

Developing A Data Collection Tool Using Urban Gamification: Case of Waterfront In Bangkok

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Received 26/05/2023; Accepted 20/04/2023

Abstract:

The participatory process is significant in contemporary urban development, as it involves multiple parties in the decision-making and design processes, while also addressing the urban development challenges. This research aims to create a data collection tool using gamification as a method to facilitate communication and decision-making between the government, private sector, and local people regarding the management of waterfront public spaces in Bangkok. The prototype of the urban simulation game is designed to engage and educate the public about the importance of these spaces in the city's development and to allow different stakeholders to explore various scenarios and solutions related to urban development and public space management. The study reviews literature on urban gamification, participatory processes, data collection tools, and waterfront development case studies. The methodology includes a description of the research design, data collection, analysis methods, study area, tool selection, and game testing. Results include a description and analysis of the data collection tool, findings from game testing comparison with existing data collection tools, and implications for waterfront development and management. The overall objective of the prototype is to promote cooperation and understanding among stakeholders in managing Bangkok's waterfront public spaces. The conclusion summarizes the key findings, implications, and recommendations.

Index Terms: Urban development, Data collection tool, Participatory methods

1. INTRODUCTION

Urban development in Bangkok has faced numerous challenges in recent years, including the management of public spaces. The development of these areas requires a collaborative effort between the government, private sector, and local people. However, stakeholders often have conflicting interests and varying levels of understanding about the importance of public spaces and their role in the city's development. To overcome these challenges, the research focuses on the development of a prototype of an urban simulation game that serves as a communication tool between these different parties.

Gamification refers to a strategic approach aimed at improving systems, services, organizations, and activities by creating experiences that are similar to those encountered during gameplay. The primary goal of this approach is to motivate and engage users in a way that fosters greater participation and interaction [3]. As per the definition provided by the Gamification Research Network [2], gamification refers to the deliberate integration of video game components in non-gaming systems to enhance user engagement and overall user experience. The concept of urban gamification, therefore, entails utilizing video game elements in non-gaming urban systems to enhance user engagement and participation with the urban

environment. The fundamental objective of urban gamification is to create an immersive and interactive urban environment that encourages citizens to explore and engage with their surroundings. By incorporating game-like elements such as points, challenges, and rewards, urban gamification seeks to incentivize citizens to participate in activities that improve their local community while also fostering a sense of community pride and ownership. Overall, the application of gamification principles in urban environments has the potential to transform the way in which citizens interact with and perceive their cities.

The game in this research is designed based on the typology of waterfront public spaces in Bangkok, which is made up of water communities. The objective of the game is to engage and educate the public about the importance of waterfront public spaces and their role in the city's development. By using gamification, the game provides an interactive and engaging experience that allows different parties to explore various scenarios and solutions related to urban development and public space management.

Overall, the prototype of the urban simulation game aims to promote cooperation and understanding among various stakeholders in managing Bangkok's waterfront public spaces. The game's design allows for a participatory process that involves stakeholders in decision-making processes and encourages them to consider the needs and interests of others. Through this approach, the research aims to contribute to the development of more effective tools for managing public spaces and promoting sustainable urban development in Bangkok.

LITERATURE REVIEW

A. Participatory Development

Participatory development (PD) aims to involve local communities in development initiatives. Since its emergence in the 1970s as a key component of the "basic needs approach" to development, PD has manifested itself in various forms [1]. In the field of urban planning, participatory planning is a paradigm that highlights the importance of involving the entire community in the process of community planning. This approach emerged as a response to the centralized and rationalistic approaches that were prominent in early urban planning work [5]. Participatory planning is a broad and diverse paradigm that incorporates various theories and approaches to community planning. There is no one theoretical framework or set of practical methods that make up participatory planning. Instead, participatory planning programs typically prioritize the integration of technical expertise with the preferences and knowledge of community members in the planning process. These programs emphasize consensus building and collective community decision making, and they prioritize the participation of traditionally marginalized groups in the planning process [6]. Participatory planning programs employ a wide range of methods and tools to facilitate public participation in the urban planning process. Since the 1960s, planning programs have relied on a wide range of tools such as referendums, focus groups, consensus conferences, citizen advisory committees, public hearings, and public opinion surveys in order to facilitate public participation [7], [8].

