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Serious Planning Games

Tese no âmbito do Programa Doutoral em Planeamento do Território, orientada pelo Professor António Pais Antunes, Professor Nelson Zagalo e Professor Nuno Norte Pinto, apresentada ao Departamento de Engenharia Civil da Faculdade de Ciências e Tecnologia da Universidade de Coimbra.

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Serious Planning Games

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GRANT INFORMATION

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RESUMO

Parece existir uma crise da participação cívica, ainda que os cidadãos desejem participar nos assuntos coletivos e públicos. Mas nas sociedades contemporâneas há um sentimento de urgência e pressão pelo tempo e atenção dos indivíduos. Os cidadãos exigem níveis mais elevados de participação e que os resultados sejam consequentes. Os planeadores estão a tentar encontrar novas abordagens para lidar com estas exigências enquanto ensaiam métodos de recolha de informação para apoio aos seus processos. As abordagens do planeamento colaborativo têm vindo a ser testadas, pelo menos, nos últimos trinta anos, como modos de fazer aumentar os níveis de participação geral e gerar resultados concretos. Participação sem resultados consequentes é um problema que planeadores, políticos e decisores devem ter em conta nas suas atividades e ações. Os jogos sérios têm sido utilizados como ferramentas de apoio ao planeamento para incentivar a participação e recolher informações que dificilmente seriam obtidas através de outros métodos.

A presente tese explora como os jogos no geral, e depois os jogos de tabuleiro modernos em particular, podem apoiar o planeamento colaborativo e lidar com a complexidade. Primeiro, tenta definir o estado da arte dos jogos utilizados no planeamento, identificando a literatura de jogos sérios para propósitos de planeamento. A tese explora o estado da arte dos jogos de tabuleiro modernos relacionados com a construção de cidades e territórios, analisando profundamente elementos dos jogos como os mecanismos e as suas representações. Depois, vários estudos de caso revelam o processo de desenvolvimento de diversos jogos analógicos sérios, incluindo uma adaptação digital. O foco nos jogos analógicos resulta da procura por métodos simples e pouco dispendiosos para gerar jogos sérios, pois os jogos analógicos são os mais simples e o ponto de partida mais provável para os planeadores que pretendam utilizar os jogos como ferramentas para os seus processos de planeamento. Os jogos de tabuleiro modernos são uma tendência mundial que está a cativar um público crescente. Muitos desses jogos são de simulação urbana ou relacionados com cidades reais.

A tese identifica muitos casos de aplicação de jogos sérios ao planeamento, revelando as suas forças e limitações. Propõe um guia para selecionar e combinar mecanismos para construir jogos sérios analógicos. Ao explorar o processo de desenvolvimento de diversos jogos sérios analógicos originais para o planeamento urbano, em diferentes estudos de caso, evidencia os desafios, dificuldades e resultados das implementações práticas com utilizadores reais (participantes) para casos reais de planeamento. Entre estes estão o caso do UrbSecurity (Urbact) sobre um caso de um processo de planeamento participativo para melhorar a segurança urbana do centro histórico de Leiria (Portugal). Também o caso do planeamento da rede de escolas básicas do concelho da Marinha Grande (Portugal), em que um jogo colaborativo *analógico foi comparado com um programa de otimização, revelando o quanto os participantes e a interação humana podem trazer para um processo de planeamento, identificando muitas outras dimensões não consideradas no modelo. Estes dois casos foram possíveis de realizar porque outras abordagens de jogos sérios foram testadas previamente com alunos e especialistas em planeamento, explorando os mecanismos de jogos, as interações humanas e a gestão dos resultados dos jogos.*

Desenvolver jogos requer conhecimentos consideráveis de design de jogos e competências de facilitação que podem ser desafios para os planeadores que pretendam explorar planeamento baseado em jogos.

Palavras-chave: *Complexidade; Design de Jogos; Jogos de Tabuleiro; Jogos Sérios; Participação, Planeamento Colaborativo; Planeamento Urbano.*

.

ABSTRACT

There seems to exist a crisis in participation. Not that citizens do not wish to participate in collective and public affairs. But, in contemporary societies, there is a sense of urgency and too many things competing for the time and attention of the individuals. Citizens demand higher participation levels and effectiveness, and that participation results are consequent. Planning practitioners are struggling to find new methods to address these demands. Planners are also exploring new data collection methods to improve their planning practices. Collaborative planning approaches have been tested, at least in the past three decades, requiring new methods to increase participation levels and propose processes where the participants can generate effective results. Participation without consequent outcomes is a problem that planners, politicians and other decision-makers must account for. Serious games have been used as support tools for these planning approaches to foster participation and to collect data that would be difficult to obtain by other means.

The present thesis explores how modern board games can support serious games for collaborative urban and spatial planning and deal with urban complexity. First, it tries to find the state of the art of games used in planning, identifying the associated literature. Then it also explores the state of the art of modern boardgames related to city and territory building, going deep into the game elements like the game mechanisms and their representations. Then several practical case studies show the development process and results of several analogue serious games, including a digital adaptation. The focus on analogue games results from the demand for easy and inexpensive methods to deliver serious games. Analogue games are the simplest and most probable starting points for planners wishing to use games as tools for planning approaches. Also, modern board games are a worldwide trend that engages a continuously growing number of gamers each year, and among these games, many are about urban simulations or real cities.

The thesis explores several serious game application cases for planning and identifies their strengths and limitations. Proposes a guide of game mechanisms to select and combine to build analogue serious games. By exploring the development process of several original analogue serious games for urban planning, for different case studies, it shows the challenges, pitfalls, and results of practical implementations with reals users (participants) for real planning problems. Among those, the UrbSecurity (Urbact) case is about a participatory planning process to improve the urban safety and security of the historical city centre of Leiria (Portugal). In the case of the Municipality of Marinha Grande (Portugal), a collaborative analogue game was compared to an optimization software to plan the elementary network of schools. The comparison revealed how individuals and human interaction brings other dimensions not considered in the model. These

two cases were only possible because other serious game approaches were tested before with students and other planning experts, testing game mechanisms, human interactions, and dealing with game outcomes.
Developing the games required considerable game design knowledge and facilitation skills, which can be challenging for planners wishing to explore game-based planning.

Key-words: *Collaborative Planning; Complexity; Board games; Game design; Participation; Urban planning.*

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LIST OF ACRONYMS

Abbreviation	**Definition**
8LLE	8 Learning Events Model
AESOP	Association of European Schools of Planning
BGG	Board Game Geek
CBG	City Building Game
CITTA	Research center for territory, transports, and environment
CIVIC	Civic Empowerment
CP	Collaborative Planning
DB	Decision Box
DM	Decision-Making
DPE	Design, Play, and Experience
DS	Development Stage
F	Form
GNAC	Games Named as Cities
HCCL	Historic City Center of Leiria
ISAGA	International Simulation and Gaming Association
MB	Map Board
MBG	Modern Board Games
MDA	Mechanics, Dynamics, and Aesthetics
MDGPP	Modding Drawing Games for Planning Process
MEDP	Mechanics for Engagement Design Protocol
ML	Municipality of Leiria
MMDE	Mechanisms, Mechanics, Dynamics, and Experiences
MMG	Municipality of Marinha Grande
ML	Municipality of Leiria
NPP	Non-player Participant
P	Participant
PII	Personally Identifiable Information
PLEX	Playful Experience framework
Pln	Planning
PO	Planning Officials

PP	Playing Participants
PS	Playtest Stage
PSS	Planning Support Systems
RT	Research Team
S	Session
SB	Side Board
SG	Serious Games
SPCV	Portuguese Society of Videogame Science
TSC	The Stakeholders Clash

1. INTRODUCTION

The thesis is organized into eleven chapters. The first chapter introduces the following nine chapters, each composed of a research article. Some were published, while others were developed to allow future publication. The chapters previously published as journal articles are referred to in the thesis manuscript as literature (each chapter published as a paper is identified in a footnote). This first chapter (introduction) is divided into five sections. The first section introduces the research framework to approach the concepts of serious games, analogue games, and their planning application, focusing on collaborative planning. The second section presents the motivation and parallel experiences that helped the author to develop the research papers and the games. The third section describes the thesis objectives and the main research questions. The fourth section explains the organization of the thesis chapters. The fourth section presents the research dissemination approach and the obtained results.

1.1. Research framework

Humanity plays games since the dawn of time. They are part of every civilization and culture (Huizinga, 2014). Games fascinate humans in a way that we play them just because they provide us with enjoyable experiences. When playing games, we accept restrictions and play by the rules in a voluntary way (Suits, 2020). Game studies scholars have been studying games and why they motivate humans to adapt behaviours and do specific activities (Lazzaro, 2009; Zagalo, 2020). In games, failure is a way to test, explore, learn and interact (Juul, 2013). Systematic approaches like those from Salem and Zimmermann (2004) argue that games are rule-bounded systems where players interact that deliver experiences.

Exploring games as systems relates to the concept of playing games for purposes beyond pure entertainment. Abt (1987) coined the term “serious game” expressing that some games can deliver other experiences to participants. This novelty meant that players could play, enjoy themselves, and use the game as a tool to learn, train or develop outcomes that could be useful for other purposes. Although, we can argue that using games for purposes beyond entertainment is older (e.g., games as rituals, entertainment for the masses, military operations, etc.). Planning was one of these purposes. Duke (2011) was one of the first academics and practitioners to use serious games for planning, making playable simulations where participants could make the decisions and see the results in a territory (e.g., regional transport system). There are records of these experiences since the 1960s.

With the rise of collaborative planning approaches (Healey, 1992; Innes & Booher, 2018), where citizens are invited to work together with planning practitioners and decision-makers to develop planning solutions, games gained new interest. The first serious games were centred on the simulation side (e.g., mathematical models), while the contemporary tendency assumes a player-centred approach to foster human interaction (Tan, 2016). The new serious game approaches were influenced by the theory of complexity applied to cities, assuming that a collaborative planning process is a way to deal with complexity (wicked problems), where solutions result from negotiation because optimal solutions that fit all demands are impossible (Innes & Booher, 1999a).

Although digital games dominate the entertainment market and serious game approaches (Becker, 2021; Boyle et al., 2016; Connolly et al., 2012; Laamarti et al., 2014), analogue games are making a comeback (Booth, 2021). This phenomenon is not revivalism, at least directly, because the analogue games (e.g., board games) trend is being influenced by new design elements (Konieczny, 2019; Sousa & Bernardo, 2019). Modern board games are attracting people seeking face-to-face game experiences (Rogerson et al., 2016, 2018; Rogerson & Gibbs, 2018). This results from game design innovations, new game mechanisms, themes and improved game components (pieces and bits), graphical art and thematic and narrative development (Calleja, 2022; Engelstein & Shalev, 2019). Despite the worldwide success of modern board games, there is still a lack of research in the field (Torner et al., 2014) and even less in game-based planning approaches (Sousa et al., 2022b). The work from (Tan, 2017) and Dodig and Groat (2019b) are references to consider. However, the available literature does not explore the development process of analogue serious games for planning purposes in a profound and explicit way.

Game design frameworks like Mechanics, Dynamics and Aesthetics (MDA) (Hunicke et al., 2004) are among the most influential. MDA provides guidelines, explored and adapted to serious games by authors like Winn (2009), where game designers combine game mechanics (or mechanisms) to generate dynamics that players perceive as experiences (aesthetics). Like Salen and Zimmermann (2004), the games are systems able to generate experiences. Building serious games for planning can follow the principles. The experiences are what the game should deliver, an engagement that fosters: debate, decision-making, and materialising planning proposals. Even if the game cannot deliver a coherent planning proposal, it can generate data useful for planners and decision-makers (Caspary, 2000; Corburn, 2003; Moote et al., 1997).

Analogue games are simpler to develop than digital games (Fullerton, 2014; Ham, 2015). Because planning practitioners, in general, are not trained to develop games, and game usage is not a widespread practice among planners (Ampatzidou et al., 2018; Dodig & Groat, 2019b), using analogue is a way to enter a serious game design for planning. Finding the game mechanisms and process to build serious games is necessary (Ampatzidou & Gugerell, 2019a; Constantinescu et al., 2020) to benefit from game usage. In the case of analogue games, to explore the collaborative face-to-face unique experiences (Duarte et al., 2015; Rogerson et al., 2018; Sousa et al., 2022b; Zagal et al., 2006).

1.2. Motivation and parallel experiences

Some personal motivations explain why the choice of the research topic of serious games for planning. The author worked as a councillor advisor for urban and regional planning for a term in the Municipality of Leiria (2014-2017). During this experience, he saw the difficulties in implementing participatory processes for planning (e.g., urban masterplans, urban mobility, etc.). The ongoing practices were not engaging the citizens. The plans lacked the insights that stakeholders and citizens could bring to the process. Citizens demanded more participation opportunities that delivered results and practical implementations. However, from 2015 to 2017, during the *UrbanWins* European project, done with the partnership of the Municipality of Leiria, the author tested modified versions of modern board games to support the collaborative project regarding the circular economy.

The author is a hobby board gamer, founder of the *Asteriscos Association*, and coordinator of the *Boardgamers de Leiria* project that organizes weekly gatherings to play board games and use them for voluntary activities in schools, hospitals, and other social institutions since 2014. The author is the founder and organizer of *Leiriataks*, the academic gathering within *Leiriacon* (the biggest national modern board game conference in Portugal). *Leriataks* is now associated with Glow (games and social impact media research lab) by Lusófona University (Portugal). These previous experiences provided practical skills for game-based approaches.

Since this research started, the author collaborated on serious game design projects and other game design initiatives. The authors' first participation in a game conference was at the "Videojogos conference 2019" organized by the Portuguese society for videogame science (SPCV), presenting a paper on a method to define modern board games (Micael Sousa & Bernardo, 2019). This introductory work was published in the conference proceedings and transformed into a chapter of the thesis proposal project. Since then, the author participated in several other academic events. The Game-On Conference workshops by Eurosis. The 18th Meeting: Games for Cities organized by AESOP complexity thematic group, conducting a workshop about modern board games about cities. Similar workshops happened during the CITTA research centre annual conferences of 2019 and 2021.

IADE – Creative university and Lusófona University invited the author to conduct game design workshops where the analogue games were used as prototyping techniques to develop video games. The Municipality of Leiria and Marinha Grande, where some case studies that generated paper included in this thesis, developed their Municipal Health Strategies with the support of game-based approaches developed by the author. These techniques were previously tested during training sessions at Leiria Business School, generating two papers about modified modern board games to train transversal skills associated with collaboration (Micael Sousa, 2020b, 2022d). These and other previous experiences resulted in being accepted as a member of the International Association of Serious Games (ISAGA) and elected to the SPCV board.

The author also collaborated with the *Flavour Game* research project held at the University of Aveiro, testing hybrid game design experiments and developing papers about modern boardgame engagement and mechanisms (Oliveira et al., 2020; Sousa et al., 2021a; Sousa et al., 2021b). The collaboration with the Faculty of Economics of the University of Coimbra lead to a paper about the relationship between game mechanisms and learning mechanisms (Sousa & Dias, 2020), with Marco Silva from Microsoft Portugal about the Artificial Intelligence in board games (Sousa & Silva, 2021), and with Carlos Martinho from Instituto Superior Técnico (University of Lisbon) about the motivations to play board games (Martinho & Sousa, 2023). Facilitation techniques and adapting games for purposes were tested during the Gym2beKing project from the Gulbenkian Foundation at the Health School of the Polytechnic of Leiria. This allowed the testing of many adapted versions of modern board games in a real context (Rosa et al., 2021a, 2021b; Micael Sousa, 2023). The author conducted game-based classes for civil engineering students for the Civil Engineering Department of the Polytechnic of Leiria, courses in transport systems and Urban and Regional Planning, resulting in a paper about board game modding to teach engineering concepts (Sousa, 2020c). The use of collaborative planning in online environments using board game mechanisms was tested with environmental engineering students from the Nova University of Lisbon (Sousa, 2021a), and to foster collaboration among the students of the University of Coimbra, resulting in a paper about collaborative game-based ideation (Sousa, 2021b).

Besides these previous experimental experiences with games, the author travelled to visit the Essen Spiel 2022 fair in Germany (the most important convention in the world regarding board games), interacting with publishers, game designers and game academics. Participated in XXIV Board Game Colloquium (at Leeuwarden, Netherlands), presenting a communication about *ludemes* in modern board games, and in the Generation Analogue 2022 (the academic event of Gencon 2022, the most famous analogue game convention in the USA). Published a book chapter about dice use in modern board games (Sousa, 2022b).

To explore Board Game Geek (BGG) website as a designer, the author created a "roll and write game" for the back of his business card (*An adventure on the card*) (Micael Sousa, 2022a) and collaborated as a volunteer in the development of *Moesteiro* (Costa & Rôla, 2022), a board game published by *Pythagoras games* about the construction of the Monastery of Batalha (Portugal). Booth games are available to play and have an entry at BGG.

1.3. Thesis objectives and the main research questions

The objectives of the thesis were to explore how games have been used for planning purposes and to identify the limitations and potentials of these practices. Among the advantages of using games is the ability to engage participants and be a planning support system (PSS) (Geertman & Stillwell, 2012), able to deliver collaborative planning approaches. The thesis has a focus on game design and development. Because analogue games are easier to develop and have inerrant collaborative dimensions, the study of modern board games supported the development of serious game approaches. There is a considerable number of modern board games that approach cities and urban planning. The thesis aims to contribute with guides and examples of game-based planning that planners can replicate and adapt to their planning practices.

To achieve this overall generic purpose, we have established several research questions:

1. Can games be effective tools for planning? And what are their limitations and potentials?
2. Why so many modern board games about city and territory planning? Can we learn something from them to build serious games for planning and engaging with stakeholders and citizens?
3. Exploring a single game mechanism be enough to develop serious games for planning? Can drawing game mechanisms deliver a game-based planning process?
4. What board game mechanisms exist, and which ones are adequate for planning games?
5. Can modern board game mechanisms be applied to online environments and deliver effective game-based planning approaches?
6. What is the level of game complexity to use in a board game to play with board game pieces over a printed satellite map?
7. Is it possible to use game-based planning methods in fast approaches and include non-player participants to deal with the initial rejection of lack of time to participate?
8. Can a codesign process with stakeholders and planning officials deliver a collaborative planning experience for other participants?
9. Is a game-based planning approach comparable to an optimization model, and what are the advantages of using these different methods for planning?

The previous questions address the purpose of each chapter of the thesis. The chapters explore serious games for planning and learning about analogue game design for game-based planning experiences. The first four questions are addressed in chapters 2 to 6, respectively. The testing of game-based approaches with real participants, reflecting on the game design dimensions, and serious game outcomes that relate to questions 5 to 8 are addressed in chapters 7 to 10.

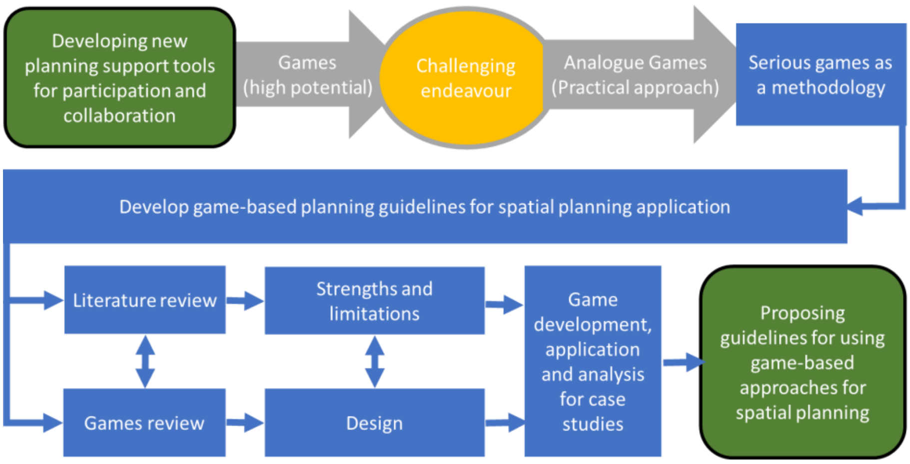

Figure 1.1 - Flowchart of the thesis objectives, overall process, and final goals.

