, a more scientific and comprehensive basis for data analysis can be provided. Actually, there is still space for improvement in my study, the weakness exposed during the study process can provide valuable experience for future study. I hope the study can introduce new measurements and aspects in the future.

References

Agarwal, R. and Karahanna, E. (2000). Time Flies When You’re Having Fun: Cognitive Absorption and Beliefs about Information Technology Usage. MIS Quarterly, 24(4), p.665. doi:https://doi.org/10.2307/3250951.

Agrawal, S., Simon, A., Bech, S., Bærentsen, K. and Forchhammer, S. (2020). Defining Immersion: Literature Review and Implications for Research on Audiovisual Experiences. Journal of the Audio Engineering Society, 68(6), pp.404 – 417. doi:https://doi.org/10.17743/jaes.2020.0039.

Assaf, R. and Rodrigues, R. (2019). The Feeling of Presence. doi:https://doi.org/10.1145/3359852.3359861.

Avedon, E.M.. The Structural Elements of Games. In: Furnham, A. and Argyle, M., ed, 2013. The Psychology of Social Situations: Selected Readings. Google Books. Elsevier. pp.11-17.

Balakrishnan, J. and Dwivedi, Y.K. (2021). Role of cognitive absorption in building user trust and experience. Psychology & Marketing, 38(4). doi:https://doi.org/10.1002/mar.21462.

Baowaly, M.K., Tu, Y.-P. and Chen, K.-T. (2019). Predicting the helpfulness of game reviews: A case study on the Steam store. Journal of Intelligent & Fuzzy Systems, 36(5), pp.4731 – 4742. doi:https://doi.org/10.3233/jifs-179022.

Bereitschaft, B. (2021). Commercial city building games as pedagogical tools: what have we learned? Journal of Geography in Higher Education, pp.1 – 27. doi:https://doi.org/10.1080/03098265.2021.2007524.

Bilibili(2009). bilibili. [online] Available at: https://www.bilibili.com/.

Bond, M. and Beale, R. (2009). What makes a good game? Using reviews to inform design. doi:https://doi.org/10.14236/ewic/hci2009.52.

Brand, J.E., Knight, S. and Majewski, J. (2003). The Diverse Worlds of Computer Games: A Content Analysis of Spaces, Populations, Styles and Narratives. 2.

Byun, J. and Loh, C.S. (2015). Audial engagement: Effects of game sound on learner engagement in digital game-based learning environments. Computers in Human Behavior, 46, pp.129 – 138. doi:https://doi.org/10.1016/j.chb.2014.12.052.

Campfire camp, 2019. [Interesting Interview] How Takahama City, Japan is using Cities: Skylines for urban planning? _Office_Software_What_is_Worth_Buying. [online] post.smzdm.com. Available at: https://post.smzdm.com/p/adwr8olx/ [Accessed 25 Mar. 2024].

Carpentier, J., Mageau, G.A. and Vallerand, R.J. (2011). Ruminations and Flow: Why Do People with a More Harmonious Passion Experience Higher Well-Being? Journal of Happiness Studies, 13(3), pp.501 – 518. doi:https://doi.org/10.1007/s10902-011-9276-4.

Cavada, M. and Rogers, C.D.F. (2019). Serious gaming as a means of facilitating truly smart cities: a narrative review. Behaviour & Information Technology, 39(6), pp.695 – 710. doi:https://doi.org/10.1080/0144929x.2019.1677775.

Chen, L.-X. and Sun, C.-T. (2016). Self-regulation influence on game play flow state. Computers in Human Behavior, 54, pp.341 – 350. doi:https://doi.org/10.1016/j.chb.2015.08.020.

De Barcelona, U., Slater, E., Lotto, M., Arnold, B., Marta, M. and Sanchez-Vives (2009). How we experience immersive virtual environments: the concept of presence and its measurement. [online] 40(2), pp.193 – 210. Available at: https://www.redalyc.org/pdf/970/97017660004.pdf.

Eberhard, L., Kasper, P., Koncar, P., Gütl, C.(2018). Investigating Helpfulness of Video Game Reviews on the Steam Platform. Valencia, SPAIN. OCT 15-18, 2018. NEW YORK: IEEE345 E 47TH ST.