B. Bangkok participatory process

At present, the avenues available for voicing opinions concerning city development in Bangkok are extremely limited. One option is to communicate with the candidate governor of Bangkok, with the belief that these opinions will be translated into policy. The lack of accessible platforms for public engagement in urban planning and development can result in the neglect of citizen voices, leading to a disconnect between the needs and aspirations of the populace and the actions of city planners and policymakers. A more comprehensive and participatory approach to urban planning and governance is essential to ensure sustainable and equitable development of cities like Bangkok. Such an approach would enable the active involvement of diverse stakeholders, including citizens, civil society organizations, and private sector entities,

in the decision-making process, facilitating the co-creation of inclusive and responsive urban spaces.

C. Public Participation and Visual Surveys

The use of visual surveys in participatory planning involves presenting sets of photographs of buildings, streets, parks, and other examples of a region's built or natural environment to community members, who are then asked to rate each image on a scale from -10 to +10. This allows participants to build consensus on how they would like their communities to be designed and situated. Anton Nelessen and Associates popularized image surveying techniques in the 1990s with the development of the Visual Preference Survey™ (VPS™), which has been successful as an educational tool and public participation process. In recent years, computer simulation has been incorporated to enhance visual surveys. CivicWell (formerly the Local Government Commission) has also developed a form of visual survey called The Community Image Survey, which consists of 40-60 slides with approximately 80% of the images coming from the specific locale in which the survey is conducted. These surveys have proven to be effective in promoting community participation and understanding, as well as providing planning professionals with a better understanding of residents' preferences.

Interactive physical design games and models have proven to be invaluable tools in supporting urban development. During the initial stages of project conception and scoping, these games and models facilitate the collaboration of all stakeholders in an open and constructive environment, enabling them to appreciate the diverse range of interests, knowledge, and constraints involved. This can help alleviate potential opposition and enable communities to meaningfully participate in decisions that affect their neighborhoods. Co-Design games can expedite the development, assessment, and refinement of options for master plans, housing, and public realm projects by leveraging the combined knowledge of different consultants and stakeholders, thereby streamlining lengthy individual consultations. Ultimately, this can lead to rapid innovation and collective decision-making, creating a genuine shared vision to anchor the development process. Dr. Anthony Duckworth-Smith of the Australian Urban Design Research Centre (AUDRC) has developed a suite of physical model tools in **Error! Reference source not found.** to tackle various development scenarios and enable the benefits of these games and models to be effectively applied in the development process.

Various models, including “Master my Plan,” are currently being developed and tested. It is evident that traditional physical game boards, along with the act of playing together, facilitate the comfortable exchange of knowledge, values, ideas, and expectations among all parties with an interest. This creates significant opportunities for learning and communication about the challenges and opportunities involved in shaping our future cities [11].

The PB Board Game in **Error! Reference source not found.** is a novel approach that facilitates public participation in the decision-making process for the preparation of specific portions of the state's budget, by soliciting ideas, suggestions, and projects that will lead to urban development that aligns with the needs of local communities. This innovative initiative was designed with the intention of promoting a collaborative and educational environment, rather than creating a competitive atmosphere with winners and losers. The board game provides a structured framework for team meetings, serving as a starting point for stimulating creativity and innovative thinking among the participants. By leveraging this approach, a diverse range of stakeholders can actively engage in the decision-making process, including members of the public who might not have otherwise had the opportunity to participate. In sum, the PB Board Game represents a compelling tool to foster public participation, collaboration, and learning, promoting the creation of inclusive and responsive urban development policies [10].

Traffy Fondue, a municipality complaint reporting and management system, was developed by NECTEC-NSTDA. This system, powered by artificial intelligence (AI) and linked with the

LINE messaging application, serves as a chatbot that engages residents in solving city problems. Urban maintenance is made easier through the use of this app, which allows residents to report city problems and receive updates on the case from city administrative offices through the LINE messaging application. Residents can file a report on the app, take a photo, and provide GPS locations. The report, along with the photos and locations, is then directed to the concerned department for resolution, and the department provides an update on the case that can be viewed by the person who filed the report.