Figure 1.1 expresses the overall process of the thesis development, departing from the previous nine research questions related to the thesis chapters (papers). In summary, the main research question is how can we develop gam-based planning support systems that are easy to apply and how can we transform this into guidelines for future use by planners, aiming for participatory and collaborative planning?

1.4. Thesis structure and organization

The thesis is organized into ten chapters. After this introduction (Chapter 1), each chapter explores how game-based approaches can support planning. The thesis focuses heavily on game design because it describes research to deliver game-based tools. Hopefully, these tools can be useful for planners as planning support systems. The purpose is to test how games can help planners develop participatory and collaborative planning approaches through simple and inexpensive methods, exposing the limitations, potentials, and simple game elements (e.g., game mechanisms) that planners can use in practice.

Chapter 2 explores the literature about serious games in planning, highlighting the strengths and limitations of game-based planning approaches. It details the available serious game frameworks and reveals the gaps and lack of support for available game design guides and methodologies for planning purposes. This chapter was published as a paper in the International Journal of Serious games (Sousa et al., 2022b).

Chapter 3 identifies the modern board game mechanisms of city building and territory building games, exploring, and analysing the top games from BGG. This method revealed the most common mechanisms of the best city building and territory building in modern board games and how they represent urban realities and are combined to form game systems. The chapter delivers practical guides planners can use to develop games when departing from game design frameworks like the MDA and their adaptations to serious games.

Chapter 4 explores the BGG database in a different way than chapter 3. Among the top-ranked BGG board games (the most popular among gamers), many are about planning and managing cities (city builder games), while others use the name of a real city to set up the game theme. A survey collected answers to why players enjoyed playing these games and how the games simulated urban realities. This data revealed that board games can represent the economic, historical, built environment and cultural dimensions of different cities and urban realities. Also, players assume that cities are themes that generate emotional attachment.

Chapter 5 analysed a set of board games characterized by a core board game mechanism. In this case, the drawing mechanisms. The chapter proposes a framework to modify and use drawing games for planning purposes. The findings revealed that drawing needs to be combined with other game elements like maps to deliver planning games. Planners can explore these relationships because it applies to maps and graphical territorial representations. The research revealed that other auxiliary mechanisms are necessary to support planning processes like voting. The chapter was published in Planext journal (Sousa, 2022c) from AESOP.

Chapter 6 tested a new approach where modern board game mechanisms are introduced into an online environment to deliver a collaborative planning approach, defining stakeholders' roles and claims in a team-based game. For this purpose, a simple game was played through Zoom and Google Slides during two online sessions, the first with planning researchers and the second with game design students. Each group identified different potentials and pitfalls of the game related to their backgrounds. Although the game delivered an enjoyable experience and used the game to discuss urban conflicts related to stakeholders' agendas, the platform features affected the playability, which would not happen in affect in an analogue game.

Chapter 7 explores a serious game experiment during an urban and regional planning class. There was a preparatory step before playing the serious game. First, the students played an adapted (modding) version of a commercial modern board game (*Spyfall*) to explore urban maps (satellite view). After this first game, students played the serious game over the same map where they simulated the land uses, economic activities, and transport system. The game delivered a collaborative planning game comparable to complex modern board games. The experiment revealed that the students deal with the game complexity if a facilitator supports them during the game. The chapter was published in a special issue about serious games in the Frontiers of Computer Science journal (Sousa, 2020a).

Chapter 8 shows the result of the development and test of a fast and simple game, played in 30 minutes during an event about sustainable transport system. In this experiment, the serious game and rules were flexible and adapted to the participants that voluntarily wished to enter the dynamic. The game layout was set to involve all the event attendants. The game was designed to explore and test how to include participants not playing the game. These serious game design techniques are strategies to deal with the uncertainty of public participation, lack of time and an unpredictable number of participants. The proposed approach defines different levels of participation and collaboration to explore a serious game about planning. The chapter was published in the Simulation & Gaming journal (Sousa et al., 2022a).

Chapter 9 describes the codesign process to deliver a collaborative serious game for the *UrbSecurity* initiative (*Urbact*) through a three-step game-based process. The game generated information that the planning officials used to report on the participatory process. The serious games resulted from two previous sessions where the stakeholders played modified modern board games to interact with each other and identify problems and priorities. The collected data and game development process generated the serious game that delivered the participants' proposals for the *UrbSecurity* report. The final serious game was played by several participants in groups (collaborative play). In each session, the participants (stakeholders, city councillors and civil servants representing departments) proposed different combinations of proposals and perceived them differently according to their needs and expectations.

Chapter 10 compared a facilities location problem solved by an optimization method and the same problem through humans playing an analogue collaborative planning game. The two approaches addressed the same problem, delivering different results when tested with different participants. The objective was to propose a network of elementary schools to serve the demand at minimal costs. Although the board game allowed the players to emulate the optimization software achieving similar solutions in some sessions, participants who played the game with more knowledge about the local characteristics considered other dimensions like the social, cultural, infrastructure and environmental beyond the minimization of costs.

1.5. Research dissemination

The dissemination of the research and its results consisted of publishing journal articles (each chapter is a published article or one ready to submit) and establishing partnerships with public entities that wished to explore game-based collaborative planning. The collaboration with the Municipality of Leiria and Marinha Grande (Portuguese municipalities and cities) tested the practical challenges, pitfalls, and limitations of real game-based planning approaches.

The research developed for the thesis was continuously discussed during conferences and events regarding serious games, collaborative planning, decision making and public policies.

The parallel experiences helped the author to learn how to build and playtest games and implement serious methodologies, like collecting data and acting as a facilitator. Organizing the sessions, delivering workshops, and collaborating with other serious game projects generated learning experiences that supported the development of the games described in the chapters. Using social media like *Linkedin*[1], the *Jogos no Tabuleiro YouTube Channel*[2] and newspaper columns in the Portuguese national press (*Jornal Público – P3*[3]) and the regional press (*Diário de Leiria* and *Diário de Coimbra*) disseminated the thesis findings through the general public. The author created a website to share more information about his experiences, projects and research about game design, game-based learning, and serious games in general: www.msseriousgames.com.

Published journal articles that are thesis chapters:

- Sousa, Micael. (2020a). A Planning Game Over a Map: Playing Cards and Moving Bits to Collaboratively Plan a City. Frontiers in Computer Science, 2, 37. https://doi.org/10.3389/fcomp.2020.00037
- Sousa, Micael. (2022b). The mechanics of drawing : helping planners use serious games for participatory planning. PlaNext, April 2022. https://doi.org/10.24306/plnxt/80.NEXT
- Sousa, Micael, Antunes, A. P., & Pinto, N. (2022). Fast Serious Analogue Games in Planning : The Role of Non-Player Participants. Simulation & Gaming, 0(0), 1–19. https://doi.org/10.1177/10468781211073645
- Sousa, Micael, Antunes, A. P., Pinto, N., & Zagalo, N. (2022b). Serious Games in Spatial Planning: Strengths, Limitations and Support Frameworks.

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[1] https://www.linkedin.com/in/micaelssousa
[2] https://www.youtube.com/@JogosnoTabuleiro
[3] https://www.publico.pt/p3/micael-sousa

International Journal of Serious Games, 9(2), 115–133. https://doi.org/10.17083/ijsg.v9i2.510

Unpublished journal articles that are thesis chapters:

- Games that use the names of cities: learn from modern board game design for game-based planning approaches.
- The mechanics of drawing: helping planners use serious games for participatory planning.
- The stakeholder clash game: from board game design to online serious planning games.
- Building urban safety with participants: implementing analogue serious games to support a collaborative spatial planning process for the UrbSecurity initiative in Leiria (Portugal).
- Game-based versus optimization-based public facility planning: the case of Marinha Grande (Portugal) elementary School.

Conference presentations:

- "The potential of modern board games as tools for collaborative planning", 18th meeting of AESOP Complexity Group: Games for Cities, Universidade Nova de Lisboa, 2019.
- "Introduction to serious games - applications to enterprises" (Keynote speaker), ICABM2020 - International Conference of Applied Business and Management, Porto, 2020.
- "Using Modern Board Game Mechanisms to develop Simple Analog Serious Games", 21th Game-on conference, Universidade de Aveiro, 2020.
- "When board games became modern", Lisboa Games Week, em novembro de 2020.
- "Trying to Understand the complexity of cities through board games", 19th meeting AESOP complexity group: Social disruption and urban complexity, 2020.
- "Bringing analog serious games to online environments: a new way to teach collaborative planning in the face of complexity", 15th AESOP Young Academics Conference, Universidade Nova de Lisboa, 2021.
- "The Middles Ages in Modern Games", in "Medieval themes in modern board games", Winchester University, 2021.
- "Engaging engineer students to learn urban history: adapting board game dynamics using Zoom and Google Drawings in online environments", Irish Conference on Game-Based Learning 2021, Trinity College, University of Dublin, 2021

- “From Modern Board Game Design to Contemporary Citizen Participation in Local Collaborative Planning”, 13th IPA Conference, 2021.
- “Representações morfológicas urbanas nos jogos de tabuleiro modernos: uma sistematização e os casos dos jogos Lisboa, Coimbra e Porto”, Congresso da Rede Lusófona de Morfologia Urbana, 2021.
- “Making Modern board games useful: two workshops about introducing and exploring new designs for purposes”, 1st GLOW Conference, Universidade Lusófona de Lisboa, 2021.
- “Transforming Google Drawings into a game-based nudging tool for collaboration”, International Workshop on Digital Nudging and Digital Persuasion (DNDP 2022), 17th International Conference on Persuasive Technology, 2022.
- “The Stakeholders Clash: Board games as online serious planning games”, 6th International Conference 'Urban e-Planning’, 2021.
- “Finding Ludemes in the top number one games of Board Game Geek”. 24th Board game Colloquium, Leeuwarden, 2022.
- “Methodological analysis of analogue game design for education”, Conference of the International Council for Educational Media, Instituto Politécnico de Santarém 2022,

Conducted Workshops:

- “Play a game”, Games for Cities, 18th meeting of AESOP Complexity Group, Universidade Nova de Lisboa, 2019.
- “Serious Gaming: adapting Modern Boardgames to Planning Practice,”, 12th CITTA Internatitonal Conference in Planning Research, Faculdade de Engenharia da Universidade do Porto, 2019.
- “Collaborative games”, V International Conference Govint, Lisboa, 2020.
- “Introduction to modern board game design” and “colaboration through modern board games”, durante o 5th Games and Mobile Learning encounter, Faculdade de Psicologia e Ciências da Educação da Universidade de Coimbra, 2020.
- “Learning from modern board games to make engaging lectures”, 4th International Conference of the Portuguese Society for Engineering Education, Instituto Superior Técnico da Universida de de Lisboa, 2021.
- “Serious Games: When citizens play with complexity: a fast serious planning game”, 13th CITTA Internatitonal Conference in Planning Research CITTA, 2021.

2. SERIOUS GAMES IN SPATIAL PLANNING: STRENGTHS, LIMITATIONS AND SUPPORT FRAMEWORKS[4]

2.1. Introduction

Why should games be used in planning practices? Departing from the concept of games as interactive processes that generate outcomes (Salen & Zimmerman, 2004), and from the notion that planning generates outcomes influenced by political powers (Brooks, 2019), promoting engaging and enjoyable planning processes can be valuable (Burkhalter et al., 2002). Participation in spatial planning needs new tools to avoid being long, tedious, and attended by the same reduced quantity of persons (Gordon et al., 2011).

Games establish active participation and collaboration while fostering innovation by incorporating multiple perspectives from participants (Lieven, 2017). This may increase civic empowerment, expression, experimentation, and even cocreation (Dodig & Groat, 2019b; Gordon et al., 2017; Lerner, 2014). Codesigning games, for serious purposes, may avoid misinterpretations and simulation failures (Ampatzidou & Gugerell, 2019a; Hofmann, 2019) and provide the opportunity to create engaging experiences that achieve predefined goals (Constantinescu et al., 2017).

Arguably, games may be the tools capable of establishing the missing bridges between experts and citizens (Mayer, 2009). When participants play games, planners can gather information and bind socially with participants (Mayer et al., 2014). When playing collective games, participants are engaged in civic learning exercises about the issues at stake, the impacts of their decision, the scales of the problems, networks, and other matters that make planning complex (Portugali, 2016; Shaffer et al., 2005). To Lundström et al. (2016), spatial planning activities are like playing a wicked game. To Dodig and Groat (2019b) planning a city can be similar to game design. However, which games should planners use? When? Are there available support frameworks and guides to use games as planning tools? What do planners need to know to develop and use games? What are the strengths and weaknesses of these approaches?

This paper provides an overview of characteristics and applications of serious games (from now on referred to as SG in singular and SGs in plural) in spatial planning, identifying four typologies of strengths and limitations to help planners use them as conceptual and practical tools. Although literature related to SGs and planning exist, systematizing SG approaches for practical

[4] This chapter, with slightly adaptations, corresponds to the article: Sousa, M., Antunes, A. P., Pinto, N., & Zagalo, N. (2022). Serious Games in Spatial Planning: Strengths, Limitations and Support Frameworks. *International Journal of Serious Games*, 9 (2), 115-133.

uses is necessary. Departing from Taylor (1971) that addressed the advantages of simulation games for planning, we aim to understand contemporary trends. We highlight Münster et al. (2017) work on digital media in participative planning and Ferri et al. (2018) on urban play as interactive participation processes related to experiences. Constantinescu et al. (2015) and Ampatzidou et al. (2018) produced relevant introductory literature reviews of SGs, while Vanolo (2018) approached SGs and gamification. The game-based approach from Hartt et al. (2020) suggests that gamification and SGs can improve teaching about planning. While Latifi et al. (Latifi et al., 2022) identify relations between gamification and smart cities. Ashtari and de Lange (2019) focused on the skills required to benefit from games for planning processes. The book Play the City (Tan, 2017) is a landmark about practical experiences of games applied to planning, and Dodig and Groat (2019b) present a compilation of game applications to urban planning case studies, focusing on codesign approaches. Despite the somewhat extensive academic literature on the subject, the use of game-based approaches in planning practices is not high (Ampatzidou et al., 2018; Constantinescu et al., 2020b; Mayer, 2009), arguably resulting from the lack of resources, reduced game design practices and overall distrust of results by the planning community.

As planners are not trained to design games, how should they deal with games? By exploring existing game approaches, and identifying game evolution, features, and their effects in planning processes, we propose a systematic overview of strengths and limitations in the application of SGs in spatial planning, completed with suggestions for future uses. We argue these findings can clarify the advantages and challenges planers face when using SGs. Our proposal provides guidelines for testing and developing or abandoning SG usage in spatial planning.

2.1.1. Defining Serious Games

Salen and Zimmerman (2004, p. 80) game definition - "system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcomes" - matches the concept of SGs developed by Abt (1987), related to learning and simulation. Games can create engaging and emotional social spaces (Zagalo, 2020), fuelled by conflicts, learning, overcoming of new challenges, and the tensions, uncertainty, and surprises they offer (Costikyan, 2013). During game activities, players acquire knowledge and develop skills to deal with problem-solving contexts through first-person experimentation (Gordon et al., 2017; Shaffer et al., 2005). Games allow players to learn and think by doing, and testing multiple options, accumulating knowledge without the negative consequences of real-life choices (Schouten et al., 2017). Games can produce experimental situations that would otherwise be impossible to undergo in real life, safely and at a low-cost (van den Berg et al., 2017).

SGs generate experimental environments where learning and comprehension occur through game experimentation (Hussein, 2015). Players' active roles in games provide meaningful contexts for choice and action, distinct from reality but related to it (Walz & Deterding, 2014). Games provide intrinsic motivation, but forcing someone to play may destroy the attraction of playability (Mouaheb et al., 2012). While the emulation of reality in games would create standard simulations, SGs avoid doing this by balancing simulations and playability (Pratt & Spruill, 2011; van den Berg et al., 2017). SGs must integrate the gaming dimensions with the serious intentions they aim to address (Ampatzidou & Gugerell, 2019a; Gordon et al., 2017). But the term serious can be problematic to describe games that tend to be associated with unserious issues (Poplin, 2012, 2014). Even the boundaries between simulation and SGs are not clear (Mayer, 2009). What is the limit of simulation SGs must achieve? SGs provide full game experiences where players can learn, understand, interact with complex environments, and actively engage in decision making (van Riel et al., 2017). These games are serious because they can be engaging work tools beyond being ludic (or fun) (Abt, 1987; De Caluwé et al., 2012; Zyda, 2005).

SGs seriousness is dependent on the way they are designed and used, regardless of the game platform (Dörner et al., 2016). Games must have rulesets to define the goals and procedures, including metaphors and narratives to generate meaning (Zagalo, 2020), game mechanics, interfaces, platforms, and objects to be manipulated (Järvinen, 2008). Mechanics are a core element because they are how players activate and interact with the game system (Adams, 2014). Game mechanics are key design elements in SGs for planning (Ampatzidou & Gugerell, 2019a). This design demand creates the need to have proper frameworks that guide conceptualization and delivers methods to develop and use games for given purposes.

The clearer the goals are, the most motivated participants will be, which is mandatory to make game results dependent upon player interaction and decisions and not from random elements or mechanics (Lerner, 2014; Torres & Macedo, 2000). The engagement and playability of SGs depend on balancing the complexity so players can activate the game system, understanding it while interacting with other players, without losing the relation to reality and simulation (de Heer et al., 2010). Games mechanics and dynamics must be interconnected to build the game experience towards SGs purposes (Mitgutsch & Alvarado, 2012). By doing so, games can reveal participants' initial assumptions, decisions, and feedback that construct experiences that simulate multiple scenarios (Olejniczak et al., 2018). Games can provide awareness to participants about the implications of their decision, individual and collective (Gordon et al., 2017), which results from combinations of different elements, knowledge, and experiences players bring to play (Ampatzidou & Gugerell, 2019b).

Framing games as tools for complex decision-making in uncertain environments requires having facilitators (Raphael et al., 2010). Planners can act as designers and game facilitators, enabling games as learning and simulation contexts for participants. Defining how to facilitate this process ensures learning and comprehension of the decisions, roles, and gameplay during the debriefing (Crookall, 2010; Devisch et al., 2016).

2.1.2. Serious Games in Spatial Planning

By the 1960s, academics and experts developed game models to build scenarios to explore spatial interactions (Constantinescu et al., 2015). The first games were strongly mathematical in their attempt to simulate reality (Devisch, 2008; Mayer, 2009). Taylor (1971) described that games could be planning simulations as ways for players to test and learn through interactive simulations. Later, this mixing between simulations and games stalled due to the difficulties of addressing human behaviour and planning complexities (Mayer, 2009; Tan, 2016).