Edgington, D.W. (2017). Comprehensive planning in Japanese large cities. Planning Perspectives, 34(1), pp.115 – 132. doi:https://doi.org/10.1080/02665433.2017.1389655.

Gibberd, J. (2017). Strengthening Sustainability Planning: The City Capability Framework. Procedia Engineering, [online] 198, pp.200 – 211. doi:https://doi.org/10.1016/j.proeng.2017.07.084.

Göb, R., McCollin, C. and Ramalhoto, M.F. (2007). Ordinal Methodology in the Analysis of Likert Scales. Quality & Quantity, 41(5), pp.601 – 626. doi:https://doi.org/10.1007/s11135-007-9089-z.

Graafland, M., Schraagen, J.M. and Schijven, M.P. (2012). Systematic review of serious games for medical education and surgical skills training. British Journal of Surgery, 99(10), pp.1322 – 1330. doi:https://doi.org/10.1002/bjs.8819.

Hall, L., Hume, C. and Tazzyman, S. (2016). Five Degrees of Happiness. Proceedings of the The 15th International Conference on Interaction Design and Children - IDC ’ 16. doi:https://doi.org/10.1145/2930674.2930719.

Jansz, J. and Martis, R.G. (2007). The Lara Phenomenon: Powerful Female Characters in Video Games. Sex Roles, [online] 56(3-4), pp.141 – 148. doi:https://doi.org/10.1007/s11199-006-9158-0.

Jennett, C., Cox, A.L., Cairns, P., Dhoparee, S., Epps, A., Tijs, T. and Walton, A. (2008). Measuring and defining the experience of immersion in games. International Journal of Human-Computer Studies, [online] 66(9), pp.641 – 661. doi:https://doi.org/10.1016/j.ijhcs.2008.04.004.

Kiili, K., Lainema, T., de Freitas, S. and Arnab, S. (2014). Flow framework for analyzing the quality of educational games. Entertainment Computing, 5(4), pp.367 – 377. doi:https://doi.org/10.1016/j.entcom.2014.08.002.

Laamarti, F., Eid, M. and El Saddik, A. (2014). An Overview of Serious Games. International Journal of Computer Games Technology, [online] 2014, pp.1 – 15. doi:https://doi.org/10.1155/2014/358152.

Leong, P. (2011). Role of social presence and cognitive absorption in online learning environments. Distance Education, 32(1), pp.5 – 28. doi:https://doi.org/10.1080/01587919.2011.565495.

Leung, S.-O. (2011). A Comparison of Psychometric Properties and Normality in 4-, 5-, 6-, and 11-Point Likert Scales. Journal of Social Service Research, 37(4), pp.412 – 421. doi:https://doi.org/10.1080/01488376.2011.580697.

Lin, D., Bezemer, C.-P., Zou, Y. and Hassan, A.E. (2018). An empirical study of game reviews on the Steam platform. Empirical Software Engineering, 24(1), pp.170 – 207. doi:https://doi.org/10.1007/s10664-018-9627-4.

Marto, A. and Gonçalves, A. (2022). Augmented Reality Games and Presence: A Systematic Review. Journal of Imaging, 8(4), p.91. doi:https://doi.org/10.3390/jimaging8040091.

Miljanovic, M.A. and Bradbury, J.S. (2018). Making Serious Programming Games Adaptive. Lecture Notes in Computer Science, pp.253 – 259. doi:https://doi.org/10.1007/978-3-030-02762-9_27.

Moro, C., Phelps, C. and Birt, J. (2022). Improving serious games by crowdsourcing feedback from the STEAM online gaming community. The Internet and Higher Education, 55, p.100874. doi:https://doi.org/10.1016/j.iheduc.2022.100874.

Nakamura, J. and Csikszentmihalyi, M., 2009. Flow theory and research. In:C. R. Snyder, Shane J. Lopez,ed.2009. Oxford handbook of positive psychology. Oxford: Oxford University Press. pp. 195-206.