Traffy Fondue offers several benefits, such as a faster response time from the city, resulting in cost savings and better maintenance planning and management. For residents, problems can be reported instantaneously via the mobile phone application, without the need to file complaints in person at the city hall, saving time and cost. The system has been used by 1,754 organizations, including 96 disaster prevention and mitigation offices, 577 town municipality offices, 459 subdistrict administrative organizations, 262 office buildings, and 18 industrial estates. It has enabled a total of 78.14 million THB cost savings, with a user satisfaction rate of 89%. The NECTEC research team will be able to obtain more information and requirements from users to further enhance the features of Traffy Fondue and better serve the public under this collaboration. The platform has been deployed to manage crisis situations such as the COVID-19 pandemic and the recent flooding in the Bangkok Metropolitan Region. With the continuous development and improvement of Traffy Fondue, the system can provide a more efficient and effective solution for urban maintenance and management in the future [9].

There're several methods in urban development to find the consensus. Urban gamification, which involves the application of game-like elements to urban environments, can offer a unique way for individuals to engage with and experience a city. While a city's infrastructure is crucial for livability, the element of enjoyability is often overlooked. By incorporating play and games into the built environment, urban gamification can improve user engagement and create transformative experiences for individuals. This approach utilizes game-like attributes such as point scoring, competitions, and rules of play to encourage participation and interaction among individuals of all social backgrounds.

Moreover, Traffy Fondue's use of artificial intelligence (AI) and gamification elements, such as the ability to take photos and track the progress of reported issues, adds an interactive and engaging element to the participatory process. This incentivizes residents to take an active role in identifying and solving problems in their community.

Overall, Traffy Fondue's participatory approach to urban governance empowers residents and promotes transparency and accountability in city maintenance operations.

D. URBAN MENUS

URBAN MENUS is an example of a tool that is utilized to create consensus among different parties which is a web-based tool that enables the display of future visions for city quarters in a multidimensional 3D format, allowing for a more holistic and comprehensive discussion. The tool provides a 3D visualization of urban spaces from various viewpoints and configurations, aiding in understanding and analysis. Additionally, it features an integral impact assessment that utilizes algorithms and indicators to demonstrate the impact of planning on factors such as happiness, safety, innovation, profitability, and circularity. To facilitate consensus among various stakeholders, users can participate and share their preferred planning versions, and the tool can be integrated into participatory workshops or online participation to optimize planning processes and identify shared visions.

It also offers a digital-assisted approach to shared future development, allowing conflicts to be resolved and greater potential to be achieved. This 3D tool and training programs are best implemented in the early stages of a project to achieve a balance between architectural features and comprehensive impact assessment. Unlike traditional tools that focus solely on in-depth

planning or specific impact assessments, URBAN MENUS allows for a discussion of essential topics while taking into account architectural and spatial planning parameters.

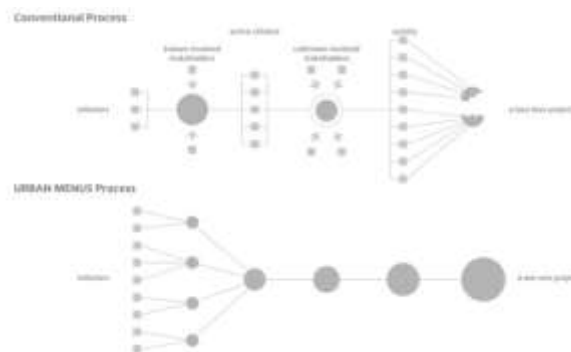


Fig. 1. URBAN MENUS's process compared to the linear conventional process.

By involving all relevant stakeholders from the outset of the process, URBAN MENUS facilitates negotiations and consensus-building, enabling the identification of risks, challenges, and opportunities prior to decision-making. As a result, all stakeholders can benefit from the decision-making process and agreements can be accepted and cherished by the community. Furthermore, the platform also provides a comprehensive understanding of a city quarter's sustainability characteristics such as happiness, safety, stability, innovation, and circular economy, in line with the UN's sustainability goals and EU green deals. The tool offers multiple perspectives and options for urban development by manipulating ecological, urban, and density levels. The integrated impact analysis generates transparency in decision-making processes by measuring impact through a multi-criteria approach that considers over a hundred detailed parameters. The holistic approach facilitates efficient information retrieval for all stakeholders, enabling them to understand the effects and derive a consensus on a balanced future scenario. The tool's generic structure allows for dynamic extensions to accommodate new collective developments and transitive impact assessments. The goal is to create urban spaces that work for inhabitants and all users.