Game approaches decreased over the years, mostly after the 1980s (Gordon et al., 2011), when post-modern views started to influence planning (Scott, 2008). But since the 2000s, games were recovered for planning uses (Hollands, 2008). Many new game approaches try to capture the variety of human behaviour and the emergence of unpredictability, both expressing the complexity of contemporary societies (Mayer, 2009; Tan, 2017). These games focused mainly on motivation and improving civic participation (Walz & Deterding, 2014). Planners realized that many of the deliberative decision-making processes and system analyses are like games, with their rules, objectives, and multiple scenario exploration (Bishop, 2011), generating unexpected interactive results (Gordon et al., 2017; Savic et al., 2016). The SG approach remerged, fusing simulation and learning with engagement and fun (Ampatzidou et al., 2018; Gaber, 2007).

Storytelling has been used in participative planning, at least since the 1980s, to engage participants, provide context, and persuade their action (Depriest-Hricko & Prytherch, 2013; Innes & Booher, 1999b). Narratives provide meaning to mechanical systems (Zagalo, 2020). These contents help planers to understand power relations, engage participants' attention and support the expression of their personal views (Grant, 2011). In the 1990s, Healey (1992) highlighted the need for more communication tools for planning, while Innes and Booher (1999b) endorsed using role-playing games (RPG). Through role-play, players can swap and experiment with multiple visions of the same problem, promoting rational communication (Wates, 2014). Personal claims, experiences, and even irrationalities and inconsistent assumptions can be addressed in a controlled way to generate common knowledge (De Caluwé et al., 2012). Introducing this storytelling dimension can improve the engagement and results of game-based planning exercises (Hartt et al., 2020). The references to RPG in planning are common since they are simpler and more flexible to implement than other game types, which demand complex game systems for simulation (Montola, 2007; Pojani & Rocco, 2020).

Portugali (2016) suggested game usage to address complexity in planning and deal with wicked problems, defined as problems for which it is impossible to achieve an optimal or efficient solution for all the criteria at stake: "*For wicked problems there is no solution that can be shown to be optimal*" (Innes & Booher, 2018, p. 11). Games can address these wicked dimensions when multiples players generate different solutions with changing rulesets and constant feedback (Bishop, 2011; Juraschek et al., 2017; Lundström et al., 2016). Designing these collaborative planning game systems reinforces the need for planners' involvement (Devisch, 2008).

Portugali et al. (2012) developed an analogue city game to address complexity by allowing participants to locate buildings in a physical model, producing a self-organizing city. This first experiment led to other city games with more rules and simulation details. The introduction of resource management, relations to real environments, and physical architectural models improved the engagement and produced more coherent results (Tan, 2017). Although game openness can be important for engagement and appropriation, adding tangibility and simulate the restrictions from reality help the participants to emotionally invest in the game (Aguilar et al., 2020; Yap et al., 2015). Valuing the gameplay is necessary to generate the desired outcomes of SGs for planning (Gordon et al., 2011), as this is essential to develop civic skills like knowledge, communication, group thinking, and decision making (Ashtari & de Lange, 2019). But allowing the game system to reveal emergent results, dependent from the participants inputs and interactions, is also important (Aguilar et al., 2020).

2.1.3. Games as contemporary tools for planning

Online digital games can be effective by providing direct feedback to players' proposals and build collective solutions. But the boundaries between entertainment and SGs may be hard to establish, even in expensive projects (Poplin, 2012, 2014). On the other hand, many games fail in consensus building due to a lack of adaptation to reality (Constantinescu et al., 2015). Transforming analogue games into 3D digital detailed simulations can improve meaning while maintaining analogue game components simplify interactions. Tangible User Interfaces and Virtual Augmented Reality are also present in planning games because they provide meaning and instant feedback to the proposals while promoting collaboration locally (Alrashed et al., 2015; Boulos et al., 2017; Noyman et al., 2017).

Small games done sporadically, as 'ice-breakers' and creative activities in ongoing and formal planning processes is a way to benefit from game usage even when more sophisticated game tools are not available (Ampatzidou et al., 2018; Devisch et al., 2016; Schouten et al., 2017). Including several of these sporadic games is not the same as transforming the entire planning process into SGs and does not increase participation automatically (Thiel et al., 2016; Torbeyns et al., 2015). Nevertheless, even the simpler games establish trust and empathy among participants and open doors for engaging participants in the subsequent actions of a planning process (Ampatzidou & Gugerell, 2019a; Baldwin-Philippi et al., 2014). Trust improves if game approaches start simple and build up with complexity while addressing reality in a comprehensive way (van Riel et al., 2017), benefiting from sequences and pauses to discuss and analyse game results (Willis et al., 2017). Designing and adapting games during play, following co-creation approaches, can enhance game advantages even more (Ampatzidou & Gugerell, 2019b; Constantinescu et al., 2017). Low-tech games, like board games, can be better for citizens than for experts that can deal with complex digital simulation approaches (Abspoel et al., 2019; Ohnmacht et al., 2015; Sousa et al., 2022a). But approachability in games that is useful to engage the broader public may produce heuristics that lead to inefficient solutions, far from precise simulation (Billger et al., 2020b;

Keijser et al., 2018; van den Berg et al., 2017). Still, SGs can be successful even if planning solutions do not emerge. Using SGs as tools for debate and social interactions might be goal and a way to avoid dropouts in a planning process (Constantinescu et al., 2017; 2015).

Despite digital games' domination, analogue games are more adaptative, allowing players to meet calmly at their own time, relaxing and building organic narratives, even for shy players, before going into more serious matters (Gordon et al., 2017). Independently of the approach, face-to-face dynamics should not be neglected (Münster et al., 2017). Even in digital games, face-to-face meetings are significant to enforce confidence, empathy, and collective learning among participants (Ampatzidou & Gugerell, 2019b; Baldwin-Philippi et al., 2014; Sousa et al., 2022a). The relationships between participants and planners can be improved through the analogue dimension of tabletop games (Champlin et al., 2021; Sousa et al., 2022a). Allowing participants to manipulate scenarios and see the impacts of that interaction can reduce the complexity of the reality being simulated (Ferri et al., 2018). But the way to do the facilitation debriefing, what to focus and how to continue to profit from the experience is not settled. These low-tech games with low thresholds are easy to start engaging people but create dynamics that are hard to document and evaluate (Constantinescu et al., 2017).

When researching planning games, the literature refers to several works about digital city builders. Games like *SimCity* (Wright, 1989) are useful for teaching planning (Gaber, 2007), though *SimCity* was prone to an unrealistic simulation of cities, reducing all urban planning and management objectives to economic growth. The game deals poorly with environmental impacts, heritage, and the complexity of transport systems and social dynamics (Devisch, 2008; Minnery & Searle, 2014; Nilsson & Jakobsson, 2011).

Despite their advantages, inexperienced players can have difficulties addressing defined objectives through city builder games (Kim & Shin, 2016). The inevitability of 'black boxes' and hidden coding hinders system understanding, relations, and cause-effects (Gaber, 2007; Reinart & Poplin, 2014). *City: Skylines* (Colossal Order, 2015) enables more configurations easily manipulated by players, although still being strongly dependent on the zoning and infrastructure location as the main gameplay, and demanding powerful hardware and a long time to design proper models to play and evaluate results (Juraschek et al., 2017). Despite all these limitations, digital city builder games are useful when combined with other planning approaches (Minnery & Searle, 2014), adapted through scenario building, and supported by proper teaching and facilitation (Arnold et al., 2019). Recently, *Minecraft* (Persson, 2011) is being used in participatory planning (de Andrade et al., 2020).

Digital games take the lead, but analogue games are still relevant. Even toys like the Lego support hybrid interactive urban simulation models that provide feedback and statistics (Chakraborty, 2011). Adapting existing board games is frequent, although some authors say they are childish and unable to simulate reality in meaningful ways (Reinart & Poplin, 2014; Slegers et al., 2015). But modern board games like *Carcassonne* (Wrede, 2000), *Agricola* (Rosenberg, 2007), and *Lords of Waterdeep* (Peter Lee & Thompson, 2012) can be combined with RPG elements, providing meaningful decision making to address spatial planning (Mewborne & Mitchell, 2019; Schouten et al., 2017).

2.2. Methodology for the literature review

To identify the strengths and limitations of using SGs in spatial planning it was necessary to find academic literature that reflected on these subjects. We searched two scientific databases that are commonly accepted to encompass the breadth and depth of previous and ongoing debates in planning (*Scopus* and *Web of Science*). Then, we conducted the literature survey using Google Scholar to be able to pick up relevant references from gaming practices which can be classified as grey literature. Figure 2.1 presents the combinations of keywords that supported the systematic literature review.

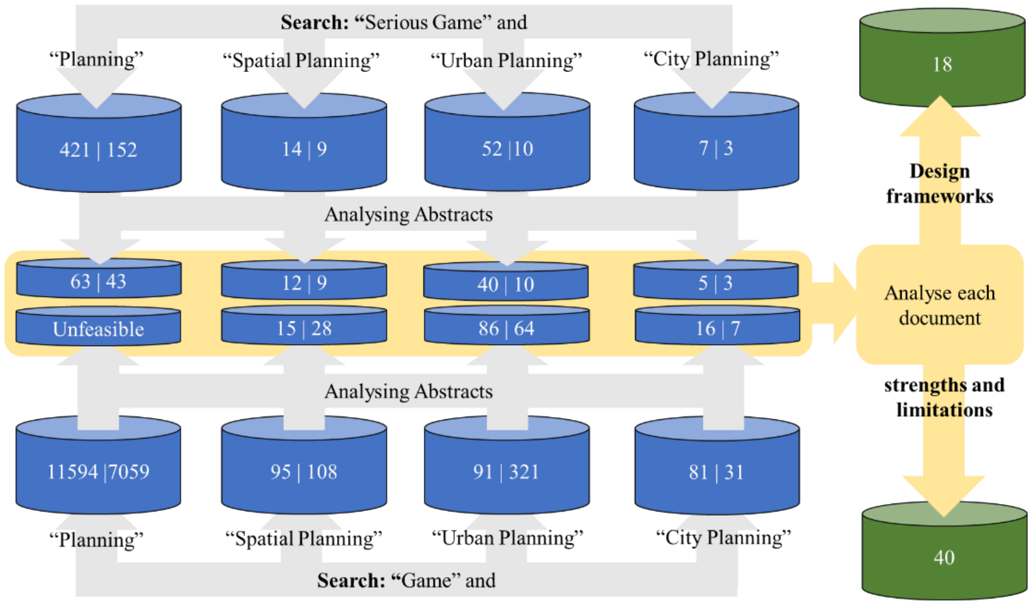

Figure 2.1 - Flowchart of keyword search and filters; numerical results indicate number of articles obtained from Scopus (left values) and from Web of Science (right values).

Using keywords like "serious game" and "planning" revealed extensive literature. Focusing on "spatial planning", "urban planning", and "city planning" was useful to aim for territory planning. The search revealed that "planning" could be associated with health, logistics, and production processes. Another search with "game and planning" returned so many results that they could not be displayed (unfeasible). However, adding "game" with keywords related to the thematic of spatial planning ("spatial", "urban", "city") identified literature about games that was ignored previously. This second additional search revealed cases of serious games, gamification, game-based planning, and games for the purposes of planning. Some literature does not define clear bounds between all the previous concepts.

We analysed the abstract of each document, then selected those related to the use of games for purposes beyond simple entertainment (SG) and were dealing with spatial planning, including transport, urban and land development. This filter removed documents that referred only to mathematics, game-theory and Olympic games held in cities. After this filtering, each document was analysed, in detail, to identify references to "strengths and limitations" of SG practices and SG design and application frameworks.

Applying the same methodology as before for a quick review of the top 50 results at Google Scholar identified literature like Ferri et al. (2018), Taylor (1971), and Winn (2009). These references might not be indexed but are relevant for game design and framework development. One paradigmatic case is the MDA framework (Hunicke et al., 2004) influence.

2.3. Limitations and strengths of games for planning

Despite the potential SGs present, they are not part of the mainstream curricula for planners, nor are they a widespread method among practitioners (Ampatzidou et al., 2018; Dodig & Groat, 2019b). The growing research about SGs in spatial planning is evident in the literature, but it did not produced unquestionable support frameworks to use games systematically (Mayer et al., 2014; Torbeyns et al., 2015).

2.3.1. From limitations to opportunities with SGs

Setting clear frameworks and usage guides will allow transferring gameplay experiences to real planning processes (Constantinescu et al., 2015; De Caluwé et al., 2012; Gordon et al., 2011). Benefits from the use of SGs increase when they build consciousness for planning complexities and increase participants' knowledge and skills just by playing (Lerner, 2014, p. 50; Thiel et al., 2016). But this can only be observed if the game results are adequate and fit demands and expectations (Mayer et al., 2014; Reckien & Eisenack, 2010). Through games, participants can understand the different scale effects, broader visions, and complex interactions about urban systems (Schouten et al., 2017; van den Berg et al., 2017). Understanding urban systems is difficult by non-experts (Nilsson & Jakobsson, 2011). SGs can engage players by levering decision power while providing new ways to access knowledge (Chakraborty, 2011). Despite the many success cases, it is still unclear what conceptual considerations guide SG design for planning (Schouten et al., 2017). Which game mechanics determine more participative involvement and what level of co-creation should be adopted in a process to reinforce participation (Ampatzidou & Gugerell, 2019a; Constantinescu et al., 2020b).

Using games is not an automatic way to bring more participation and do better plans (Torbeyns et al., 2015). Game design may deliver superficial or obscure experiences (Leggett, 2014; Poplin, 2014), and choosing which participants to play may jeopardize the whole process (Bond & Thompson-Fawcett, 2007). Game legitimacy for planning is not unquestionably established, due to the lack of measurable and accountable bases (Torbeyns et al., 2015). The problem might be the way games have been used in planning practices (Lerner, 2014). Exploring game design reveals that game rules and mechanics help participants to focus on the goals, avoiding subjectivity and dispersion, framing the models to understand reality in engaging ways (Mayer et al., 2014; Poplin, 2014; Tan, 2016). In practice, these design options led to many simulation simplifications to provide playable experiences (Billger et al., 2020b; Devisch et al., 2016; Gordon et al., 2017; van Riel et al., 2017; Vanolo, 2018). Competition is one of these effects, which can engage some participants but distort the SGs goals (Ampatzidou et al., 2018).

Because games are social activities of personal expression, players can be exposed to uncomfortable situations that demand anticipated design control and gameplay facilitation (Gordon et al., 2017). Facilitated face-to-face games seem better to address complex, uncertain, confrontational, and ethical problems in planning through the easiness to generate empathy with richer communication (Gastil, 2000; Innes & Booher, 2018). Game facilitators can manage unpredicted behaviours, different player profiles, and interpretations while incentivizing balanced participation (Ampatzidou et al., 2018; Johnson & Mayer, 2010). Having experts participating in the game also influences higher coherent solutions (Tan, 2016), although negotiations become tenser and game models more questioned (Roukouni et al., 2020). It is also improbable that inexperienced players participating in SGs would provide perfect solutions (Koens et al., 2020). Although collaboration and agreement are something planners may want games to provide, planners must develop games to foster critical analysis to avoid manipulative effects from participants claims when playing the game (Tóth & Szilágyi-Nagy, 2019).

The openness of some games is suited to deal with wicked planning problems, although difficult for systematization and evaluation (Hollander, 2011; van Riel et al., 2017), which is challenging to support academically (Koens et al., 2020). Devisch et al. (2016) also argue that SG approaches need to start from the objective definition before game development. Improving the coherence of game results in planning is one of the most challenging design processes (Lieven, 2017), relating the game mechanics to the SG objectives (Ampatzidou & Gugerell, 2019a; Constantinescu, et al., 2020a; Raphael et al., 2010).

Younger citizens usually are very open to game-based participation processes (Baldwin-Philippi et al., 2014; Münster et al., 2017), although older adults can also be engaged (Poplin, 2014). On the other hand, adults are the most resistant to games because they expect them to be childish, unserious, and adults are used to passing directly to conflict and negotiation (Ampatzidou et al., 2018). The rejection of games for planning processes might be related to the process and not the games themselves (Gordon et al., 2017). When the first prejudice barriers fall, even sceptics tend to enjoy and recognize the value of SGs (Koens et al., 2020). Politicians and planners can be averse to games when they feel their power undermined due to game unpredictability (Tan, 2016). Nevertheless, most people are available to try planning games if the goals are clear (Gordon et al., 2017). Highlighting the intended effects of SG usage at the start of the planning process might help avoid initial rejection (Constantinescu et al., 2017; 2020b). Games should be included carefully, in a way they do not drive away participants who might not appreciate them, also avoiding time and resource consumption with no obvious gains (Thiel et al., 2016).

Despite the many game-like approaches for planning, Ampatzidou et al. (2018) criticize the gap between theory and practice. Planners may recognise the strengths of games, but they say they are hard to apply, design, adapt, and monitor in planning practices due to the lack of a common language, supporting frameworks, and clear usage guides (Ferri et al., 2018). Acknowledging all these uncertainties, limitations, and challenges is essential to develop successful SG approaches.

2.3.2. Finding existent SG frameworks for planning

Taylor (1971) provided the first generic analysis to find the strengths and weaknesses of using games to generate playable simulations for spatial planning. This first approach highlighted the need to systemize ways to use games for serious purposes as a distinct activity from playing for enjoyment.

Several authors build what we can call debriefing strategies that we can combine into a framework for SG facilitation. To evaluate the impacts of games, Johnson and Mayer (2010) prescribe a methodology where players report their decisions during and after gameplay, explaining their choices. Then these self-assessments should be debriefed and debated among other players. This mediation happens through the debriefing process (Lederman, 1992), possibly organized in a sequence of introduction, self-reflection, analyses, and generalisations (Reckien & Eisenack, 2010). Like in participatory and collaborative planning approaches, facilitation and debriefings are mandatory in SGs to achieve planning goals (Crookall, 2010; De Caluwé et al., 2012).

Mayer et al. (2014) present their evaluation framework in the form of a sequence of three moments of evaluation: before, during, and after the game. Before play, it records the players' characteristics: early experiences with games, attitudes (motivations and styles of learning), skills, and behaviour (intentions and group organization characteristics). During play, it assesses the performance of the game element, its processes (effort, dominance, power), and the game experience (flow, immersion, presence). After the game, it assesses the game experience (engagement and fun, the interactions, facilitator quality, relations to the role and the group of players), the player's satisfaction, and evaluation of the learning dimension. Dörner et al. (2016) follow this idea from generic SG development, recommending the need to register the attitudes and interactions among players during gameplay to identify the critical factors and steps of the creative and learning exercises.

Van den Berg et al. (2017) propose another framework to successfully design an SG, based on Harteveld’s (2011) three worlds: the reality world, consisting of the relationships between game simulation and reality; the meaning world, reflecting the values and objectives to achieve; and the game world, consisting of the game mechanics, platforms, and environments. Van den Berg et al. (2017) recommend implementing this by testing with real players, registering the dynamics and players’ feedbacks, redesigning the game, and testing again as many times as needed.

The Mechanics, Dynamics and Aesthetics (MDA) framework (Hunicke et al., 2004) dominates the game design literature, despite the many alternatives, variations and critiques (Walk et al., 2017). Constantinescu et al. (2017) argued the MDA allowed codesigning SGs for planning, meaning that participants and planners could design the game as the planning processes advanced towards conclusion. Ferri et al. (2018) found that codesigning games engage participants, delivering better participative experiences. Later Constantinescu et al. (2020a) followed the procedural criticism design to develop multiple prototypes to achieve the desired goals for a specific SG. The dominant role of the game mechanics, according to the MDA framework, was noticed. Ashtari and de Lange (2019) also used the MDA to explore what civic skills foster civic participation in planning. They argued that the mechanics, dynamics, and aesthetics of a game developed participants skills, knowledge, and information. That the games fostered expression and communication, promoted public gatherings to take actions.