Nilsson, M. (2023). Game graphics, motivation & engagement in serious games : Game graphics impact on serious games. [online] DIVA. Available at: https://his.diva-portal.org/smash/record.jsf?aq2=%5B%5B%5D%5D&c=1&af=%5B%5D&searchType=SIMPLE&sortOrder2=title_sort_asc&query=Milla&language=en&pid=diva2%3A1765635&aq=%5B%5B%5D%5D&sf=all&aqe=%5B%5D&sortOrder=author_sort_asc&onlyFullText=false&noOfRows=50&dswid=-4555 [Accessed 8 Feb. 2024].

Olszewski, R., Cegiełka, M., Szczepankowska, U. and Wesołowski, J. (2020). Developing a Serious Game That Supports the Resolution of Social and Ecological Problems in the Toolset Environment of Cities: Skylines. ISPRS International Journal of Geo-Information, [online] 9(2), p.118. doi:https://doi.org/10.3390/ijgi9020118.

Panagiotopoulos, G., Giannakopoulos, G., & Liapis, A. (2019). A study on video game review summarization. Workshop MultiLing 2019: Summarization Across Languages, Genres and Sources, Varna, pp. 35-43.

Park, N., Min Lee, K., Annie Jin, S.-A. and Kang, S. (2010). Effects of pre-game stories on feelings of presence and evaluation of computer games. International Journal of Human-Computer Studies, 68(11), pp.822 – 833. doi:https://doi.org/10.1016/j.ijhcs.2010.07.002.

Pinos, J., Vozenilek, V. and Pavlis, O. (2020). Automatic Geodata Processing Methods for Real-World City Visualizations in Cities: Skylines. ISPRS International Journal of Geo-Information, 9(1), p.17. doi:https://doi.org/10.3390/ijgi9010017.

Plass, J.L., Homer, B.D., MacNamara, A., Ober, T., Rose, M.C., Pawar, S., Hovey, C.M. and Olsen, A. (2019). Emotional design for digital games for learning: The effect of expression, color, shape, and dimensionality on the affective quality of game characters. Learning and Instruction, [online] p.101194. doi:https://doi.org/10.1016/j.learninstruc.2019.01.005.

Poplin, A. (2012). Playful public participation in urban planning: A case study for online serious games. Computers, Environment and Urban Systems, 36(3), pp.195 – 206. doi:https://doi.org/10.1016/j.compenvurbsys.2011.10.003.

Prensky, M. (2001). Digital Game-Based Learning From Digital Game-Based Learning (McGraw-Hill, 2001) Fun, Play and Games: What Makes Games Engaging. [online] Available at:https://marcprensky.com/writing/Prensky%20-%20Digital%20Game-Based%20Learning-Ch5.pdf.

Rachmatullah, A., Reichsman, F., Lord, T., Dorsey, C., Mott, B., Lester, J. and Wiebe, E. (2021). Modeling Secondary Students' Genetics Learning in a Game-Based Environment: Integrating the Expectancy-Value Theory of Achievement Motivation and Flow Theory. Journal of Science Education and Technology. doi:https://doi.org/10.1007/s10956-020-09896-8.

Raghothama, J., Baalsrud Hauge, J. and Meijer, S. (2022). Curating Player Experience Through Simulations in City Games. Urban Planning, 7(2). doi:https://doi.org/10.17645/up.v7i2.5031.

Rahimabad, R.M. and Rezvani, M.H. (2020). Identifying Factors Affecting the Immersion and Concentration of Players in Serious Games. 2020 International Serious Games Symposium (ISGS). doi:https://doi.org/10.1109/isgs51981.2020.9375239.

Riva, G., Anguera, M., Wiederhold, B., Mantovani, F., Coelho, C., Tichon, J., Hine, T., Wallis, G. and Riva, G. (2006). From Communication to Presence: Cognition, Emotions and Culture towards the Ultimate Communicative Experience. [online] Available at: https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=91c7ce405eccda1b8cffe88059cf22cff4a65d8c.

Schalbetter, L., Salliou, N., Sonderegger, R. and Grêt-Regamey, A. (2023). From board games to immersive urban imaginaries: Visualization fidelity's impact on stimulating discussions on urban transformation. Computers, Environment and Urban Systems, 104, pp.102003 – 102003. doi:https://doi.org/10.1016/j.compenvurbsys.2023.102003.