SimCity **Error! Reference source not found.** is a popular and influential city-building video game series that was first developed by game designer Will Wright in 1989. The original game, which was published by Maxis, quickly gained a cult following and spawned several sequels, as well as numerous other spin-off titles in the "Sim" series, including the hugely successful 2000 game *The Sims*.

Maxis continued to develop the series independently until 1997, when it was acquired by Electronic Arts (EA), which continued to release new titles in the series. During the 2000s, EA also commissioned spinoffs from other companies, with a focus on console and mobile releases.

However, a 2013 reboot of the series developed by EA-Maxis was widely criticized for its poor quality and subject to what has been called "one of the most disastrous launches in history". This event has been cited as a contributing factor in the 2015 closure of Maxis Emeryville and the eventual end of the franchise. Despite this setback, the *SimCity* series remains an important and influential part of the video game industry, and its impact can be seen in many other city-building games that have followed in its wake.

Using 3D Participatory Planning to Enrich Community Engagement: Lessons From a City Planning Project in Turku, Finland "3D enables citizens to understand the plan better than on a 'traditional' 2D map, and thus also makes it easier to comment on the plan" — Matilda Laukkanen, City Planner in Turku. A pilot project conducted by the University of Turku and the City of Turku in Finland explored the potential of 3D participatory planning. The project

involved creating a survey using 3D maps for public engagement and feedback on the redevelopment plan of the Aninkainen district in Turku, one of the largest urban areas in Finland. The initiative was inspired by the university's GreenPlace research project, which utilizes digital 3D models and public participation methods to evaluate the impact of urban green space on wellbeing. The project was spearheaded by Dr. Nora Fagerholm, an adjunct professor at the university's Department of Geography and Geology. The results of the project showed that 3D participatory planning can enhance public engagement and participation in the planning process, particularly in large urban areas. Cities are progressively incorporating their data models into three-dimensional reality, which provides a visual representation of the scale and height of a plan. This 3D modeling technique can be used in public participation initiatives to understand how citizens experience urban spaces. It also allows citizens to access spatial information in a more comprehensive way and provide precise feedback, including commenting on specific elements of the modeled environment such as roofs and walls of buildings. As far as urban planning is concerned, 3D modeling is becoming an integral part of the planning process [11].

E. The String Questionnaire

In order to investigate the needs and preferences of different demographics regarding the design of waterfront public spaces, a playful questionnaire board was installed at the Bangmot festival. The board was designed to collect information under the topic of "Design Your Waterfront Public Space," asking participants to choose their preferred spaces and activities. The questionnaire included basic demographic information such as whether they lived in the waterfront area, the size of their family, and their age, as well as inquiries about preferred activities.



Fig. 2. Questionnaire board installed at Bangmot fest asking about “What is your dream waterfront public spaces?”

Audiences were asked to wire the string on each node connected in different colors, which allowed for a visual representation of the density of interest in each specific node. Participants were also able to pin sticky notes expressing their personal opinions about the public waterfront area. This methodology was able to highlight the different needs between various demographic groups, such as small families requiring more recreational areas where they can enjoy activities with their children.

While the questionnaire board methodology may not have captured a representative sample of the entire population, it provided a valuable platform for ordinary citizens to express their opinions and thoughts on the city's development in a personalized manner. The results of the questionnaire board illustrated a basic correlation between the answers and the string density,

offering insight into the different preferences and needs of various demographic groups. After reviewing all secondary data and the questionnaire board mockup, the researcher was able to establish the themes and questions for the study. These include investigating people's needs for waterfront public spaces in terms of function and aesthetics, exploring how game-based tools can improve data collection and encourage participatory processes, and analyzing how players from different generations seek different solutions to urban development challenges. By addressing these questions, the study aims to contribute to the creation of more inclusive and effective urban development strategies.