Alternatively, Ferri et al. (2018) propose a method that combines PLEX (Arrasvuori et al., 2011) and civic empowerment (CIVIC). This PLEX/CIVIC framework is the Playful Experience framework (PLEX) that evaluates the non-utility defined as aesthetics of the game, using the background of the MDA framework. While the CIVIC relates to civic empowerment. PLEX/CIVIC establish how game engagement can lead to civic engagement. Ferri et al. (2018) added the civic empowerment layer (CIVIC) to the PLEX framework arguing that: personal motivation impact participants and agency; participation leads to relatedness, empathy, and companionship; and that advocate leads to awareness, understanding, gaining perspective, scenario building, and action.

The MDA framework influenced the Design, Player, Experience (DPE) framework (Winn, 2009). The DPE added more layers to the MDA, introducing the specific flows for the learning dimension and narrative dimensions. Ampatzidou and Gugerell (2019b) adopted the DPE framework, an approach that inspired Sousa et al. (2020a; 2022a) to introduce the facilitation and debriefing dimensions. The DPE, as an adaptation of the MDA to SG usage, establishes a bidirectional interactive process between game designers and players, allows the evaluation proposals by Meyer et al. (2014). Ampatzidou and Gugerell (2019a) also related the learning mechanics with the game mechanics through the 8 Learning Events Model (8LLE) (Leclercq & Poumay, 2005). They concluded that different player profiles experienced the game \differently and that the game mechanics triggered more than one learning event. The 8LLE as the DPE are specific frameworks from SGs in which the learning dimension is essential.

From the framework analysis, we conclude that the MDA influence is evident. There is a notion that the game mechanics are the elements planners as SG designers must use and combine to provide the dynamics and experiences that can engage participants while conducting them to find planning solutions that emerge from gameplay. The extra layers that the CIVIC/PLEX and DPE add reinforce the importance to add other dimensions to the mechanics, like the narratives, and focusing on the experiences of the players as the key to provide meaningful experiences from where planning solutions can emerge. Facilitation and debriefing recommendation appear necessary to improve the information flows and meanings from the design and the actual playable experiences. The DPE and the 8LLE frameworks deal with learning as an important outcome from playing a game, which is a relevant dimension for participatory and collaborative planning. Participants need to learn about the context of the planning process, what is at stake, what other participants claims and what can be done. In Figure 2.2 we propose a summary of the origins and generic outcomes planners can expect from the available SG frameworks for planning in the literature. We considered the facilitation and debriefing recommendations as a type of framework and the evaluation as another. The literature review returned many references to game-theory and the prisoner's dilemma to frame zero-sum games that define interactions and gameplay. This was the framework used to define the emergent systems of participants in *Metropolis* SG (Aguilar et al., 2020).

Despite most of the stated frameworks highlight that the mechanics are how game designers can deliver the SG experiences and reach goals, the literature about SGs for planning is scarce in identifying what mechanics planners can use in their games. The works from Constantinescu et al. (2017; 2020a) and Ampatzidou and Gurell (2019a) try to define the mechanics for planning games, but they are not specific enough to deliver guides for newcomers in game-based planning approaches. Sousa (2022c) found that focusing only on one game mechanic is not enough for spatial planning practice because each mechanism can serve different purposes in a SG (i.e., drawing mechanics to express ideas and voting mechanics to decide). Berg et al. (2017) design interactions also relate to the codesigning approach that Champlin et al. (2021) transformed into a method with the following requirements: structured dialogue and multiple representations; fostering ideation and collective recognition; and developing game environment for interactions and debriefing.

Figure 2.2 summarizes our classification of the findings of SG frameworks applied in spatial planning. Our analytic proposal defines three origin areas for SG frameworks: game design, education, and groups dynamics. These frameworks can generate learning, impact user experiences, and achieve each SG's goals, for example, define a solution for housing, a transport system, master plan, how to rehabilitate or expand an urban zone, and many other options. The origins can be different; however, the frameworks tend to contribute to similar outcomes.

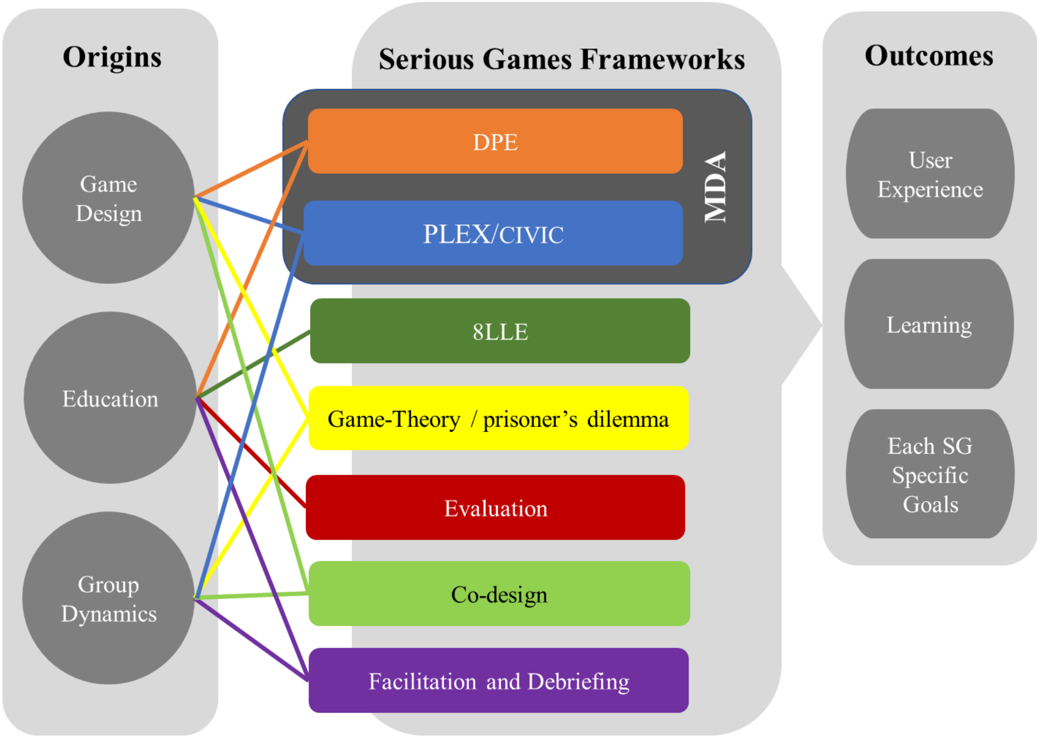

Figure 2.2 – Origins and outcomes identified in the literature about SGs for planning. Authors' proposal.

2.3.3. Summary of strength and limitations of Serious Games in spatial planning

Acknowledging what frameworks are available to explore SGs for planning should prepare us to explore the strengths and limitations of these approaches. It allows us to understand which practical solutions planners can use and where to research and develop to improve SG applications. From the systematic literature review about SGs and spatial planning, we obtained 40 entries published after the year 2000, when there is a renewed research interest in SGs for planning to address the human interaction (Ampatzidou et al., 2018; Constantinescu et al. 2020a)

		0 – 40	%	**Total**
Strengths	**Experimentation**		90%	**36**
	Engagement		70%	**28**
	Collaboration		68%	**27**
	Adress Complexity		40%	**16**
Limitations	**Inconsistency**		83%	**33**
	Oversimplification		53%	**21**
	Distrusted Method		35%	**14**
	Cost		30%	**12**

Figure 2.3 – Number of references about strengths and limitations of using SGs in planning according to Table.

Figure 2.4 presents the authors and the identified groups of strengths and limitations that planners need to consider when using or developing SGs. Figure 2.3 summarizes these findings. We identify four main groups of strengths and limitations, ordered by the importance (based on the content and quantity of literature) to spatial planning practices. This information appears in Figures 2.3 and 2.4 according to the following criteria.

The main strengths, by order of importance (based on quantity of references from Table 1), are:

1 - Experimentation: test model/scenario, map and test ideas, gather information, provide global visions, feedback, and knowledge building in safe environments, focusing on problem-solving and innovation.

2 - Engagement: engaging, enjoying, motivating, and energizing direct participation.

3 - Collaboration: interaction, negotiation, learning from other participants, compromise, and collective decision-making.

4 - Complexity: addressing urban/spatial self-organization, complexity, wicked, polarized, and opaque problems.

The main limitations, by order of importance (also according to Table 1), are:

1 - Inconsistency: restrain participants, incoherent and inconclusive solutions, lack of accountability, methodologies, and frameworks.

2 - Oversimplification: to deliver playable experiences and adapt to users' inputs, interactions, and outputs.

3 - Distrust: lack of confidence and experience from planers and politicians, general prejudice about games, and uncomfortable situations they enable.

4 - Cost: demands high resources like design expertise, data, support tools (i.e., software, materials, facilities), time, and facilitation.

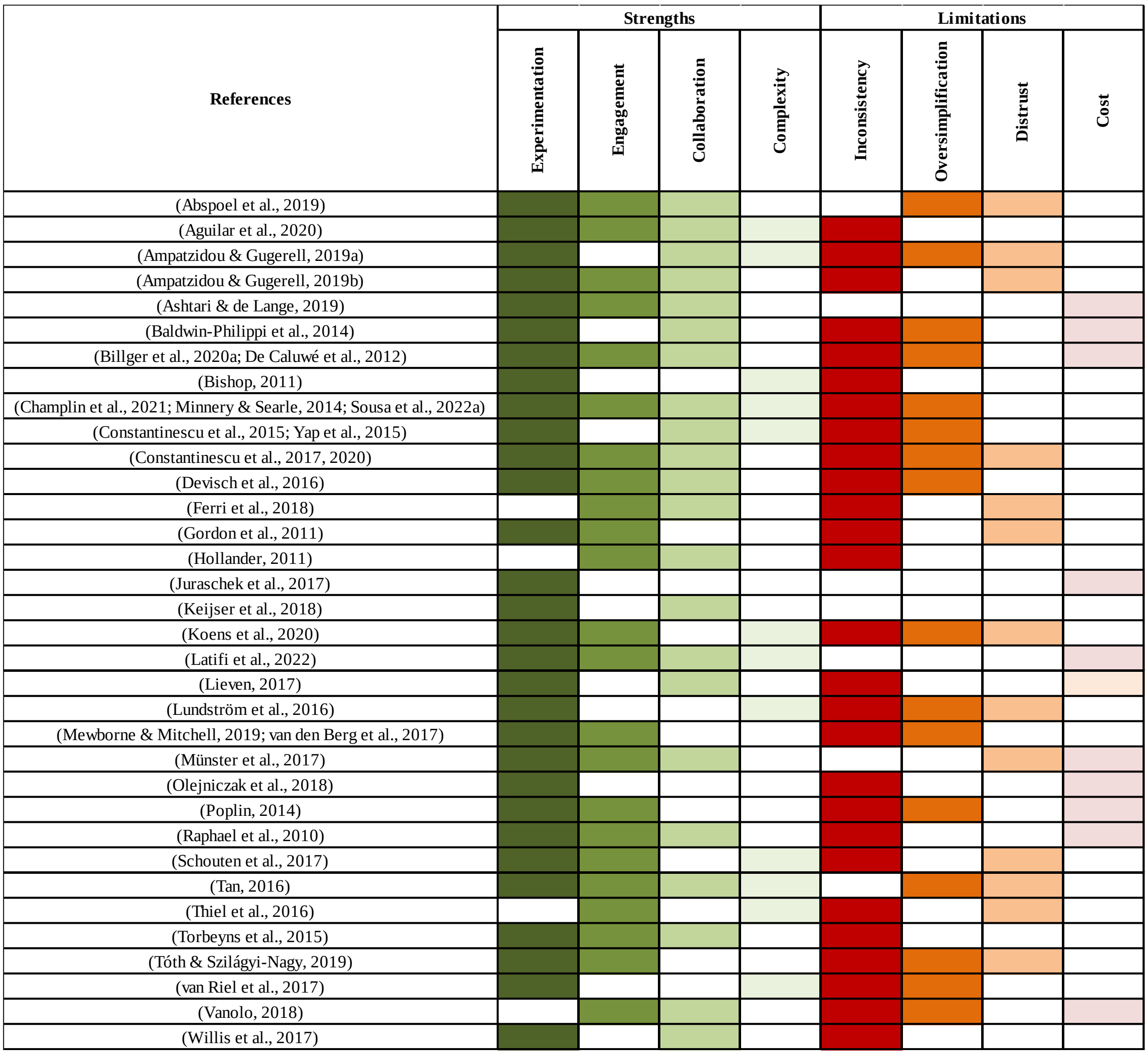

Figure 2.4 – Literature about Strengths and limitations of using SGs in spatial planning after year 2000[5]

The literature highlights the importance of codesigning and testing prototypes to ensure the balance between the topic and the level of playability (Ampatzidou & Gugerell, 2019b). Codesign brought ways to deliver a meaningful and fun experience. It is usually done by exploring and adapting various prototypes to engage the participants (Champlin et al., 2021; Constantinescu et al., , 2020b; Ferri et al., 2018). Codesign deals with the challenges of developing SGs and allows participants to experience planning complexity. Codesign techniques allow planers/game designers to adapt the game models to the reality perceived by participants. By playing the games, participants realize the quantity of data to process and the impacts of their decision within an interactive system. The nature of games allows these kinds of exploratory participation and collaboration through first-person experimentation. But the inconsistencies, oversimplification of reality, and distrust about using games as tools for planning are real issues planners must

[5] As the references appear in sequence in the chapter.

consider. This distrust is even more problematic considering the high costs that developing SGs may imply.

Adopting an established framework like MDA, which is dominant in the literature, or the DPE that fits more to the SG approach, codesign, and continuous playtest of the games with control groups seems promising. However, it is imperative to analyse the game design and results with evaluation frameworks. Game elements need to provide players with engaging and rewarding experiences. Game mechanics are one of these core elements and an essential trait of the MDA and DPE. Besides the fun dimension, the participants must feel they did not waste their time playing SGs. Game results must be considered useful by participants as well as by planners. Planners expect to collect data from SGs that they would not access through other means. Planners also rely on SGs to build planning solutions that result from negotiation and have public acceptability. The MDA and DPE guaranty the flows of information between planners/designers and players/participants.

Analysing the gamming experiences can follow approaches like the PLEX/CIVIC (Ferri et al., 2018) that focus on the player experiences and the evaluation frameworks like the one proposed by Mayer et al. (2014). Game approaches can start with low-complexity and low-cost games. Games can function as ‘icebreakers’ or be somehow parallel to the planning process. The gradual introduction of games as tools allows a planning process to deal with the distrust effect and help planners manage these new tools, developing trust. Exploring these games helps to build low-cost SG solutions. This progressive SG usage can be a way to train planners' facilitation skills. Using and adapting pre-existing games also can be a viable way to begin, benefiting from well-tested game systems that simulate planning, despite this might make adaptation to new planning realities difficult. Building a multidisciplinary team with planners and game designers to develop SGs is recommended. It is more expensive, but it allows planners to approach a specific reality better. Role-playing gaming techniques provide easy game systems to address participants' clashing demands and foster collaboration, even in wicked problems.

From previous findings, we propose in Figure 2.5 a general method to introduce SGs in planning. We propose an interactive process where SG goals are constantly redefined according to available resources (i.e., time, money, tools, facilities, expertise in game design and topics to address, facilitation). The SG goals are defined for each planning process and evaluated according to the strengths and limitations of the defined game-based planning approach (as identified in Figure 2.3 and using the knowledge listed in Figure 2.4). Understanding previously what an SG can achieve in a planning process considering the available resources reduces the time spent discussing and assessing unrealistic goals.

The scheme of Figure 2.5 proposes an approach to introduce SGs into planning practices and continuously evaluate the strengths and limitations of a particular game. This approach allows to use SGs for long and complete simulations or just small game dynamics to do ‘icebreaking’ exercises. The decision boxes in Figure 2.5 force planning practitioners to reflect if available resources and data seem adequate to reach SG goals at each stage: “Use of SG viable?”). These decisions might seem too subjective, but only experimentation, playtesting and debriefing will prove the SG effectiveness due to the intrinsic uncertainties of games. Realizing the level of the available resources, including time and game design knowledge, might force to redefine SG goals along the process or abandon the SG usage. During playtesting evaluations, the user's reactions can lead to redefining the whole process. The proposed approach (Figure 2.5) is compatible with interactive codesign processes (Ampatzidou & Gugerell, 2019b; Champlin et al., 2021; Dodig & Groat, 2019b; Goodspeed, 2016), following the recommendations of playtesting and continuous adjustments (Fullerton, 2014; Schell, 2008).

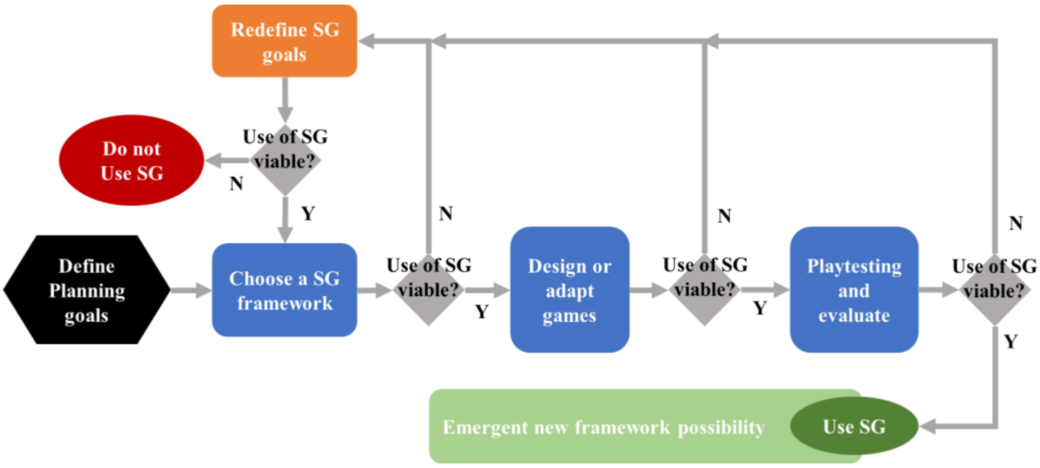

Figure 2.5 – Scheme to introduce SGs in planning.

Besides the available resources and the game-design knowledge necessary to modify or adapt games (i.e., mastering game mechanics and building a context to explore the narrative dimensions), planners can question the adequacy of the available frameworks. After doing several iterations (as proposed in Figure 2.5), planners may realise that the available frameworks might not be adequate to support their processes and achieve the intended planning goals. At this point, planners could try new frameworks (designing a new one if necessary) and dive into SG design, conscious of the uncertainties and limitations they will face. New frameworks may emerge from the playtesting and evaluation when the SG is ready to be used. Planners may realise that the redefinition of goals might be so substantial that the defined objectives might never be achieved with the available resources. In this case, abandoning the SG approach is recommended.

2.4. Conclusions

Using games is not an easy endeavour in planning. The limitations of the available frameworks and their prescribed methods are evident, although the serious games (SG) experiences regarding participation, collaboration, and innovation in planning seem promising. Game usage for serious issues is not new, but its common use in planning teaching and practices is still low. The game-based planning literature is abundant, exploring many different case studies. However, it remains to a great extent unclear when providing frameworks and guides for planners to use them. Despite some efforts, there are no specific suggestions of the suitable mechanics to build effective games (achieving planning goals and engagement). This gap reinforces the need for more research on these SG elements. Only then can a specific game-based approach be replicated as a game-based planning process with some level of confidence.