Scribbr (2023). The Beginner's Guide to Statistical Analysis | 5 Steps & Examples. [online] Scribbr. Available at: https://www.scribbr.com/category/statistics/.

Singer, M.J. and Witmer, B.G. (1999). On Selecting the Right Yardstick. Presence: Teleoperators and Virtual Environments, 8(5), pp.566 – 573. doi:https://doi.org/10.1162/105474699566486.

SteamDB. (n.d.). Steam Database. [online] Available at: https://steamdb.info/.

Steam(2003). Welcome to Steam. [online] Steampowered.com. Available at: https://store.steampowered.com/.

Susi, T., Johannesson, M. and Backlund, P. (2007). Serious Games : An Overview. [online] DIVA. Available at: https://his.diva-portal.org/smash/record.jsf?dswid=-4555&pid=diva2%3A2416&c=2&searchType=SIMPLE&language=en&query=Serious+games%3A+An+overview&af=%5B%5D&aq=%5B%5B%5D%5D&aq2=%5B%5B%5D%5D&aqe=%5B%5D&noOfRows=50&sortOrder=author_sort_asc&sortOrder2=title_sort_asc&onlyFullText=false&sf=all [Accessed 8 Feb. 2024].

Tianmei Miaowu, 2021. Fantastic: Is it possible to use games for urban planning? - GameRes. [online] Available at: https://www.gameres.com/891307.html [Accessed 25 Mar. 2024].

Tse, D.C.K., Nakamura, J. and Csikszentmihalyi, M. (2022). Flow Experiences Across Adulthood: Preliminary Findings on the Continuity Hypothesis. Journal of Happiness Studies. doi:https://doi.org/10.1007/s10902-022-00514-5.

Vasuthanasub, J., Bucovețchi, O., Stanciu, R.D. and Badea, D. (2019). Conceptul de serious gaming aplicat în educaţie pentru managementul oraşelor viitorului. Revista Română de Informatică şi Automatică, 29(3), pp.41 – 50. doi:https://doi.org/10.33436/v29i3y201904.

Webster, J. and Hackley, P. (1997). Teaching Effectiveness in Technology-Mediated Distance Learning. Academy of Management Journal, 40(6), pp.1282 – 1309. doi:https://doi.org/10.5465/257034.

Wiseli, D., Tanusetiawan, R. and Purnomo, F. (2017). Simulation Game as a Reference to Smart City Management. Procedia Computer Science, 116, pp.468 – 475. doi:https://doi.org/10.1016/j.procs.2017.10.053.

Witmer, B.G. and Singer, M.J. (1998). Measuring Presence in Virtual Environments: A Presence Questionnaire. Presence: Teleoperators and Virtual Environments, 7(3), pp.225 – 240. doi:https://doi.org/10.1162/105474698565686.

Wikipedia Contributors (2019). Average. [online] Wikipedia. Available at: https://en.wikipedia.org/wiki/Average.

Wikipedia Contributors (2019). Standard deviation. [online] Wikipedia. Available at: https://en.wikipedia.org/wiki/Standard_deviation.

Wikipedia. (2022). Gameplay. [online] Available at: https://en.wikipedia.org/wiki/Gameplay.

Wu, H. and Leung, S.-O. (2017). Can Likert Scales be Treated as Interval Scales?—A Simulation Study. Journal of Social Service Research, 43(4), pp.527 – 532. doi:https://doi.org/10.1080/01488376.2017.1329775.

Appendix A - Questionnaire

Version1: Game Immersion Questionnaire

Chapter 1

Scoring criteria for chapter 1:

1: Not at all 2: Less 3: Fairly 4: More 5: Very much

1. To what extent did the game hold your attention?
2. To what extent did you feel you were focused on the game?
3. How much effort did you put into playing the game?
4. To what extent did you lose track of time?
5. To what extent did you feel consciously aware of being in the real world while playing?
6. To what extent did you notice events taking place around you?
7. To what extent did you feel as though you were separated from your real-world environment?
8. To what extent did you feel that you were interacting with the game environment?
9. To what extent was your sense of being in the game environment stronger than your sense of being in the real world?
10. To what extent did you feel as though you were moving through the game according to you own will?
11. To what extent did you find the game challenging?
12. Were there any times during the game in which you just wanted to give up?
13. To what extent did you feel emotionally attached to the game?
14. How much would you say you enjoyed playing the game?
15. How immersed do you feel at the start of the game?
16. How immersed do you feel at the end of the game?
17. Would you like to play the game again?