2. METHODOLOGY

a. Research methodology

The present research employs secondary data from various sources such as books, research papers, and online examples to identify gaps and interesting points regarding the thesis questions. This study utilizes a mixed-method approach, combining both qualitative and quantitative methods, specifically, the administration of a self-administered questionnaire. The questionnaire will be administered to the testing samples, who will be invited to play the game mockup and provide information on several aspects, including demographic data, city development, the participatory process, and their subjective rating of the game.

b. Testing samples

In order to ensure a broad and representative testing sample for the game mockup, participants will be recruited from a wide range of age groups. This includes individuals from the teenage generation who are currently studying in university programs, as well as adults and elders. By incorporating a diverse range of participants, the research aims to gain insight into how different generations engage with the participatory process of city development, as well as how they perceive the game.

The rationale behind recruiting participants from multiple age groups is based on the assumption that each generation may have unique experiences and perspectives when it comes to urban development. For example, younger generations may have grown up in a more digitally-oriented environment, and may be more accustomed to utilizing technology in everyday life. Meanwhile, older generations may have lived through significant changes in urban landscapes and may have a deeper understanding of the historical context of urban development. The game mockup is designed to allow participants of all ages to express their personal opinions and attitudes toward city development in a playful and interactive manner. By gathering feedback from a diverse range of participants, the research can identify patterns and commonalities in the way that different age groups approach the participatory process of urban development. The testing results will also allow the researcher to identify areas where the game design could be improved to make it more accessible and appealing to a wider range of age groups.

c. Game Development Software Selection

The methodology utilized in this research involved a thorough consideration of available software options for game creation to ensure a suitable match with the research framework. Testing was conducted using a variety of software options, starting with 2D game software such as GDevelop 5. This software was chosen due to its status as a free, open-source, and cross-platform game creation tool that does not require programming skills. Results showed that GDevelop 5 was an effective choice for creating 2D games and offered a comprehensive range of features and functionality, making it a valuable asset to the research efforts.

As the research progressed, testing was expanded to include 3D software options, such as

Unreal Engine 5, with a rich history, having first been showcased in the 1998 first-person shooter game Unreal, and since utilized in a wide variety of game genres and industries, including film and television. Developed by Epic Games, Unreal Engine 5 is written in C++ and boasts an impressive degree of portability, with support for desktop, mobile, console, and virtual reality platforms. Results showed that Unreal Engine 5 was an excellent choice for creating 3D games, offering a robust set of features and tools that were well-suited to the research needs. Overall, the selection process for game creation software was thorough and considered, with the choices made instrumental to the research success.

3. RESULTS

a. Game Design Development

The present study has sought to develop game mockups utilizing a diverse range of software options, with the objective of identifying potential software tools that align with the research framework. Each game mockup version has been designed to be distinct in its graphics, interfaces, gameplay processes, and city design outcomes. The implementation of a varied range of software options has allowed for a comprehensive examination of the differing capabilities and limitations of each option. By exploring the potential of different software tools, the study has been able to establish the most suitable software options to employ in order to meet the research objectives. The results of the game mockups have revealed notable differences between the software options in relation to their potential for game development. Specifically, certain software options have been found to be more advantageous for the creation of 2D games, while others demonstrate a greater aptitude for the development of 3D games.

Moreover, the outcomes of the game mockups have facilitated an in-depth exploration of the features and functionality offered by each software option. This has facilitated a more informed selection process in regard to the most suitable software option for the research.

b. The game user's Journey

The game design process for the user journey was developed to be simple and easy to understand for a wide range of users. Initially, users are asked to fill out a basic questionnaire with demographic information. Once completed, they can begin the game and access the main interface, which presents a canvas of the waterfront area along with a sidebar containing provided elements separated into different categories, including social, economic, and environmental aspects. Users can then add desired elements to their own space on the canvas and click on a video button to switch the camera angle to view the design from different perspectives, including eye-level and holistic views. This feature distinguishes the urban game from normal games, as users can view the real-time results of their design and communicate with others to establish an agreement or conversation, even if they have no background in design. This game design process offers various benefits. First, it enables a more comprehensive understanding of the proposed design from various angles. Additionally, users can interact with one another to establish a common agreement and receive feedback from others, which can enhance the overall design quality. The game's simplicity and intuitive interface make it accessible to users with varying levels of experience, including those without a design background. The design process also presents some limitations, such as the limited range of provided elements and the lack of customization options. Nonetheless, the game still serves as a valuable tool for engaging and involving the community in the urban design process, allowing users to provide input and feedback that may inform and improve future city planning initiatives.