Reflecting on our initial research questions (third paragraph of the Introduction), we recognize that games are not a panacea to all planning processes. There are no infallible recipes to design and implement SGs in planning, and available frameworks for spatial planning are still in their infancy. Each case must be addressed considering its unique issues and limitations (e.g., context, resources, goals). One complex digital game of urban simulation might work in a case where a simple storytelling game that supports discussion among stakeholders might be enough in another.

Nevertheless, we state that games are useful for planners as supporting planning tools, but using games demands specific approaches. SGs play a decisive role in this matter. SGs require starting the process by defining precise objectives, acknowledging available resources, knowledge about game design, testing, and remaking them, if necessary, while continually evaluating if the chosen or developed games will achieve the planning goals. We proposed a simple process for planners that want to start using game-based planning approaches, allowing to establish codesign principles between planners and users/stakeholders, depicted in Figure 2.5. Our proposal takes into consideration the limitations of the available frameworks, suggesting that after exploring their design possibilities (designing/adapting →playtesting/evaluation → redefine goal), planners may need to create new frameworks that result from SG design practices. SG-based approaches provide a solid background from simulation and education experiences. Their application for approaching complexity while engaging participants to build collaboration processes is growing. Introducing ad-hoc games to support a planning process or developing a planning process as a complete SG, with analogue or digital game platforms, are viable options. Analogue SGs can achieve planning goals while requiring a low level of resources.

Despite these promising possibilities, SGs may fail. Game design knowledge experience is necessary to develop a successful SG, which is problematic when there is no specific training for these approaches or spaces to test. Our proposal warns planners about the strengths and limitations of SGs and the need for interactive and continuous evaluation of results during their development. By mastering available SG frameworks, planners can decide whether to invest or abandon SGs usage. This experience background, based on continuous playtest and evaluation, can lead to developing new SGs and even some associated new frameworks (Figure 2.2).

Figures 2.3 and 2.4 systematises the strengths and limitations of SGs, identifying where SGs can be most applicable (delivering interactive testing environments, engaging participant, fostering collaboration, and approaching complexity,), and clarifying what to avoid during development and use (inconsistency of the results, oversimplification, distrust, and high costs). SGs can generate successful or failed planning processes. It depends mostly on their development process, design elements, implementation, and goal definitions.

Future approaches can follow different ways. We envisage two avenues of research: (1) evaluating existing games (including entertainment games with possible use in planning) and how they could support spatial planning process; and (2) exploring SG typologies for real case studies that develop a new framework to design and evaluate SGs for different planning practices (including the identification of the game mechanics).

3. GAMES THAT USE THE NAMES OF CITIES: LEARN FROM MODERN BOARD GAME DESIGN FOR GAME-BASED PLANNING APPROACHES

3.1. Introduction

There seems to exist a crisis in participation in urban planning (Legacy, 2017). Citizens, stakeholders, and all concerned with the future of cities and places are interested in participating. This crisis is related to time, motivation, and having too many activities competing for time and attention, something transversal to capitalist western societies (Lipovetsky, 2002), and in a way to the Global North. There is a perception that participation efforts sometimes produce ineffective nor the expected outcomes (Baker et al., 2007; Bobbio, 2019; Bovaird, 2007; Van Empel, 2008). These failures led to the development and application of new methods to engage participants that have been tested in planning processes. Game-based approaches are one of these possibilities because games are interactive systems that provide outcomes resulting from players' interactions (Salen & Zimmerman, 2004). Offering playable ways to citizens can interact with the urban system and other users, explore, test, and debate results to deal with urban problems is considered by different authors as a promising approach (Dodig & Groat, 2019a; Ferri et al., 2018; Poplin, 2011; Tan, 2017).

Besides the pragmatic problem-solving justification for urban planning participation, where engaged participants try to enforce their claims and solve their problems (Innes & Booher, 2018), cities seem to fascinate people (Lévy, 2016). There are several games about building cities and exploring urban realities. Games of the Sim City series and Cities: Skylines are among some of the most popular video games. Researchers found that these games are adequate for educative and participation purposes but hard to implement when simulating specific real urban contexts and when users have low game habits (Devisch, 2008; Kim & Shin, 2016). Finding alternative game solutions can solve this limitation. Are modern analogue games a possibility? Since modern board games are becoming increasingly popular, and many are city-building games and others that use names of cities, exploring this phenomenon can help find alternative ways to do game-based planning uses?

Using games developed for entertainment purposes have evident limitations. Adapting and changing these games to deliver tools fitted to the realities planners wish to explore is an effort worth exploring. However, these digital games cannot be modified easily due to intellectual property rights and the need to master game programming and deal with the "black boxes" of the algorithms (Gaber, 2007). Developing games from zero is not a simple endeavour. Complex video games comparable to those done by big companies involve budgets of millions of dollars. It demands considerable resources, time, and human knowledge that requires teams of experts (Fullerton, 2014; Schell, 2008). This game development is even more demanding when these games are more than entertainment products. Deliver the game-based planning tools (i.e., serious games for planning) that generate experiences beyond entertainment is an even higher challenger. Serious games must engage users and still deliver effective experiences related to the goals of a project (Dörner et al., 2016). There are already good examples in the literature: helping users to decide how to define a transport system (Sousa et al., 2022a), an urban development plan (Tan, 2016), or approach energy efficiency in a territory (Ampatzidou & Gugerell, 2019b).

One of the limitations of using serious games for planning are the development cost and the lack of training and preparation from planners to use game-based approaches (Ampatzidou et al., 2018; Sousa et al., 2022b). Finding easier ways for planners to use game-based tools is a clear usability gap. Analogue games are easier and cheaper to create than digital ones (Fullerton, 2014; Salen & Zimmerman, 2004), and there is an ongoing board game revolution happening (Donovan, 2017; Konieczny, 2019). Modern board gaming as a hobby is becoming increasingly popular among the general public, and their distinctive design features are starting to influence analogue serious games (Castronova & Knowles, 2015; Sousa, 2020a). The mechanisms, physical components and other game elements from Modern Board Games (MBG) can engage users and simulate complex processes (Andrews, 2013; Triboni & Weber, 2018).

We argue that exploring these city-focused MBGs may reveal some design traits applicable to analogue serious game design that may be useful to develop new planning support systems (PSS) (Geertman & Stillwell, 2012) for urban planning. Many of these MBGs are city-building games, while others adopt names of existing cities, going beyond city material development and management. In this paper we explore the MBG international movement, the most popular games being created that relate to cities and how players perceive these games.

Our exploration of this phenomenon brought new insights into how planners can engage participants and what game elements to use efficiently in game-based planning. More than using complete games, our research revealed what simulation experiences these MBGs do better according to the players' perspective. This awareness is expected to help planners identify what game elements and dimensions to use in possible new game-based PSS. We departed from the players' perspectives (using a sample of hobby gamers) as users (generally speaking participants which could be citizens) are who planners need to engage with in common participatory planning processes. Considering players' perspectives is core for user-centred design approaches (Pagulayan et al., 2002). Understanding what motivates them to play games related to cities is expected to shed light into the design and use of board games in participatory and collaborative planning approaches.

The paper is organized into the following subsections. The first sections address the human fascination with cities as an introduction to explore how the MBG phenomenon approaches cities. People seem to like MBG and favour those that deal with cities. The methodology presents the survey development, dissemination, and data processing. Discussion and conclusions summarize the findings and future research recommendations. Players relate to places (i.e., cities) and designers also. The urban themes provide rich and engaging playable worlds for players to interact with each other. Acknowledging how this happens can be replicated for game-based planning approaches.

3.2. Defining cities and our fascination toward them

Asking people how they define a city leads to very different answers, depending on the context (e.g., personal experiences, the type of conversation, the disciplinary approach, etc.). A city can mean or represent many things to an even higher number of persons (Pile, 1999, p. 4). The European Commission defined cities by concentration levels of inhabitants, although arguing that "*A city is much more than a physical imprint on a map. It is an organic entity with its own identity and capacity to respond to the demands and needs of its inhabitants, as well as influence its surrounding territory*." (2019)[6] These institutional definitions tend to set quantitative limits and thresholds that are not enough to define what a city is. Looking for other descriptions helps to show the diversity and richness cities hold. The following statement is one of the most known definitions of a city.

> *"The essential physical means of a city's existence are the fixed site, the durable shelter, the permanent facilities for assembly interchange, and storage; the essential social means are the social division of labor, which serves nor merely the economic life but the cultural process. The city in its complete sense, then, is a geographic plexus, an economic organization, an institutional process, a theater of social action, and an aesthetic symbol of collective unity" (Mumford, 1937, p. 39).*

As Pile (1999, p. 16) highlighted, Munford defined a city as a geographic plexus, the overlayed and connected networks of flows and activities. Cities generate clusters by the dimension and complexity of these dynamic networks and concentrations, affected by spatial locations (Kostof, 1991, p. 38). Kostof (1991, pp. 37–39) also invoke Munford, remembering that the cities are "*The points of maximum concentration for the power and culture of a community*" when saying that cities can hold energizing crowds and accumulate wealth, materialized in the urban construction and monumentality that symbolizes the dominance over a region.

The previous definition from Munford refers directly to the specific form of the city, which can be represented graphically, and to the social, economic, and cultural dimensions (material and immaterial dimensions). A city can be defined by its size, scale, and location. However, a group of human-made constructions only became a city by combining different human, material, and immaterial features. The flows and the spatial relations matter, likewise the entities, institutions, and associations that fuel the city's life.

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[6] "*What criteria are used to define a city?*" Available at: https://urban.jrc.ec.europa.eu/thefutureofcities/what-is-a-city#the-chapter

Therefore, considering all that cities promise many opportunities and surprises, it is not surprising that they fascinate us. Besides delivering our most basic needs like shelter and access to resources, cities held much more than this. Lévy (2016, p. 33) argues that cities are the places where the surprise of discoveries and encounters have the most potential, both related to the built environment and human activities. When we visit or live in a city, there are some elements we can predict, but many others are surprising due to the multiple urban activities. If we travel through human history, we cannot escape the influence of cities. Paul Bairoch (1988, p. 1) says this directly when describing the connection between cities and human history "*It is all the more fascinating because there can be little question that the birth of cities and thus the emergence of the historical context that either favored the or actively gave rise to cities constitute between them one of the major turning points in the history of humanity*. […] Without cities there could be no real civilization.". Although civilization is a concept charged with ideological influences related to cultural dominance, imperialism, and colonialism (Goudsblom, 2006), inhabited cities are where human culture has been concentrated and maintained the most, preserved and shifting through continuous adaptation. Living cities present layers of history combined with contemporary dynamics in a physical and spatial form, a lens for the present and the past. Cities are where complex cultural and economic relationships have developed (Holton, 2013), which are associated with complex societies and civilizations. Cities result from collective human interactions throughout history, each settlement with its specific traits (Mumford, 1961). Although most of humanity is settled permanently in a territory, exploring new places fascinates us. Many touristic activities result from this desire. In the following sections, we will explore how MBGs represent the cities' complexity, richness, and importance, delivering engaging analogue game experiences.

3.3. Modern boardgames and cities

Despite the dominance of digital games, apparently we are living in a golden age of board games (Booth, 2021; Konieczny, 2019). The number of people seeking board games is growing, as well as the economic value of the board game industry (Consulting, 2022). *Statistica* (2023)[7] reports say that the board game industry in 2022 represented 3.12 billion US$. *Board Game Geek* (BGG)[8], the most important website regarding hobby board gaming, surpassed 3 million users in 2022, and the *Essen Spiel* 2022 fair received 147.000 visitors to see the newest novelties of the industry. This is the population we are aiming for in the survey. Arguably, we are dealing with something relevant from a cultural and economic perspective.

The current interest in board games is not a revivalism because the growing number of players are not seeking older board games (Donovan, 2017). They are looking for new types of games, those known as hobby games (Woods, 2012). These are updated (modern) board games with new design elements that provide strategic and interactive experiences, with distinctive artwork and

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[7] www.statista.com
[8] www.boardgamegeek.com

high-quality components (Rogerson et al., 2016; Micael Sousa & Bernardo, 2019). Hobby gamers tend to classify MBGs as *Eurogames* and *Americangames*[9], the first focusing on the mechanical system and the second more on narrative and interaction. Despite this distinction, recent games are mixing the two design approaches. The available demographic studies for MBGs reveal that the majority of hardcore hobby gamers are adult men with high education and a comfortable social and economic situation (Kosa & Spronck, 2019; Rogerson & Gibbs, 2018). Although some criticize the denominated Eurogames (a class of modern board game responsible for part of the expansion of the hobby board game market in the last 20 years) for being abstract, these games adopt themes and narratives that fit adult preferences, like economic and historical simulation (Wilson, 2015).

The material fascination of these games and the meaningful playable experiences they provide are some of the reasons to explain MBGs' success (Booth, 2021). From a game design analysis, these games demand higher agency from the players to function. Without previous knowledge and players' activations, games would not work (Duarte & Battaiola, 2017; Xu et al., 2011). Likewise, playing a board game in a multiplayer format demand a social contract between the players, the agreement to play by the rules or change them unanimously. Even in competitive wargames, there is a significant level of collaboration between the players for the game to function (Zagal et al., 2006).

Among the MBG movement, there is a curious phenomenon that does not appear in other game formats. A considerable number of MBGs, mostly eurogames, use names as real cities. The BGG top board games show this phenomenon[10]. In the top 400 games, according to users' preferences, 22 are eurogames with names of cities (5,5% of the total). This trend of using real cities names does not manifest in video games. Remembering that popular board games, defined as eurogames, are appreciated by adults and families means they can deliver engaging adult activities (Woods, 2012). Exploring MBGs' design characteristics might be useful for urban and city planning. Analog games are easier and cheap to develop/adapt (Fullerton, 2014; Ham, 2015) and some practitioners are starting to experiment with game-based analogue approaches (Dodig & Groat, 2019b; Sousa, 2020a; Tan, 2017).

3.4. City building games and games about cities

When searching for games related to cities, there are at least two different types. Games that let the player generate generic cities and those that try to simulate urban elements of real cities. In video games, the most popular games tend to be about building generic cities, called City-Building Games (CBG). Games like Sim City and Cities skylines have been very popular. The board game industry also produces similar games. BGG describes city-building games as a type

[9] Although several sources use the term *Ameritrash* games, this might be considered offensive. We adopted the term: *Americangames*.
[10] See the list of games by rank at www.boardgamegeek.com.

(family) of games (BGG, 2000): "*City Building games compel players to construct and manage a city in a way that is efficient, powerful, and/or lucrative*"[11].

The top 400 most appreciated BGG games reveal 43 city-building games (10,75%), showing that building and managing cities are popular among gamers. When analysing some of these games in detail, for example, only the ten better-classified games, the relationship to city management and planning is tenuous. *7 Wonders duel* (Bauza & Cathala, 2015) is an abstract simulation of an ancient civilization's cultural and material development, symbolized by the accumulation of cards and scores. In *Everdell* (Wilson, 2018), players acquire cards representing animal fantasy inhabitants and some buildings displayed in an orthogonal grid. *Puerto Rico* (Seyfarth, 2002) is about colonial farming exploration and exporting, introducing some urban buildings. *Underwater Cities* (Suchý, 2018) represent the utopian futuristic expansion of cities deep in the oceans, focusing on resource management and network flows. *On Mars* (Lacerda, 2020) game simulate the early colonization of planet Mars by adding modules that can accommodate human life. *Lisboa* (Lacerda, 2017) addresses the rebuilding process of the Portuguese capital after the 1755 earthquake effects with a graphical representation of the new urban plan, buildings, and public facilities. *Le Havre* (Rosenberg, 2008) is a game about building factories, warehouses, port facilities and boats to transform and transport material resources. *Lords of Waterdeep* (Peter Lee & Thompson, 2012) represents the urban dynamics of a fantasy city where players can hire adventures for quests. *7 Wonders* (Bauza, 2010) is similar to *7 wonders Duel*, allowing more than two players to play the game. *Architects of The West Kingdom* (Phillips & Macdonald, 2018) represent a medieval settlement where resources are explored to build a cathedral and its urban surroundings.

The previous games did not seem very detailed when simulating all the complexities and dimensions of cities. Many are simplifications and abstractions of the production and development of cities in general or just a specific urban dimension. Arguably, it would be difficult to use them directly for planning purposes. Attempts have been made to use commercially available games; some researchers used games like *Lords of Waterdeep*, combined with role-play elements, to approach the human capital a city can offer (Schouten et al., 2017).

Exploring the other popular MBG defined in this paper as Games Named as Cities (GNAC) might offer some other possibilities. These games are not as easy to find at BGG as the city-building ones because some are not classified as a "family of games" (like a category) by BGG. However, they must have some features in common. They also represent the social, historical, and architectural dimensions of cities. GNACs seem different from CBGs. To understand the characteristics of these MBGs, we proposed a method to find why users like playing these games and if they can relate the game experiences to urban dimensions.

[11] www. boardgamegeek.com/boardgamecategory/1029/city-building

3.5. Materials and Methods

To find what drives gamers to play GNACs, we developed a survey where they could express their preferences and comment on the relationships between the games and urban dimensions.

The survey followed the European legal and ethical requirements for personal data protection. Data collected referred only to gaming habits and perceptions about a selection of GNACs. No personally identifiable information (PII) nor data on personal habits were collected that could expose or warm the participants were collected. The survey was created through *LimeSurvey* tool (GDPR compatible), and all the participants signed an informed consent form explaining the purposes of the research and identifying the researchers involved. The survey questions are available in Appendix A.

We deployed the survey in social media know to be attended by MBG (*WhatsApp, Facebook, Discord, Reddit*) and directly on BGG guilds (thematic forums) related to research and as a trend in the forums associated with the selected games.

First, we analysed all the general BGG ranks, identifying 22 GNACs in the top 400. The survey was online from 1 June 2022 to 1 January 2023. The analysis date was January 2023. This process facilitated the dissemination process because the survey was posted in the forums of the BGG page for all 22 games.

The questionnaire is divided into five parts:

- Part 1 – personal information (generic and non-identifiable).
- Part 2 – Board game habits.
- Part 3 – City builders and board games about cities.
- Part 4 – About the game at stake (users selected one of the 22 games to analyse).
- Part 5 - Comments and suggestions about the questionnaire.

Part 1 and 2 collected information about the gaming habits and perceptions of users, their relation to urban planning, and MBG preferences. Part 3 explored how urban MBGs address the following dimensions: Built fabric and infrastructure; Economy; Historical context; Nature and Environment; Social and cultural; Transport system. We expected participants could relate these generic dimensions of urban places to CBGs and GANCs. To complete this information, in Part 4, we asked what game elements and traits participants think are relevant for CBGs: Cultural information (names of the places, events, etc.); Maps (space representation 2D/3D, multiple scales, relationships, etc.); Miniatures and dioramas (buildings, nature, vehicles, heritage, etc.); Quantitative information and indicators (population, wealth, pollution, etc.). Also, in Part 4, but regarded the chosen selection of 22 GNACs, participants chose one of these games to classify it according to generic urban dimensions and gameplay. In Part 4, there were two open-ended questions. The first question requested the identification of the best CBG and why. The second one asked the participant for reasons for the proliferation of GNACs and reasons leading gamers to like to play them. In part 5, participants could freely comment about the survey and the aim of the research.