Chapter 2

Scoring criteria for chapter 2:

1: Very negative 2: Negative 3: No impact 4: Positive 5: Very positive

1. To what extent does the game has a full background including player affect the immersion of Cities: Skylines

2. To what extent does the processing and further use of products and resources in the game affects the immersion of Cities: Skylines
3. To what extent does the realism of the game affect the immersion of Cities: Skylines
4. To what extent do the visuals and audios that fit the game setting affect the immersion of Cities: Skylines
5. To what extent does the great amount of thinking and strategy affect the immersion of Cities: Skylines
6. To what extent does the initial distribution of resources affects the player's choice of initial build influences the immersion of Cities: Skylines？
7. To what extent does the ability to perspective shift affect the immersion of Cities: Skylines
8. To what extent do the different game stages where variations and limitations exist affect the immersion of Cities: Skylines
9. To what extent does the non-compulsory needs of the game's residents affect the immersion of Cities: Skylines
10. To what extent does the game has a clear objective affect the immersion of Cities: Skylines
11. To what extent does the game offers a lot of choices of building modules affect the immersion of Cities: Skylines
12. To what extent does the game is built from scratch affect the immersion of Cities: Skylines
13. To what extent does the game has transition animation to narrate affect the immersion of Cities: Skylines
14. To what extent does the weather system affect the immersion of Cities: Skylines
15. To what extent does the player needs to assign different numbers and types of workers to build rather than generating buildings directly affect the immersion of Cities: Skylines
16. To what extent does the player can customize their character's image affect the immersion of Cities: Skylines
17. To what extent does the game involves a lot of expertise affect the immersion of Cities: Skylines

Vesion2: Game Immersion Questionnaire

Chapter 1

Scoring criteria for chapter 1:

Using the words:

1. Very unaware 2. Unaware 3. Neither aware or unaware 4. ware 5. Very aware

How would you describe your play session with respect to the following statements:

1. To what extent did the game hold your attention?
2. To what extent did you feel you were focused on the game?
3. To what extent did you put into playing the game?
4. To what extent did you lose track of time?
5. To what extent did you feel consciously aware of being in the real world while playing?
6. To what extent did you notice events taking place around you?
7. To what extent did you feel as though you were separated from your real-world environment?
8. To what extent did you feel that you were interacting with the game environment?
9. To what extent was your sense of being in the game environment stronger than your sense of being in the real world?
10. To what extent did you feel as though you were moving through the game according to you own will?
11. To what extent did you find the game challenging?
12. To what extent did you just want to give up during the game?
13. To what extent did you feel emotionally attached to the game?
14. To what extent did you think you enjoy playing the game?
15. How immersed do you feel at the start of the game?
16. How immersed do you feel at the end of the game?
17. To what extent did you want to play the game again?

Chapter 2

Scoring criteria for chapter 2:

The concept of immersion means a state in which an individual is engaged in an activity, such as gaming, and is fully focused on that activity and loses awareness of external factors, such as time and sound. In this state, players may experience a sense of isolation from the real world. Flow theory, cognitive absorption, and presence are three key concepts used to describe immersive experiences. Flow theory is the ordered, fully functioning mental state in which an individual is fully focused on a challenge, which is usually accompanied by a loss of self-awareness and a distorted sense of time. Cognitive absorption is the trait of an individual's tendency to be fully attentive, which causes all of the individual's attentional resources to be consumed by the object of attention. Presence, on the other hand, is the subjective feeling of being in an environment even when the individual is not physically present in that environment. These three concepts of immersion form the theoretical basis for immersion research and related questionnaire design.