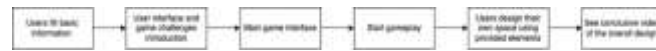


Fig. 3. The game user's journey

c. Version 1 Game Development

The findings of the initial game mockup, Version 1, were generated using sketches, a 2D game development. The focus of this version was to create a user-friendly interface, ensuring accessibility for users with minimal game development experience.

To achieve this objective, Version 1 features a simplistic design and layout, with easily navigable menus and intuitive gameplay mechanics. The use of Keynote as the software tool for this mockup allowed for the seamless integration of user-friendly interfaces and the creation of a visually appealing game environment.

Version 1 of the design tool was developed with the purpose of integrating tiles depicting various urban elements, such as furniture and trees. Additionally, the tool provides a canvas where users can drag and drop these elements to express their ideas. Certain areas on the interface are designated for presenting the score, which is calculated based on the quantity and categories of elements added by the user. These categories align with the Sustainable Development Goals (SDGs) and emphasize sustainable aspects.

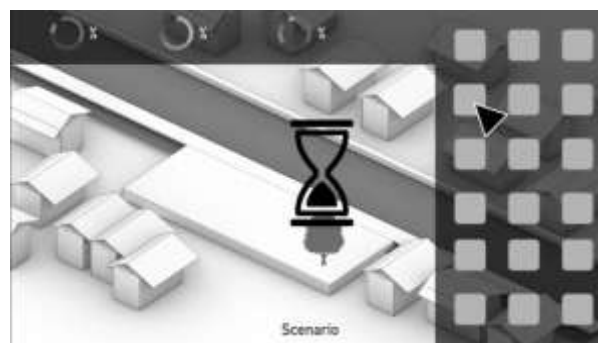


Fig. 4. The initial user interface of the prototype game (Version 1)

d. Limitation of version 1

The experimentation for version 1 gives the idea of how the overall of the game will look like when the end-user is playing. However, the tool used to develop, Keynote, can only show the apperency of the game without the interaction and user engagement. The next step could be the development of the interface where user can interact using their gesture to control the game element.

e. Version 2 Game Development

Version 2 of the game was designed with a focus on enhancing the visual appearance of the surroundings, using realistic colors and materials. The game was developed using GDevelop5, a 2D game maker that allows users to drag and drop elements onto the canvas. As users drag an element, it follows their finger until it is dropped onto the canvas. Users can select as many objects as they wish until the desired result is achieved. This version was specifically developed with the understanding that users will be playing on touch screens, such as an iPad, to provide a user-friendly experience for a wider audience.

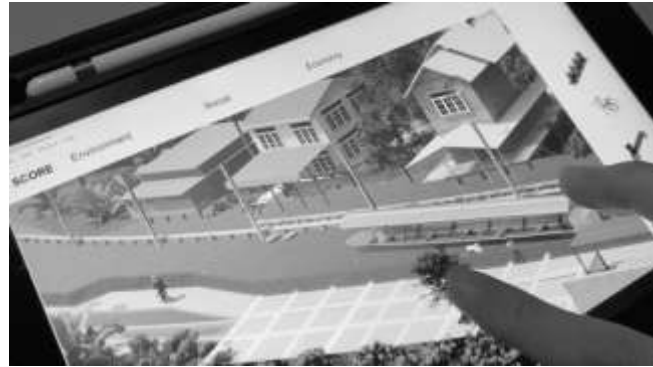


Fig. 5. The initial user interface of the prototype game (Version 2)

f. Limitation of version 2

Version 2 of the game design emphasizes a more realistic and interactive approach to the user's experience. However, it has been noted that the final result for the user remains on the isometric viewpoint, which may not be easily understood by the general public. To address this issue, researcher has planned a final phase of development where a "conclusive video function" will be added to showcase the final outcomes of the user's input. This function will provide a view constructed using a camera positioned at eye level, allowing users to see the overall environment and provide a more relatable human scale. The addition of this function is expected to enhance the user experience and improve the game's overall accessibility.

g. Version 3 Game Development (Final Version)

The final version of the game is primarily focused on testing and evaluation with the participation of 20 users. These users will be asked to test the game for a specific period of time and then provide feedback about the game's overall performance, their participation in the city's development, their satisfaction with the game, and any suggestions for future development.