Parts 1 to 4 of the survey generated direct quantitative data (multiple choice questions and Likert scales of 1 to 10), allowing simple statistical analyses and a correlation test between the BGG rank and the games that participants suggested as better ones to represent cities. The open questions (Part 4 and 5) delivered indirect qualitative results analyses based on the grounded theory principles (Charmaz, 2014), clustering the answers per types of stated issues.

3.6. Results

We present the demographics of the sample. Later, the data analysis and interpretation regarding CBGs and the selection of GNACs.

3.6.1. Participants' demographics

We collected 102 valid participations (*n*=102). Figure 3.1 reveals the participants' demographics, age group, gender, education, and board game habits.

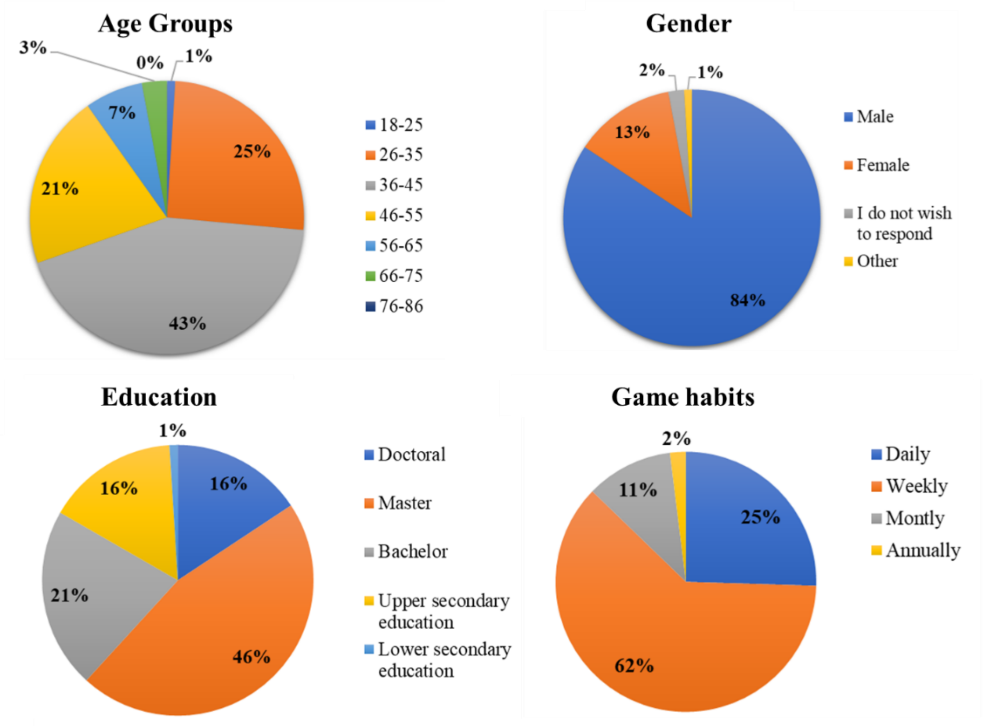


Figure 3.1 – Demographics of the participants (non PII).

Male players dominate the sample (84%), like those with higher education (67%). Age groups vary, although younger active cohorts from 25 to 46 are the majority (68%). They are experienced gamers because 62% play at least once per week, and 11% play daily. 46 participants prefer high complexity games, 56 the medium complexity, and only one the low complexity ones. This summary allows us to portray the sample, composed of highly educated young and middle-aged men with strong playing habits, tending towards medium to heavy games. We also asked the users if their professional or academically were related to urban planning. Only 8 confirmed this relationship (7,84% of the sample), revealing that the preference to play GNACs and CBGs depends on other reasons.

3.6.2. City-building games (CBG)

To find more information about the type of games users enjoyed the most, we asked them to define their preferences according to generic types of games, those categories defined by BGG (categories) relatable with generic and urban games (Table 3.1).

Table 3.1 – Users' game types and themes preferences

Game types and themes	$\bar{x}$	$\tilde{x}$	σ
Abstract	5.75	6	2.40
Adventure	6.20	6	2.03
City Builder	7.41	7	1.66
Deduction/Mystery	5.65	6	2.26
Economic	7.96	8	1.82
Humour/Party	4.78	5	2.42
Narrative/Storytelling	5.48	6	2.48
Sports	4.10	4	2.25
Wargame/Combat	5.92	6	2.50

Table 3.2 reveals more details about what simulation dimensions participants valued the most in CBGs. When compared with Table 3.1, participants prefer economic games and games that simulate building cities. Table 3.2 dimensions do not present the same variation as in Table 3.1. Table 3.1 scores for MBGs related to Sports was 4.10, while the lowest value in Table 3.2 was 6.71 for the "Nature and Environment" dimensions.

Table 3.2 – Users' simulation dimension preferences in CBGs.

Dimensions present in a city building game	$\bar{x}$	$\tilde{x}$	σ
Built fabric and infrastructure	7.57	8	1.92
Economy	7.88	8	1.62
Historical context	7.09	7	2.24
Nature and Environment	6.71	7	1.95
Social and culture	6.97	7	1.84
Transport system	7.33	8	1.95

We were concerned about addressing the practical implementation of the games. In the survey, participants classified the game elements CBG should have. To better address cities in a general way. Table 3.3 shows these results, considering the cultural and identity dimensions, maps, urban morphology representations, and other physical and living existences that populate cities. Table 3.3 also shows how the users consider the importance of quantitative information and indicators in CBG. Maps and graphical representation were the most valued dimensions (7.22), although all had similar preferences.

Table 3.3 – Traits and game elements of CBGs.

Traits of city building games	$\bar{x}$	$\tilde{x}$	σ
Cultural information (names of the places, events, etc.)	7.05	7	2.24
Maps (space representation 2D/3D, multiple scales, relationships, etc.)	7.22	8	2.02
Miniatures and dioramas (buildings, nature, vehicles, heritage, etc.)	5.53	6	2.53
Quantitative information and indicators (population, wealth, pollution, etc.)	6.40	7	2.13

Participants suggested 33 different games when answering the open question about the best CBGs. However, 24 participants were not able or did not wish to identify one game. Of the 78 participants that answered suggesting a game, 64 did not justify why that was the best CBG. Only a minority of 14 participants described the reasons for their choice, revealing that users might not be aware of the urban dimensions in the games they selected. These answers were analysed, grouped by cluster, and presented in Table 3.4. *Suburbia* (Alspach, 2012), *Lisboa*, *Carcassonne*, and *Praga Caput Regni* (Suchý, 2020) are among the top games, all with tile placement game mechanisms (Engelstein & Shalev, 2019) that represent spatial dynamics.

Table 3.4 – Identified city builder games and their characteristics by participants.

Game	Number of citations	Spatial dynamic	Landscape and buildings	Environment	Social	Economy	History	None
Suburbia	19	2	2	0	0	0	0	15
Lisboa	10	3	1	0	0	0	5	4
Carcassone	8	1	2	0	0	0	1	4
Praga Caput Regni	7	1	0	0	0	0	3	4
Antiquity	2	0	0	1	1	1	0	1
Kingdomino	2	0	0	0	0	0	0	2
London 2ed ed	2	1	0	0	1	1	0	0
Quadropolis	2	1	0	0	0	1	0	1
Small City	2	0	0	1	0	0	0	1
7 Wonders Duel	1	0	0	0	0	0	0	1
Alhambra	1	0	0	0	0	0	1	0
Anno 1800	1	0	0	0	0	1	0	0
Attika	1	1	0	1	0	0	0	0
Between Two Cities	1	1	0	0	0	0	0	0
Brass	1	0	0	0	0	0	0	1
Bruges	1	0	0	0	0	0	0	1
Citadels	1	0	0	0	1	0	0	0
Era: Medieval Age	1	0	0	0	0	1	1	0
Everdell	1	0	0	1	0	0	0	0
Foundations of Rome	1	1	1	0	0	0	0	0
Kingdom builder	1	0	0	0	0	0	0	1
Le Havre	1	0	0	0	0	1	0	0
Macao	1	0	0	0	0	0	0	1
Machi koro	1	0	0	0	0	0	0	1
My City	1	0	0	0	0	0	0	1
Puerto Rico	1	0	0	0	0	1	0	0
Terraforming Mars	1	1	0	1	0	1	0	0
The Capitals	1	0	1	0	0	1	0	0
Through the ages	1	0	0	0	0	0	0	1
Underwater cities	1	1	0	0	0	0	0	0
Urban Sprawl	1	1	0	0	0	0	0	0
Warsaw: City of Ruins	1	1	0	0	0	0	0	0
7 Wonders Duel	1	0	0	0	0	0	0	1
Total	**102**	**16**	**7**	**4**	**3**	**9**	**11**	**64**

3.6.3. Games named as cities (GNAC)

The selection of the top 22 GNAC allowed the participants to choose a game to classify according to generic urban dimensions. Table 3.5 shows that the distribution was not equitable and that the BGG rank had no statistical correlation (R=-0.267) with the number of selected games participants chose to classify. Analysing the sum of the median value (Table 5), "The historic period portraited" (125), "The economic context and dynamics" (106) and the "Flows and spatial relationships" (84) and "Social and cultural context and dynamics" (82) got the higher scores.

Table 5 shows the sum of median ($\tilde{x}$) evaluations per game (column) and per generic urban dimension (line) to compare the games and dimensions that scored higher according to participants.

Table 3.5 – Evaluation of the generic urban dimensions of the top 22 GNAC ($\tilde{x}$)

Game	BGG Rank	N Participants	Economic context and dynamics	Environment and natural context and dynamics	Flows and spatial relationships	Land uses and densities	Social and cultural context and dynamics	The historic period portrayed	Transport system	Urban amenities and public facilities	Urban Morphology	Sum of the $\tilde{x}$ evaluations
Carcassonne	201	23	4	5	7	6	4	5	3	3	41	**41**
Lisboa	57	13	8	9	8	7	8	9	4	7	68	**68**
Praga Caput Regni	140	10	6	8	7	6	7.5	9	3	5.5	47	**47**
Orléans	30	7	7	7	8	6	8	8	6	5	60	**60**
Istanbul	148	5	8	3	6	3	7	7	4	4	45	**45**
Tikal	299	5	3	3	3	3	3	7	5	2	32	**32**
Troyes	99	5	5	6	5	3	7	8	2	5	45	**45**
Le Havre	61	4	8	5	2.5	2.5	3.5	5	3	8	31	**31**
London 2nd ed	383	4	8.5	5.5	4	5	7	8	3.5	7	31	**31**
Yokohama	121	4	7	5	6	5.5	3.5	7	2.5	4	29	**29**
Bruges	300	3	5	5	4	3	3	8	3	3	37	**37**
Caylus	93	3	6	5	5	5	7	8	5	5	51	**51**
Coimbra	196	3	6	5	6	4	7	8	3	1	44	**44**
Nusfjord	325	3	8	7	5	4	5	4	3	6	45	**45**
Saint Petersburg	369	3	7	5	4	3	5	6	1	2	35	**35**
Jaipur	158	2	4.50	2	1	1	3.5	4	1	1	11	**11**
Maracaibo	50	2	5	6	7.5	4.5	7.5	8	6	4.5	29	**29**
The Great Zimbabwe	340	2	9	7.5	7.5	8.5	6	5.5	10	6.5	27	**27**
Mombasa	95	1	4	5	5	5	5	6	4	5	43	**43**
Bruxelles 1893	377	0	0	0	0	0	0	0	0	0	0	**0**
Goa	228	0	0	0	0	0	0	0	0	0	0	**0**
San Juan	350	0	0	0	0	0	0	0	0	0	0	**0**
Sum of the $\tilde{x}$ evaluations			**106**	**91**	**84**	**64**	**82**	**125**	**66**	**68**	**65**	

According to the participants, the game that deals better with all the dimensions is *Lisboa* (68), followed by *Orléans* (60) (Stockhausen, 2014), *Caylus* (51) (Attia, 2004), and *Praga Caput Regni* (47). From all of these, *Lisboa* is the one with the better score in "Urban morphology " (7) and "Land uses and densities" (7). The *Lisboa* game board represents the urban renewal plan in detail, allowing players to build it as part of their actions. All the other graphical representations of the cities portrayed in *Caylus* and *Praga Caput Regni* are only schematic. In *Orleans*, there is no meaningful representation of the form of the city (it's just an indistinctive zone in a regional map of medieval France). *Lisboa* and *Praga Caput Regni* appear in the CBGs and GNACs list of games.

The analysis of the free answers regarding the question "Why do you think there are games with the name of cities and gamers play them" generated some extended answers while others were blank (6 in 102). The available data allowed us to organize the answers by main clusters and cluster subdimension, following the grounded theory method of qualitative analyses and iterative classification and grouping (Table 3.6). The simulation cluster refers to what is represented in the game, the personal experiences to the emotional attachment of the players and designers to the game representations, and the design practices refer to the processes of designing, developing, and marketing the game as a product.

Table 3.6 – Analysis of the participants' answers about: " Why do you think there are games with the name of cities and gamers play them?"

Main cluster	Cluster Subdimension	Quantity of references in the answers
Simulation	Building, development, and management	15
	Maps and spatial representations	9
	Architecture, Historical and cultural background	30
Personal experiences	Sense of belonging and relatable	21
	Travel and discover another reality	20
	Liking/fascination with a place	32
	Author hometown / personal relation	3
Design practices	Seriousness and grandiosity of the theme	2
	Perceptible / relatable entity	30
	Game mechanisms overlay theme	35
	Easier to implement	19
	Marketing	25
Nothing / Do not know		6

From the 102 participants (noted generically as P#), we collected six comments about the survey. P14 wrote, "*I can't imagine what useful value you're possibly getting out of this survey. Seems like a typical survey by a non-gamer. Better to actually play these games and learn by doing.".* P14 assumes its hobby culture as a movement apart from casual gamers and people that talk about games without playing them. Generic texts published online in newspapers and websites[12] speak about the success and growth of board games but they might distinguish between hobby games and mass-market games. All games in the sampled were analysed: rules and game mechanisms were checked for references to cities and MBG feature. This reinforces the systemic analysis of MBGs to deliver serious games approaches (Sousa, 2022e). P17 said "*Some of the games you have chosen have nothing to do with city building, for example, Jaipur. And you have missed games that seem a much better fit, such as Suburbia."*, highlighting that because the game uses the name of a city, it does not mean it would simulate the urban dimensions of a city. According

[12] If we do an online search, in any web browser search engine, using words like "Board games" reveals tops and suggestions that mix mass market games and some simple hobby/modern board games. Considering this standard search method might be how some users try to find new board games, this might confuse newcomers about the differences.

to P17, CBGs do this better. P17 states that some games assume the names of cities in a very abstract representation and simulation. "*I believe games usually are not worried about the actual cities they portray. I was disappointed with Coimbra because there isn't any City feeling, but it is a very good game with an interesting use of dice*." argued P27. P27 revealed the frustration because some games do not detail the relationship with the portraited city (Coimbra in this case). Game designers seem more concerned with the mechanical aspect of the gameplay. In Table 6, we see this as a design practice when 35 participants stated that in GNACs the game mechanisms overlayed the themes, meaning that the games be adapted to approach any other theme besides that particular city. P53 complements this perception by saying that "*There are plenty of non-Euro games named after cities and games that don't involve building a city which are named after cities*". The answers that generated the Table 6 clusters referred to the mechanical dominance over a theme (narrative) as something typical of the eurogames. Arguably, the game theme is a generic hook, a way to engage players, giving the game a serious and adult dimension. Despite this, the thematic relationship with a specific urban context inspires some representations of the urban dimensions but tends only to support the game mechanisms. P92 comment reinforces this idea: "*Note that this trend of using city names occurs more in abstract or euro games and not so much in thematic ones.".*

3.7. Discussion

There is a clear distinction between CBGs and GNACs, although some games can be classified as both. GANCs tend to be eurogames, described as elegant (Calleja, 2022)[13], with innovative and puzzling game mechanisms that use a theme in a very abstract way (Wilson, 2015; Woods, 2012). Nevertheless, these are popular games when adapting names of cities to build a narrative context tends to explore our human fascination with cities. According to the participants' perspectives, the selected games seem adequate to simulate historic processes and how human societies grow and prosper regarding the economy and land development (Table 3.6).

MBGs also have high scores in the economy and historical dimensions (Table 3.5). The difference is that CBGs are better at representing spatial dynamics, having pieces players can manipulate and change maps and other graphical representations. MBGs such as *Lisboa*, Suburbia, and Carcassonne all have tile placement mechanisms that represent land uses, buildings, natural spaces, and infrastructures. In the case of complex games like *Lisboa* and *Suburbia*, the tile-laying mechanisms are combined with other mechanisms such as tracking bars where urban indicators like population and economic activities are quantifiable. Players can play with these tiles (flat cardboard pieces with graphical printed information) to change space representations, relationships, activities, and interconnections. Using tiles components combined with tiling mechanisms provide tangible and graphical meaningful play experiences. Due to the

[13] Elegance is a common term used by board game designers, describing what seems to be a game with few rule exceptions, where the mechanisms connect to the theme/simulation. It means it has a functional user interface and delivers pleasant experiences to the players (UI/UX).

tiles with different urban densities and roads, Carcassonne was adapted and used for geography teaching and introduced the concepts like gravitational models (Mewborne & Mitchell, 2019). Despite these direct relationships in games like *Lisboa*, *Suburbia* and *Carcassonne*, we must observe that only 13.72% of the participants identified urban dimensions in the games they proposed as the best city-building games. Apparently, the participants' perceptions are more emotional than based on a systematic analysis about urbanism and cities. Only 7,84% had a relationship to urbanism and cities as working or academic activities (in general terms), revealing that urban themes engage participants. These values can mean that the planning community might be unaware of the potential and that games related to cities engage users with no professional or academic relationship to the subject.

The participants highlighted dimensions regarding design practices and marketing of the games. For them, having a perceptible entity like a city helps designers to frame a game (Table 3.6), even if they are more concerned with the mechanical side of the game. It seems that GANCs represent well the material manifestations of growth and development, making economic cycles more tangible. The cultural, social, and environmental dimensions are part of these representations. And the aesthetic, architectural and art manifestations also can be invoked through the city landmarks and distinctive urban morphologies or cultural activities. All these combinations can engage users. Some users look for economic and strategic puzzles that result from managing urban activities, while others are drawn by the fascination of cities as places to visit and explore (Table 3.6). There is a clear relationship between different player profiles and motivations to play games in general, seeking problem-solving, exploration and social interactions (Zagalo, 2020). The collected data reinforces this. Some players enjoy mathematical problem-solving to manage the city, while others see themselves travelling to the depicted city in the game (Table 3.6). Designers and publishers know this and use it as a marketing strategy. They decide to name the game as a support to build the narrative and playable context, avoiding abstraction and trying to highlight the game seriousness (not for children).

We argue that practitioners linked to urban planning looking for game-based approaches for PSS can learn from these games. Users say that maps and graphical representation matter for CBGs (Table 3.3), technical expertise planners are trained master and can easily explore. Planners interested in using serious board games as PSS could find what games are available and play them while exploring the types of simulations and experiences those games provide, following a similar process of learning game usage by playing, discussing and adapting them for serious purposes (Sousa, 2022e). After this introduction, which explored what board games are available to use directly, developing new games might be necessary. It is recommended that planners comprehend game mechanisms and perceive what experiences they may provide to users (citizens) when designing games for serious purposes (Constantinescu et al., 2020a; Sousa et al., 2021a; 2022b). As stated before, developing games is challenging and even more for planners or any others that do not design games regularly. (Ampatzidou et al., 2018; Dodig & Groat, 2019b). Alternatively, MBG trends show that people like games related to cities, even when they are abstract constructions of urban realities. When gamers dive deep into playing MBGs they can become game designers and create their own games more easily (Booth, 2021; Engelstein, 2020b). This process of learning to design by playing can contribute to increasing engagement in participatory planning. It is highly probable that planners that play more can be more prepared to use the games for serious purposes. Moreover, analogue games are easier to develop, replicate and adapt than video games. Planning practitioners can use game mechanisms to complement their planning approaches and PSS without the need to master and build deep and complex games (Ampatzidou & Gugerell, 2019a).