Using the words:

1: Very negative 2: Negative 3: No impact 4: Positive 5: Very positive

How would you describe the following game components impact on your immersion

Pre-question：Did you play the Cities: Skylines before?

Pre-question2：How long did you spend on this game?

1. In what ways does a full back story affect the immersion of Cities: Skylines?
2. In what ways does the processing and further use of products and resources in the game affect the immersion of Cities: Skylines?
3. In what ways does the realism of the game affect the immersion of Cities: Skylines?
4. In what ways do the visuals and audios that fit the game setting affect the immersion of Cities: Skylines?
5. In what ways does the amount of thinking and strategy required to play the game affect the immersion of Cities: Skylines?
6. In what ways does the initial allocation of resources resulting in a different distribution of buildings affect the immersion of Cities: Skylines?
7. In what ways does the ability to perspective shift affect the immersion of Cities: Skylines
8. In what ways do the different game stages where variations and limitations exist affect the immersion of Cities: Skylines
9. In what ways does the non-compulsory needs of the non-playable characters affect the immersion of Cities: Skylines
10. In what ways does the objective of the game affect the immersion of Cities: Skylines
11. In what ways does the amount of choices of building modules affect the immersion of Cities: Skylines
12. In what ways does buildings are built from scratch Instead of having semi-finished buildings in advance affect the immersion of Cities: Skylines
13. In what ways do the narrative transition elements affect the immersion of Cities: Skylines
14. In what ways does the weather system affect the immersion of Cities: Skylines
15. In what ways does assigning different numbers and types of workers to build rather than generating buildings directly affect the immersion of Cities: Skylines
16. In what ways does character image customization affect the immersion of Cities: Skylines
17. In what ways does the required level of expertise affect the immersion of Cities: Skylines

Appendix B - Tables

Table 3 Chapter1

Question Number	**1**	**2**	**3**	**4**	**5**	**6**	7	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Person 1	5	5	4	5	3	2	4	5	4	4	3	3	2	5	2	5	5
Person 2	5	5	5	5	4	3	2	3	3	4	2	1	4	5	3	5	5
Person 3	5	5	4	5	4	3	4	5	3	4	3	1	5	5	4	5	5
Person 4	4	4	5	4	3	2	4	3	1	2	5	2	3	3	4	1	2
Person 5	5	4	5	4	3	4	3	4	4	5	4	2	5	5	4	4	5
Person 6	3	3	4	4	2	3	3	3	3	3	3	2	2	4	3	2	3
Person 7	3	3	3	5	2	2	4	3	4	4	4	1	3	4	4	2	4
Person 8	5	5	5	5	1	2	5	5	4	3	4	3	4	5	3	5	1
Person 9	3	4	5	3	5	5	3	2	3	3	4	2	3	4	2	4	1
Person 10	5	4	3	3	4	2	4	4	2	2	2	2	4	4	1	5	4
Person 11	3	4	2	3	4	5	2	2	2	2	3	3	4	4	2	4	2
Person 12	3	2	3	4	2	1	4	4	3	4	3	2	3	4	2	4	3
Person 13	4	4	4	4	4	4	4	5	4	5	4	3	3	4	3	5	4
Person 14	5	5	5	3	5	4	2	5	5	4	4	3	4	4	4	4	4
Person 15	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Person 16	4	4	4	4	3	5	4	4	5	5	4	3	4	5	4	5	4

Table 4 Chapter2(1)

Question Number	Pre-question1	Pre-question2	1	2	3	4	5	6	7	8
Person 1	Yes	150h	This game doesn't have it	This game doesn't have it	5	5	4	4	2	3
Person 2	Yes	>2.000 hours	This game doesn't have it	3	5	3	3	2	3	1