Version 2 limitations were taken into consideration while developing the final version. The game is built on a 3-dimensional world using Unreal Engine 5, which provides a comprehensive view of the environment. UE5 offers a more realistic and real-time rendering of the environment, including shadows, materials, water movement, and other aspects. This rendering is expected to be a significant factor in user satisfaction, as users can see their designs come to life in the game.

The interface includes buttons that allow the user to select and drag elements from the menu and drop them onto the site. Additionally, a conclusive video button has been added to the interface. When this button is pressed, the camera will be oriented throughout the site to show an overall picture of the design, providing users with a better understanding of the design and how it fits into the surrounding environment.



Fig. 6. The initial user interface of the prototype game (Final version)

This scenario serves as an exemplary demonstration of how users can configure the game objects by utilizing the drag and drop feature, which enables them to see the outcome of their designs in real-time. The objects themselves are categorized into various groups, including physical activities, entertaining activities, environmental elements, utilities, education, and commercial activities. When given a blank canvas, users are prompted to design their own waterfront area based on the "Dream Waterfront" topic, which is intentionally open-ended to encourage creative and diverse ideas.

By utilizing this approach, the game aims to provide users with an engaging and interactive platform to explore various design concepts and strategies, thereby promoting greater awareness and understanding of the importance of waterfront public spaces in the context of urban planning and development. Moreover, the categorization of game objects enables users to create a holistic and well-rounded waterfront area that incorporates various elements essential to the success of any public space, such as commercial amenities, educational facilities, and environmental sustainability features. Through the use of the drag and drop feature and the open-ended design prompt, users are empowered to exercise their creative and critical thinking skills, and to develop a deeper appreciation for the complexities involved in designing and managing urban public spaces. Overall, the game serves as a valuable tool for promoting cooperation and understanding among various stakeholders in the process of managing waterfront public spaces and advancing the broader goals of urban planning and development.

h. Questionnaire Survey

In order to gain insights into the relationship between the game prototype and the user's personal opinion, a survey was conducted in parallel with the game testing. The survey was divided into four parts, namely general information of the user, their opinion about the existing process of participation in Bangkok, their views on the game development and its performance, and an open-ended section for feedback and suggestions for future development. The first part of the survey aimed to collect demographic information such as age, gender, and place of residence of the user.

The second part of the survey was designed to explore the user's engagement with the process of city development in Bangkok. Users were asked to provide their opinions on how they currently participate in the city development process, and to suggest ways in which they can effectively raise their voice to the public.

The third part of the survey focused on the game development itself and evaluated the performance of the game. Users were asked to share their emotions and opinions after playing the game. This section was particularly important in evaluating the effectiveness of the game prototype in achieving its objectives.

The fourth and final part of the survey provided an open forum for the user to give their feedback and suggestions for future development. This section was particularly useful in gathering information on areas that require improvement or innovation. The survey was an important component of the research design, providing valuable insights into the users' perspectives and opinions.

The results of the game testing conducted with the first 10 users have provided valuable insights into the preferences and needs of the younger generation with regards to urban design and development. The users who participated in the testing were a mix of physical and online players, with half of them belonging to the age group of 12-25 years old, which mainly comprises university students.

The findings of the research indicate that social media is the primary platform that these users use to share their opinions related to the city design and development, while they have limited

opportunities to participate in public forums. This was reflected in the low rating given by the users when asked about their engagement levels towards city participation. The responses to the question about their "dream waterfront space" revealed that they need more green spaces and areas for activities and music events. This suggests that the city lacks sufficient relaxing spaces.

In addition, the research explored the factors that influence users' decisions to use public spaces. The majority of the respondents rated cleanliness and security as the most crucial factors, followed by service facilities, parking areas, and green spaces.

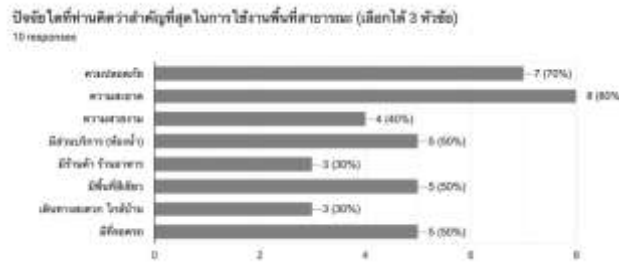


Fig. 7. Questionnaire results of “What is the most important factor in using public space?”