Considering the sample demographics, it fits the other more generic demographic studies conducted recently about board gamers (Martinho & Sousa, 2023). There is a gender imbalance and a high percentage of highly educated participants; although this seems a biased sample, highly educated male tend to be a significant cohort in common participatory processes (Dobson & Parker, 2023). These characteristics reveal that MBGs might be more appreciated by specific social groups, although authors like Paul Booth (2021) highlight that more and more women are playing MBGs, and general inclusivity is increasing. These limitations are something planners must consider when developing inclusive game-based approaches.

3.8. Conclusions

Our research shed light on how board game players, designers (through the games they create), and the general public (perceived by the board gamers) see cities from many different perspectives. Some think in the material, architecture, and geographic dimensions, while others look for the historical background, the culture, or the economic manifestations. All these approaches delivered successful games (according to BGG ranks), exploring the human fascination for cities. However, we must acknowledge that the sample was not representative of a country or the culture of any local specific community. We dealt with MBG gamers in general. We cannot review all cohorts of participants in public participation as it is too large a group to survey, it would be too expensive, and they differ in socio-economic context, engagement, regulatory frameworks, and attitude towards urban planning. We identified a large community (145.000 participants in the Essen Spiel fair, plus the 3 million users of the BGG website) of board game players and developers that, due to the size (and even representation of urban planning linked members 7.84%). The distribution of the sample has some characteristics that can be found in the know distributions of participants in urban planning processes (Dobson & Parker, 2023). Learning from MBG design to build serious games for planning seems promising to reinforce participation and experiment with new publics as these games are reaching new publics every year.

Existing MBGs successfully explore cities from a marketing perspective, engaging players that seek to interact with the economy, flows and development of urban places. Some simulate other dimensions like social, cultural, and ecological dimensions. Those recognized by the target population sampled as the best games to represent cities (CBGs) tend to have maps and graphical tangible information, combined with game pieces, that represent the urban morphology, buildings, and the built environment. Participants in urban planning participatory processes are known for desiring to have concrete and perceivable conceptualizations of their cities to discuss and decide upon.

In general terms, MBGs that use the name of cities (GNACs) do not seem fully suited to be used directly as tools for urban planners, not even for the specific city portrayed. This is due to the focus on playability and not in detailed simulation or achieving a specific purpose besides engagement. Despite these limitations, they successfully explore specific urban dimensions that game designs invoke to engage players. In some cases, it is the local economy, other the aesthetics of the built environment. City builder games (CBGs) seem to be better for urban simulation because they represent the spatial dimension, changes, and interactions resulting from players' actions.

We believe that MBGs can be useful for those wishing to address cities from a game-based perspective but in an indirect way, as design examples to build other games (e.g., game mechanisms, components, etc.). Exploring these games reveals how a game system (and which game elements) can simulate and address urban dimensions in interactive, tangible, and playable ways. Future research could test what types of game-based approaches urban planners can create after being exposed to these board games and what can complement their possible training on serious game design for PSS.

4. FINDING BOARD GAME MECHANISMS TO BUILD SERIOUS SPATIAL PLANNING GAMES

4.1. Introduction

Games have been used in spatial planning at least since the 1960s (Constantinescu et al., 2015). They have been applied in planning practice mainly as tools to foster participation and collaboration (Ampatzidou et al., 2018; Tan, 2017). However, despite some promising results (Sousa et al., 2022b) games have not become frequent tools for planning practitioners.

When planners use games as tools, they expect them to provide data and interactive dynamics other than traditional participatory approaches. Using game and game-like activities in spatial planning may increase stakeholders' engagement and help collecting data that otherwise would not be accessible (Gordon et al., 2011). Some planners have been using gamification and serious games in their planning processes, both start-to-finish games or just some game elements. Nevertheless, these game exercises tend to be purely academic, lacking guides, frameworks and protocols to assist their implementation (Brömmelstroet & Schrijnen, 2010; Ferri et al., 2018; Mayer et al., 2014). Ongoing research seems to be trying to change this reality. Champlin et al. (2021) propose a codesign method with seven requirements to overcome the difficulties involved in the development of games for planning purposes. They recommend building games that result from multiple steps of codesigning, combining planning professionals and stakeholders/citizens knowledge to adapt game elements (e.g., mechanisms) in order to make them more effective. This will deliver game platforms recognized by users as suitable and valuable for achieving planning goals.

Planning practitioners consider it challenging to use games in their daily planning and participatory approaches. There is a clear gap between academia and planning practice about game usage (Ampatzidou et al., 2018). If games are to be used in spatial planning processes, then it is necessary to provide support guides to planners and simplify their application. If the participatory and collaborative planning approaches started to appear in planning schools since the beginning of the this century as recognized by Gordon et al. (2011), games as tools are still rare practices. There are been cases of gamification (introducing game elements to a planning process) or serious games (the game is the planning process) (Becker, 2021; Walz & Deterding, 2014). Game mechanisms are some of the necessary elements to create game-based planning approaches, as the building blocks game designers use to create games and allow players to interact with the game system to change the game state and produce feedback/results. Some examples are moving pieces and adjusting tracks to represent decisions and their impact.

In this paper, we attempt to identify the mechanisms to use in game-based spatial planning, under the idea that such mechanisms are the building blocks of game design (Engelstein & Shalev, 2019). We will focus on analogue game design mechanisms as the game elements that planners can easily adapt and implement in their activities. Following the MEDP protocol of looking for the game mechanisms in the top modern board games related to territory and city building (Sousa et al., 2021a). If game mechanisms are well understood, planners will be able to combine them and build game-based spatial planning processes. Mastering these game design techniques will also help to explore digital games if desired (Brathwaite & Schreiber, 2009; Ham, 2015). Planners can choose between serious games or gamification approaches since both depart from game mechanisms to achieve goals beyond playing for entertainment. Despite the recognition that game mechanisms are core elements of game-based planning approaches (Ampatzidou & Gugerell, 2019b), few works identify what mechanisms can be used.

The paper is structured as follows. After this introduction, in Section 2 we analyse the potential of analogue games for spatial planning, focusing on game design frameworks and on game mechanisms. Section 3 presents the method we have followed to identify game mechanisms for spatial planning using existing databases (MEDP). Section 4 reveals the emerging patterns of game mechanics in analogue games about city and territory building. In Section 5, we discuss the difficulties and potentials of mastering game design for spatial planning. Finally, Section 6 concludes this paper with game design recommendations planning games.

4.2. Building serious analogue games for planning

Despite games being part of human history (Huizinga, 2014), game design academic studies are still in their infancy. In conference and journal publications, directly or indirectly related to game studies, several different approaches have been tried. Case studies and conceptual proposals to understand games as systems can be overwhelming for newcomers. The Mechanics, Dynamics and Aesthetics (MDA) framework (Hunicke et al., 2004) is one of the most influential ones of these approaches. It continues to guide the most recent attempts to develop methods and protocols to build games, considering the roles (Designers/Players), flows and tools (e.g. mechanisms) to reach experiences resulting from playing the game (Walk et al., 2017; Zubek, 2020). Games are composed of game elements like mechanisms, rules, interfaces and themes that can be identified but are interconnected within the overall game system (Järvinen, 2008). These game elements within a particular game system provide dynamics where players try multiple experiences, resulting from activating, directly and indirectly, game mechanisms (Sousa et al., 2021b). This approach that highlights the importance of the game elements (e.g. mechanisms) as part of an interactive system (the game system) to deliver experiences is grounded in the influential works of Salen & Zimmerman (2004) and Elias et al. (2012), complementing the MDA framework and all other related contributions that defend design for experience Such experiences are what engages players (Zagalo, 2020). In the case of analogue games, because of the lack of automation, the need to establish a social contract and dominate the rules (Zagal et al., 2006) makes some players enjoy the mechanical activation of the game as part of the experience (Duarte & Battaiola, 2017).

Even serious game approaches, which must be engaging and deliver other goals beyond entertainment (Dörner et al., 2016), are influenced by "design to experience" concepts. The Design, Play, Experience (DPE) concept introduced by Winn (2009) is applied in several urban planning games (Ampatzidou & Gugerell, 2019b; Sousa, 2020a; Sousa et al., 2022a). It was also used to explore how game mechanisms engage different player profiles as in the Mechanics for Engagement Design Protocol (MEDP) (Sousa et al., 2021a). These combinations allow adapting and detailing the game mechanics and mechanisms to engage typified player profiles that might value other game elements.

Before exploring more the mechanical side of game systems, it is necessary to clarify the differences between game mechanics and game mechanisms. In general, the videogame literature uses the term mechanics (Adams & Dormans, 2012) while analogue games are adopting the term mechanisms. Game mechanisms are the smallest game elements and the building blocks of game design (Engelstein & Shalev, 2019). From now on, we will use the term game mechanisms only, because mechanics tend to result from sets of combined game mechanisms in motion (Sousa et al., 2021b). Game mechanisms define serious games and transform gamification into effective approaches, mostly when the mechanical dimensions are integrated into the external goals (Chou, 2019). Although serious games and gamification are not the same (Becker, 2021; Walz & Deterding, 2014), both share the need for designers to explore the mechanical side of game systems. Players activate (directly and indirectly) the game mechanisms according to the rules of play and implement the rules of play (Salen & Zimmerman, 2004). The abstracted dimension of individual game mechanisms gains meaning within the game system and the chosen platform (digital, hybrid or analogue game). When designers combine several of these game mechanisms and introduce other game elements to support themes or narratives games can deliver new layers of meaning (Arjoranta, 2017; Barbara, 2017). They can tell a stories and support simulations in engaging ways.

Recognizing mechanisms as the basic elements of game design establishes a bottom-up development process departing from the smallest parts of the game system. The Mechanisms, Mechanics, Dynamics and Experiences (MMDE) framework from Sousa et al. (2021a) is based on the idea that mastering these game mechanisms is a way to start designing games. MMDE is an adaptation of the MDA (Hunicke et al., 2004) framework, considering the contribution from Duarte and Battaiola (2017) that argues that the absence of automation in analogue games places the designer and the players as agents able to interact with all the elements of the game system, including the mechanics (Figure 4.1). MMDE divides and classifies the mechanics into different types of mechanisms, following the list of mechanisms identified by Engelstein and Shalev (2019).

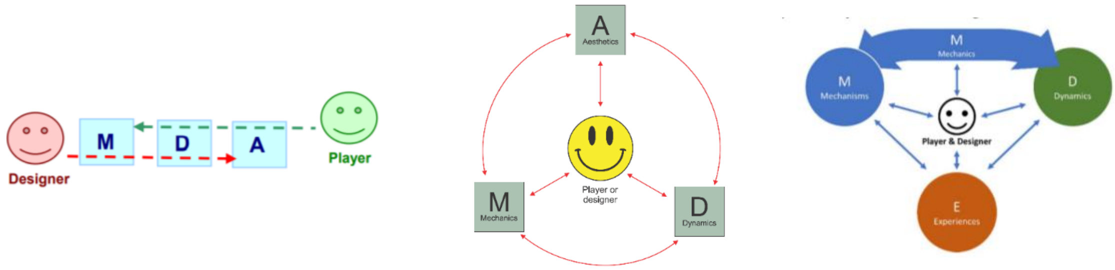


Figure 4.1 – MDA (Hunicke et al., 2004), adapted MDA to analogue games (Duarte & Battaiola, 2017) and MMDE (Sousa et al., 2021b).

Finding what game mechanisms exist as singular entities, how to combine them, and the kind of representations they enable in each playing platform helps planners build better game-based planning approaches. Balancing the game system is one of the most difficult parts of designing a game. The fact that different mechanisms can trigger different experiences and goals (Ampatzidou & Gugerell, 2019b) is a strength and a weakness. The development process demands multiple cycles of playtesting, trial and error, and reformulation to achieve goals (Engelstein, 2020b; Fullerton, 2014). Each game is unique and fitted to the reality and goals it aims to address.

4.2.1. Using analogue games in the age of digitalization

Some authors consider we are living in a golden age of board and tabletop gaming (Booth, 2015; Konieczny, 2019). This analogue game phenomenon appears to be a manifestation of a post-digital movement (Cramer, 2015), the need to look for more tangible activities and their unique user experiences. Regardless of some philosophical interpretations that go beyond the scope of this paper, people are playing more analogue games than ever, and new game releases increase every year. Only the Covid-19 pandemic halted the exponential growth of publications and the two-digit growth of this market (Samarasinghe et al., 2021; Sousa & Bernardo, 2019).

Players are engaged in these modern board and tabletop games for many reasons, some related to the internal design of these games and others to the external social environments they generate (Farkas et al., 2020). Although the reasons are not yet totally clear, the social experiences, strategic challenges and discovery, tangible and face-to-face, seem to be what drives players to sit at the table and play these games (Booth, 2021; Martinho & Sousa, 2023; Woods, 2012).

Game design courses, including those aiming for videogames, tend to propose analogue game design and prototyping exercises to their students (Brathwaite & Schreiber, 2009; Fullerton, 2014; Ham, 2015). Students learn to use, combine, and test low-tech prototypes before coding and modelling their digital games. These prototypes are easy and cheap to modify, suited for testing in real-time, allowing immediate users' feedback (Sousa et al., 2022a). Mastering the available game mechanisms is essential to do these game development processes.

4.2.2. Profiting from the analogue dimension of games for planning

Analogue low-tech games are easy to adapt for different realities, lowering barriers to entry for new users (Constantinescu et al., 2017). Using simple rulesets and recognizable parameters can foster nudging (Sousa, 2022d) and the co-creation of game-based planning processes (Champlin et al., 2021). In analogue multiplayer games, users can play at their rhythm, and the game facilitator can change the game when necessary to achieve the intended goals (Gordon et al., 2017). The simplicity and tangibility of these games facilitate fast simulations to broader publics (Ferri et al., 2018), creating alternatives and complements to participatory GIS and videogames (Champlin et al., 2021; Gordon et al., 2011). Although Reinart and Poplin (2014) dismiss analogue games as unable to deliver suitable simulation and decision-making, these authors ignored modern designs (game elements like the innovative mechanisms and how they address complex themes). In opposition, Schouten et al. (2017) show that modern tabletop games can support game-based planning processes.

The approachability of analogue games is valuable for participatory and collaborative planning (Abspoel et al., 2019; Ohnmacht et al., 2015). Tan (2017) compiled several successful case studies where analogue games fostered collaboration to address complex urban and spatial problems. Dodig and Groat (2019b) also compiled a book about analogue serious games for urban planning processes. But these publications lack game design concepts and tools to guide planners. One can see the results but not how to get there.

Constantinescu et al. (2020a) state that semi-abstract game mechanisms can help explore the complexity of urban reality and provide an interactive platform for public participation in planning processes. These authors recognize that the quantity of game mechanisms can be overwhelming and hard to master by beginners. They describe mechanisms in generic ways, as in the videogame literature, in a manner that is hard to separate them from the game dynamics. Considering game mechanisms as building blocks can clarify how planners could build their game approaches. Identifying the small mechanical parts is recommended to establish and adapt the playable models to the purposes at stake. Serious game systems can be among the most flexible, rapid and interactive scenario development and outcomes evaluation for planning practices (Champlin et al., 2021). But only if the game systems are designed accordingly. Adding and testing different mechanisms could be a solution during the game development, testing and evaluation process (Sousa et al., 2022a).

4.3. Method used to find game mechanisms

Since 2000, Board Game Geek (BGG) (www.boardgamegeek.com) is the primary database concerning modern tabletop and board games, including card, dice and miniature games (Woods, 2012). BGG covers more than 125,000 registered games and surpasses 2 million users. The available information results from crowdsourcing. BGG allows filtering games by their features. Users can identify games by users' evaluation rank, mechanisms, and many other features.

Following Sousa et al. (2021a) MEDP protocol of identifying all game mechanisms of the top-ranked games in the categories of city and territory building games on BGG. This filtering leads to a database of games that allows analysing how game mechanisms are combined to build and simulate interactive decision-making collective processes to change cities and territories. It is expected that mastering these mechanisms delivers engaging game experiences because they are the same used in successful modern board games.

Kritz et al. (2017) argue that BGG game mechanisms should be grouped by typologies and similarities, while others are not mechanisms at all. Sousa et al. (2021b) also propose to classify some mechanisms as mechanics or game dynamics. Some result from the combination of several singular game mechanisms. This classification reinforces the vision of Engelstein & Shalev (2019) that adopt the concept of mechanisms as the elements of the mechanical side of a game system.

Recently, Samarasinghe et al. (2021) performed an extensive quantitative analysis of BGG mechanisms, stating that the isolated mechanisms might not say much about the game and the experiences they provide, but the combination of several mechanisms can define the game (Sousa, 2022c). We propose to evaluate the mechanisms in games themed as city and territory building to find specific patterns. Although there are new game mechanisms being constantly created (Sousa et al., 2021b), game developers tend to build new game systems from existing game mechanisms or tweak existing ones to create desirable game experiences (Reiber, 2021).

4.3.1. Finding BGG mechanisms for planning games

As stated before, BGG is the place to find which game mechanisms appear in contemporary (modern) analogue games. The adopted process (Figure 4.2) can be carried out for any theme or narrative using the first part of the MEDP protocol regarding game mechanisms (Sousa et al., 2021a).

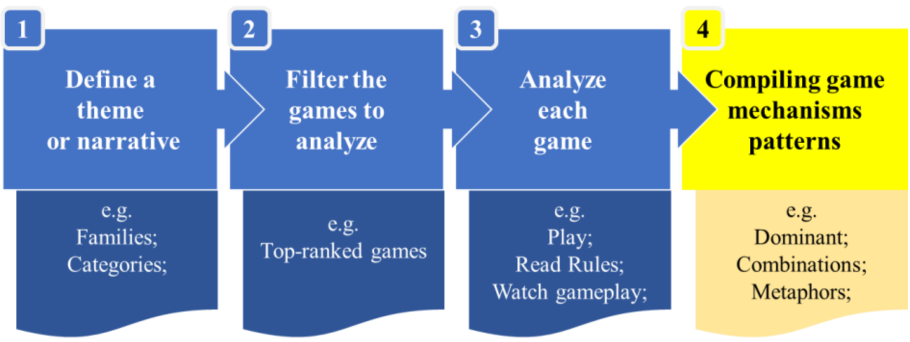


Figure 4.2 – Process to find game mechanisms at BGG related to specific theme or type of games.

The adopted process with its four steps is suited to any game theme, related to the serious game goals or context to be played. In step 1, serious game developers choose the theme and narrative context. For general spatial planning games, we selected the “City building” and “Territory building" categories. In step 2, we selected the top-ranked 50 games to guarantee that the game mechanisms considered are engaging contemporary users. If they engage such users, it is plausible that they engage participants in a game-based planning approach. Step 3 consists in a long process of exploring the 50 selected games, reading the rules of the games, and watching playthroughs. Finally, step 4 delivers the outcome of our research, exposing mechanisms (single and combined), other game traits, and metaphors the mechanisms support. Emerging game mechanisms patterns are what planners can use to build their game-based approaches, testing them and adapting them to reach the intended serious game goals.