Person 3	Yes	11000 hours	4	4	4	5	4	3	5	4
Person 4	Yes	40h	This game doesn't have it	4	4	4	3	4	4	2
Person 5	Yes	27hours	4	3	4	4	5	4	2	3
Person 6	No	0	3	3	3	3	3	3	3	3
Person 7	Yes	140hrs	This game doesn't have it	4	3	4	4	4	4	3
Person 8	Yes	< 10 hours	2	3	2	4	4	4	3	3
Person 9	Yes	2h	This game doesn't have it	3	5	3	5	1	1	5
Person 10	Yes	32h	3	3	4	4	2	3	2	3
Person 11	Yes	3h/day	2	4	2	4	4	4	4	2
Person 12	No	0	4	3	3	3	4	3	2	4
Person 13	Yes	2h	4	5	5	4	5	4	3	5
Person 14	Yes	95.3h	This game doesn't have it	4	This game doesn't have it	4	4	4	This game doesn't have it	4
Person 15	Yes	20Hours	2	5	5	5	4	3	5	4
Person 16	Yes	twice a week	4	3	4	3	3	4	4	4

Table 5 Chapter2(2)

Question Number	9	10	11	12	13	14	15	16	17
Person 1	2	2	4	5	1	2	This game doesn't have it	This game doesn't have it	3
Person 2	2	3	5	1	2	3	4	This game doesn't have it	5
Person 3	4	4	5	3	5	4	4	4	4
Person 4	2	3	4	5	3	3	4	5	2
Person 5	4	4	4	3	4	4	2	5	2
Person 6	3	3	3	3	3	3	3	3	3
Person 7	This game doesn't have it	3	4	3	This game doesn't have it	2	3	This game doesn't have it	2
Person 8	3	4	4	4	3	5	4	4	5
Person 9	3	4	1	4	2	4	2	1	This game doesn't have it
Person 10	3	3	3	5	3	5	3	3	3
Person 11	4	1	2	4	4	3	5	3	2
Person 12	4	3	3	4	3	4	4	3	4
Person 13	4	5	4	5	4	5	5	4	5
Person 14	5	5	5	4	4	4	3	4	4

Person 15	2	5	4	5	This game doesn't have it	5	5	1	5
Person 16	4	4	4	4	4	4	4	4	4

Table 6 Average Value and Standard Deviation Chapter1

Question	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Average Value	4.19	4.12	4.13	4.13	3.38	3.25	3.56	3.88	3.44	3.69	3.56	2.38	3.63	4.38	3.13	4.06	3.56
Standard Deviation	0.91	0.89	0.96	0.81	1.20	1.34	0.96	1.09	1.15	1.08	0.89	1.02	0.96	0.62	1.09	1.29	1.41

Table 7 Average Value and Standard Deviation Chapter2

Question	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Average Value	3.2	3.6	3.87	3.88	3.81	3.38	3.13	3.31	3.27	3.5	3.69	3.88	3.21	3.75	3.67	3.38	3.53
Standard Deviation	0.92	0.74	1.06	0.72	0.83	0.89	1.19	1.08	0.96	1.10	1.08	1.09	1.05	1	0.98	1.26	1.19

Appendix C - Consent

Consent Form

Name of activity: The study of immersive experiences in city simulation games

Description of the activity

This is an activity based on a Master's thesis in Serious Games at the University of Skovde. The research conducted by the activity is related to immersion. I Sincerely ask you to help me with this activity by filling in the questionnaire and letting me analyse the information from the questionnaire result data.

Risks and benefits

This programme does not collect any personal information about participants, including names, emails, etc.

Confidentiality and data handling

The data you provide about the questionnaire will be used to analyse in what ways gameplay elements in the City Simulation Game affect immersion
The information you give us will be recorded and stored securely. Even though I will not be collecting any sensitive information, I will still keep your data confidential and only use it for research on immersion in city simulation games. I will not use the data from this activity in any other way that is not relevant to the research.

Consent of activity participants

I have read the above information and have been given the opportunity to ask questions about the research on immersion in city simulation games and how my information will be used. I understand the purpose of this activity and what my participation entails.

I agree to participate in this activity and complete the questionnaire and agree to share the data I have provided with the researcher. I understand that I have given my consent and that I can withdraw at any time if I wish.

I understand that the data I provide may be used in a Master's thesis examining immersion in city simulation games and may also be published online.

I understand that my participation is voluntary and that I may withdraw from the study at any time I choose.

Because this activity does not collect any personal information from participants, so signatures and email addresses are not required.

Name of researcher: Peng Ding

Contact information: a23pendi@student.his.se

Date: 2024.3.31