The game testing proved to be a success, with more than 80% of users stating that they would consider playing the game if it were available in the market. The feedback received from the users highlighted that the game was easy to understand and follow, and the time spent on the game varied from less than 1 minute to more than 10 minutes, depending on the users' preferences. The testing game was different from serious games that have a mission to be achieved and workshops conducted in public in urban design where people have a chance to play while discussing related issues.

Regarding the testing game preferences, users gave a high score in three areas, including game journey, artwork design, and eye comfort, which were the main factors that the research aimed to achieve for the general use. However, it is important to note that the users who participated in the testing were mainly university students who are already familiar with technology adoption and may be easily convinced with these types of products.

The users expressed the need for additional functions in the game's future development, such as a gallery displaying the works of other players who have had the chance to play the game, a web board where they can share their opinions using words and pictures, and a feedback mechanism to submit their opinions to the government, whose actions can reflect the voice of the people. Overall, the game testing results have revealed useful insights into the preferences and needs of the younger generation related to urban design and development, and provide a basis for further research in this field.



Fig. 8. Questionnaire results of “What is your dream waterfront public space?”

The questionnaire also provided an opportunity for participants to share their opinions on design intention derived from the game results, specifically how their proposed solutions could create public spaces that support various activities. Notably, some of the interesting comments highlighted the importance of green spaces that facilitate relaxation and social activities. The final question asked about how design proposals could reduce the heat island effect, and respondents offered two main suggestions. The first involved increasing the amount of green space, which would provide shading, while the second focused on reducing energy consumption.

4. DISCUSSION

The results of the present study have demonstrated the effectiveness of utilizing gamification as a method for urban participatory processes in collecting individual needs and acting as a tool for negotiation among different parties. However, it should be noted that the study mainly focused on the first prototype of the game which was designed based on the context of Bangkok, Thailand, to provide users with a full understanding of how to express their opinions. Despite the success of the game, there are still several areas that need to be addressed in future research.

One of the areas of concern is the limited coverage of certain subjects, such as generational gaps and implementation of the game in real urban situations and problems. Another area for improvement is the adoption of the game on different platforms, including mobile or tablet devices. Additionally, there is a need for a more systematic method for collecting data from the game results.

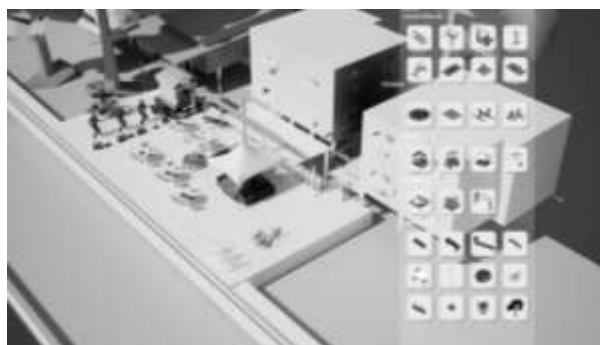


Fig. 9. The initial user interface of the prototype game (Testing by questionnaire participant)

Furthermore, the resources required to craft a full version of the game pose a significant challenge. The game's graphic quality needs to be tailored to the Thai context, and the game elements must cover both private and public sectors where conflicts of interest may emerge. Additionally, the game's rules, including its scoring system, could be further integrated to increase its level of challenge and to align with established standards, such as the Sustainable Development Goals (SDGs) or other sustainability-related issues.

5. CONCLUSION

The study has focused on the creation of a prototype urban simulation game that functions as a communication tool between the government, private sector, and local communities. The game map has been designed based on the typology of waterfront public spaces in Bangkok, which mainly consists of water communities. The primary aim of the game is to inform and

educate the public about the significance of waterfront public spaces in the city's development. Additionally, the game provides diverse stakeholders with an opportunity to explore various scenarios and solutions related to public space management and urban development. The result of the testing game showed that it creates an engaging and interactive platform for the public to express their opinions on the design and development of the city within the context of Thai public spaces. The research provides insights into the use of gamification as a tool to facilitate urban participatory processes and promote cooperation among stakeholders.

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