4.3.2. Filling gaps and compiling information.

Not all game mechanisms are identified for each game in the BGG database. Some games have more information than others, which demands adding data when necessary. Games for which the available information was higher, helped fill the gaps of the games described more poorly. Consulting Engelstein & Shalev (2019) tabletop mechanisms encyclopedia clarified the meaning of some mechanisms when BGG descriptions were not available. Figure 4.3 shows the detailed sequence of Step 3.

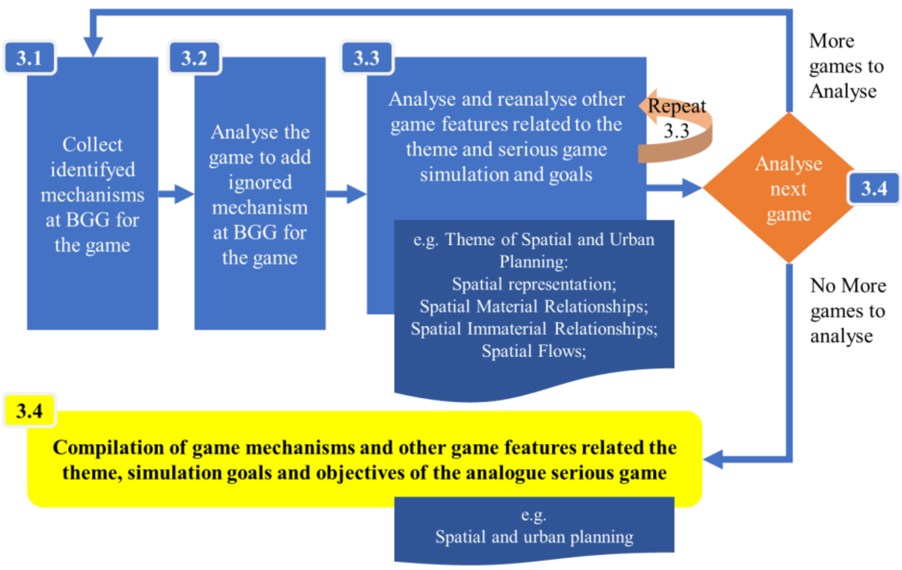


Figure 4.3 – Process to complete mechanism gaps at BGG and explore other game features and relationships with game mechanisms combinations and metaphors.

Beyond standard tabletop game mechanisms, new sets of features related to the theme of spatial planning were identified for each game (step 3.3). This identification resulted from exploring each game to conclude how abstract mechanisms can simulate and build meaningful models (e.g., spatial and urban models). We realized that it was necessary to describe the mechanisms by identifying associated features like the way a physical component is used. When a game design feature appeared in a game, all other games were reanalysed to check whether they had that feature or approached that thematic dimension (e.g., economy, sustainability, governance). This repetition is represented by the "repeat cycle" in step 3.3. because BGG might not have identified some relevant features for the purpose of our analysis. These multiple interactions (step 3.3) and game analyses (step 3.4) originated the compilation of game mechanisms and other features (step 3.5), leading to the output data in step 4 of Figure 4.2.

4.4. Building serious analogue games for planning

BGG information was sometimes incomplete and not organized to understand each game mechanism in a particular game. This gap would jeopardize knowing how mechanisms relate to the intended simulation (game experience and aesthetics). The individual analyses allow identifying games general characteristics (e.g., complexity, duration, number of players, etc.) context, and typical themes. Most of these games deliver simplifications of the environment they want to generate. They are not simulations but playable models that reflect some similarity to reality (Pulsipher, 2012). These data are available in Table 4.1.

4.4.1. General game characteristics

The general characteristics of the top 50 BBG games for the selected categories are presented in Table 4.1. With more than 125,000 registered games these are among the best ranked 6,500. Highlighting the novelty of these games, the majority (39) was published in the last ten years and six since the beginning of the Covid-19 pandemic (12% of the sample).

Table 4.1 – Games' general characteristics

BGG Rank	ID	Name of the Game	General game characteristics					
			Year	Max players	Duration	Complexity (1-5)	City / Territory Building	Player Interactions
43	1	*Underwater Cities*	2018	4	150	3.60	CB	Comp
61	2	*Lisboa*	2017	4	120	4.56	CB	Comp
78	3	*Keyflower*	2012	6	120	3.35	CB/TB	Comp
82	4	*Caylus*	2005	5	150	3.80	CB	Comp
130	5	*Welcome to*	2018	12	25	1.82	CB	Comp
150	6	*Ora et labora*	2011	4	180	3.90	CB/TB	Comp
161	7	*Suburbia*	2012	4	90	2.77	CB	Comp
184	8	*Carcassonne*	2000	5	45	1.91	CB/TB	Comp
191	9	*Glen More II: Chronicles*	2019	4	120	3.05	CB/TB	Comp
213	10	*Praga Caput Regni*	2020	4	150	3.69	CB	Comp
260	11	*Antiquity*	2004	4	180	4.31	CB/TB	Comp
330	12	*My City*	2020	4	30	2.01	CB	Comp
374	13	*Chinatown*	1999	5	60	2.27	CB	Comp
380	14	*Quadropolis*	2016	4	60	2.21	CB	Comp
402	15	*Sprawlopolis*	2018	4	20	1.84	CB/TB	Comp
435	16	*Roads & Boats*	1999	4	240	4.19	TB	Comp
623	17	*Between Two Cities*	2015	7	25	1.82	CB	Semi-coop
956	18	*Honshu*	2016	5	40	1.96	TB	Comp

975	19	*Santa Monica*	2020	4	40	2.19	CB	Comp
1017	20	*Era: Medieval age*	2019	4	60	2.30	CB	Comp
1045	21	*New York 1901*	2015	4	60	2.05	CB	Comp
1161	22	*Capital*	2016	4	60	2.24	CB	Comp
1171	23	*Murano*	2014	4	75	2.73	CB	Comp
1245	24	*NEOM*	2018	5	45	2.60	CB/TB	Comp
1273	25	*Tramways*	2016	5	120	3.82	CB/T	Comp
1460	26	*Big City*	1999	5	60	2.22	CB	Comp
1759	27	*Founders of gloomheaven*	2018	4	120	4.12	CB	Comp
1786	28	*Urban Sprawl*	2011	4	180	3.31	CB	Comp
1792	29	*20Th Century*	2010	5	120	2.98	CB	Comp
1995	30	*Key to the city: London*	2016	6	120	2.72	CB/TB	Comp
2061	31	*Capitol*	2001	4	60	2.64	CB	Comp
2280	32	*The capitals*	2013	5	120	3.50	CB	Comp
2381	33	*Small City*	2015	4	120	3.98	CB/TB	Comp
2656	34	*Cities skylines: the board game*	2019	4	70	2.36	CB	Coop
2695	35	*Tokyo Metro*	2018	5	120	3.20	T	Comp
2745	36	*String Railway*	2009	5	30	1.43	TB	Comp
2760	37	*Aquädukt*	2005	4	30	1.70	CB	Comp
2852	38	*Subdivision*	2014	4	45	2.38	CB	Comp
2968	39	*Welcome to Centerville*	2017	4	80	2.45	CB	Comp
3040	40	*Canterbury*	2013	4	90	3.09	CB	Comp
3059	41	*Wacky Wacky West*	1991	4	45	1.84	TB	Comp
3192	42	*City Tycoon*	2011	5	120	2.81	CB	Comp
3328	43	*Expancity*	2018	4	60	2.00	CB	Comp
4029	44	*Doodle City*	2014	6	30	1.40	TB	Comp
4197	45	*The Walled City: L&B*	2014	4	60	3.19	TB/T	Comp
5051	46	*Card City: XL*	2017	4	60	2.90	CB/TB	Comp
5202	47	*Town Center*	2012	4	30	2.85	CB	Comp
5516	48	*City Hall*	2014	4	90	2.78	CB	Comp
5836	49	*Urbanization*	2012	4	75	2.87	TB	Comp
6463	50	*City Council*	2013	5	60	3.00	CB	Semi-coop

Only five amongst those 50 games can be played with over five players. Half of the games plays in less than one hour. Nineteen games have a complexity to play of 3 or more (in a scale of 1 to 5) and can be considered complex games. There is a strong correlation ($R = 0.84$; P<0.01) between complexity and game duration. Faster games tend to be less complex (having few game mechanisms) and to provide poorer simulations.

Only three games are about phantasy or science fiction themes[14], 47 are about simplified spatial realities. Half of the games is about contemporary issues, while the other half is about previous periods in history or about the future. It was possible to identify (Table 4.2) four frequent themes in the sample of 50 games: Networks (19); Urban Patterns (40); Flows (19); and Governance (7).

Almost every game is competitive. The exceptions are *Between Two Cities* (O'Malley & Rosset, 2015) and *City Council* (Goldsteen, 2013) (included because of the negation mechanisms), which

[14] Games ID: 1; 24; 27.

are semi-cooperative, and *City: Skyline - The board game* (Håkansson, 2019), which is fully cooperative.

Table 4.2 – Thematic implementation of core game mechanisms

ID	General Theme	Urban themes				From core mechanical systems to thematic spatial simulation
		Networks	Patterns	Flows	Governance	
1	Networks of underwater cities	●				Action selection (resources) to develop infrastructures/network of cities, each with different facilities.
2	Rebuilding Lisbon (earthquake)		●			Political action selection (multi-use cards) to rebuild Lisbon's urban plan (blocks, roads, facilities, etc.).
3	Colonizing North American	●	●	●		Village buildings tiles. People in buildings (own/other players) to produce/transport goods.
4	Building a medieval linear town	●				Combining workers and resources, build a city along a road. Distant buildings decrease efficiency.
5	Planning a residential area		●			Add lines/numbers (defined by cards) over an urban suburb plan to define urban and housing features.
6	Planning a monastery village		●			Land grid tiles to put building cards. Workers use buildings to produce resources to grow the place.
7	Building urban zones		●			Buy urban tiles (land uses and buildings) that generate income/population (adjacency and overall effects).
8	Building a medieval region	●	●			Placing land tiles with varieties of medieval land uses and infrastructures.
9	Medieval region in Scotland		●			People/resources can claim and develop land regions, forming patterns TO grow the territory.
10	Building the city of Prague		●			Adding building tiles define quarters in the city and contributes to public works.
11	Medieval regional planning		●	●		Develop/exploit/exhaust the territory around the city. Adding and removing tiles (some staked).
12	Building a contemporary city		●			Placing polyominoes buildings, forming urban patterns, and overlaying over a territorial grid.
13	Planning a commercial zone		●		●	Tiles represent shops. Players can negotiate to increase the economic effect of grouping shops adjacent.
14	Building a contemporary city		●	●		Placing tile buildings in a grid, forming patterns and density. Managing energy, waste, and flows.
15	Organize city regions and roads	●	●		●	Partially laying cards over the previous cards form new land use urban patterns and a network of roads.
16	Economic territory exploration	●		●		Drawing roads over a map (hexagon grid) to produce, access, use, and transport resources (adding tiles).
17	Building a XIX century city		●		●	Drafting/adding tiles to left and right cities, cooperating with neighbours to build efficient urban patterns.
18	Landscape in medieval Japan		●	●		Drafting/choosing cards to partially overlay played cards to form the landscape and urban patterns.
19	Urban beach development		●	●		Adding buildings/facilities (combinations) over a beach (grid board) to generate income/tourists.
20	Medieval City building		●			Buildings create patterns (adjacency) that score positive/negative effects (economy, disease, defence).
21	Build skyscrapers in New York		●			Placing polyominoes tile buildings in different shaped blocks. Adjacent facilities give a bonus.
22	Building Warsaw over time		●			Adding tiles to the urban grid size to form urban patterns. Overlaying the tiles represents urban renewal.
23	Build medieval Venice	●	●	●		Place road/ building tiles (combinations) in islands (modules) according to boat transport capacity (rondel).
24	Build a futuristic city	●	●	●		Drafting/ placing buildings and road tiles generate patterns over a grid to generate resources and trading.

25	Build a train transport system	●		●		Placing railway tiles to transport passengers (origin-destiny). Development generate new places/passengers.
26	Real estate managing	●	●			Define blocks for tile buildings and transports. Buildings demand a specific space and adjacent buildings.
27	Build a medieval phantasy city	●	●	●	●	Tiles for buildings/roads, producing/transporting resources over an urban grid. Voting for public buildings.
28	Urban growth		●			Action points to play investment and policy cards. Cubes/tiles on the map represent ownership/ sprawling.
29	Sustainable region planning	●		●		Placing tiles to form a network of connected cities increases the economy and associated pollution.
30	Building the city of London	●	●			Hexagonal tiles simulate buildings/urban zones. Coloured sticks represent different infrastructures over tiles.
31	Ancient Rome urban zones		●			Staked the cubes to simulate urban density. Public buildings and facilities to increase urban value.
32	Build and rebuild a city		●	●		Road tile limits urban expansion (enclose). Energy management and tracks (employment, tourism, etc.).
33	Build and develop a city		●	●		Urban development action roles. City growth through resource management, tile placement/grid coverage.
34	Build a growing city		●		●	Pay card to place tile buildings over a modular grid map that affects tracks (crime, traffic, pollution, etc.).
35	Explore Tokyo transport system	●		●		Players acquire shares of the Tokyo metro system. Traveling the transport system generates income.
36	Build a train network	●				Laying strings (colours/lengths) to connect tile places (urban sites). Other strings represent terrains.
37	Roman water system	●		●		Tiles/sticks in a grid to distribute water to a city. Tiles represent buildings and stick the pipes.
38	Build an urban zone	●	●			hexagonal urban patterns (adjacent tiles). Covering/connecting to the highway/sidewalks (sticks over tiles).
39	City activities and spaces		●			Drafting/rolling dice to generate effects to claim urban spaces. Urban patterns and unlock special abilities.
40	Build the city of Canterbury		●			Tile buildings (may overlay) in blocks (orthogonal grids) provide resources/services to adjacent blocks.
41	Build a train network	●			●	Vote (cards) to place railway tiles. Players score according to hidden objectives (building not covered).
42	Urban flows of energy/goods		●	●		Buildings produce/converts and simulate flows of resources, people, and waste (traveling distances).
43	Urban Growth/concentration		●			Stacking pieces represent urban density. The adjacency to infrastructures/facilities increases the value.
44	Urban Transport system	●				Drawing road lines in paper sheets (grids) to connect locations. Available lines (roads) depend on dice.
45	Medieval neighbourhoods		●			Roads define the sections (blocks) of the city for habitants. Blocks must defend respective walls.
46	Build a growing city		●	●		Placing adjacent cards (buildings in a grid) triggers automatic growth. Avoid pollution/wasting land space.
47	Build a growing city		●	●		Add/stack coloured cubes over a grid (land uses/densities). Automatic growth according to combinations.
48	Management of New York		●			Bidding for roles that unlock building the city. Money can claim more urban districts/zones/buildings.
49	Land development		●	●		Buying/developing land spaces produce income. Adjacent land prices increase by moving money tiles.
50	City politics and government		●		●	Councillors respond to claims by negotiating/voting for buildings/facilities. Tracks for indicators.
	Total	**19**	**40**	**19**	**7**	

Figures 4.4 and 4.5 shows how the games mechanical dimension implements the theme (e.g., meaning, environment, narrative). As stated before, we adopted the mechanics as a composition of individual mechanisms. Most games rely on players' decisions to affect the state of the game, developing urban areas, networks to connect and establish flows, each according to the thematic

context and historic period. Each game introduces positive and negative feedback to incentivise players to develop urban and transport systems as the games progress. This first analyse (Table 4.1 and 4.2) aims to identify all the mechanisms might not be evident at first glance (ignored by BGG or described differently).

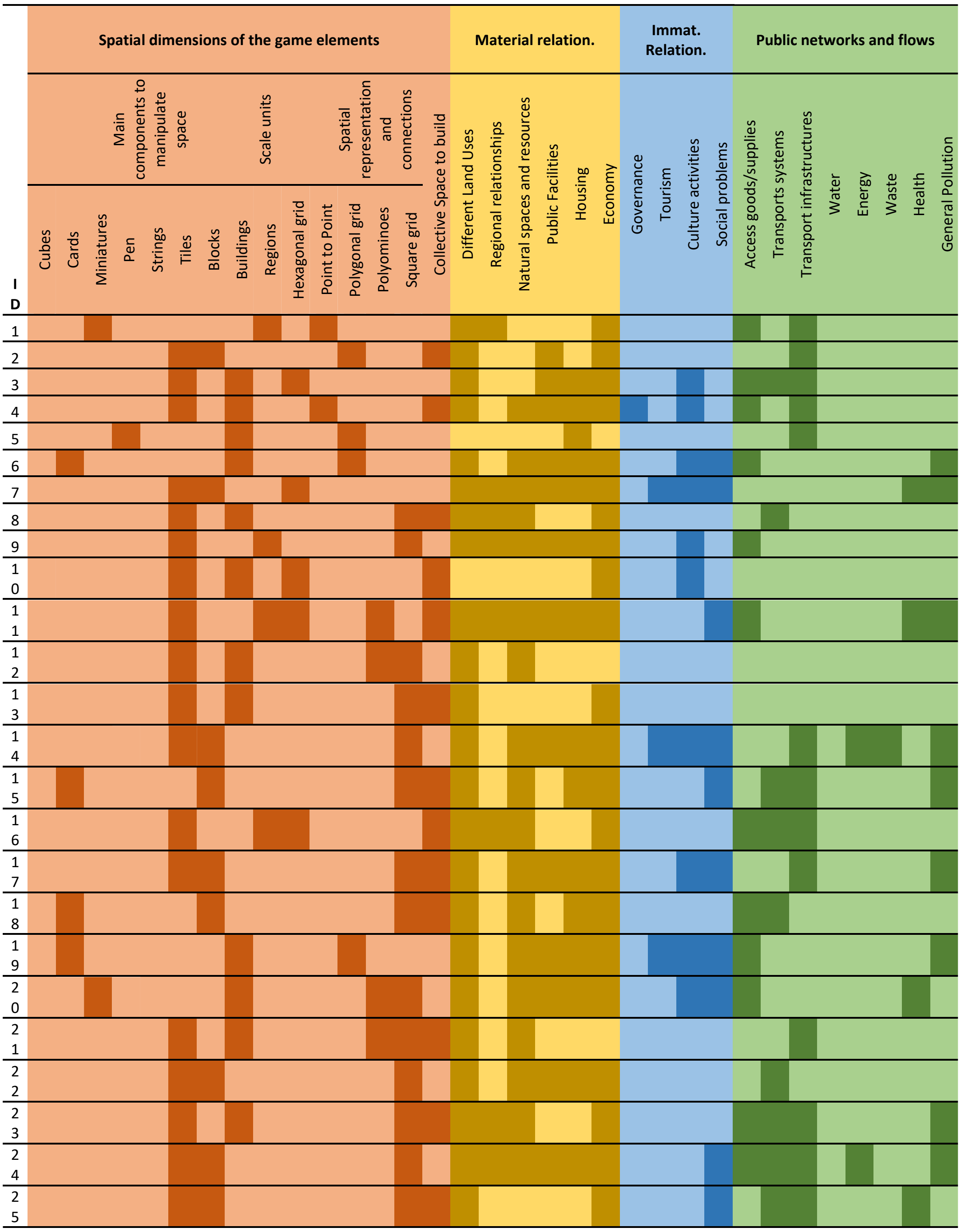


Figure 4.4 – Game components related to simulation of spatial dimensions (Games ID 1 to 25).

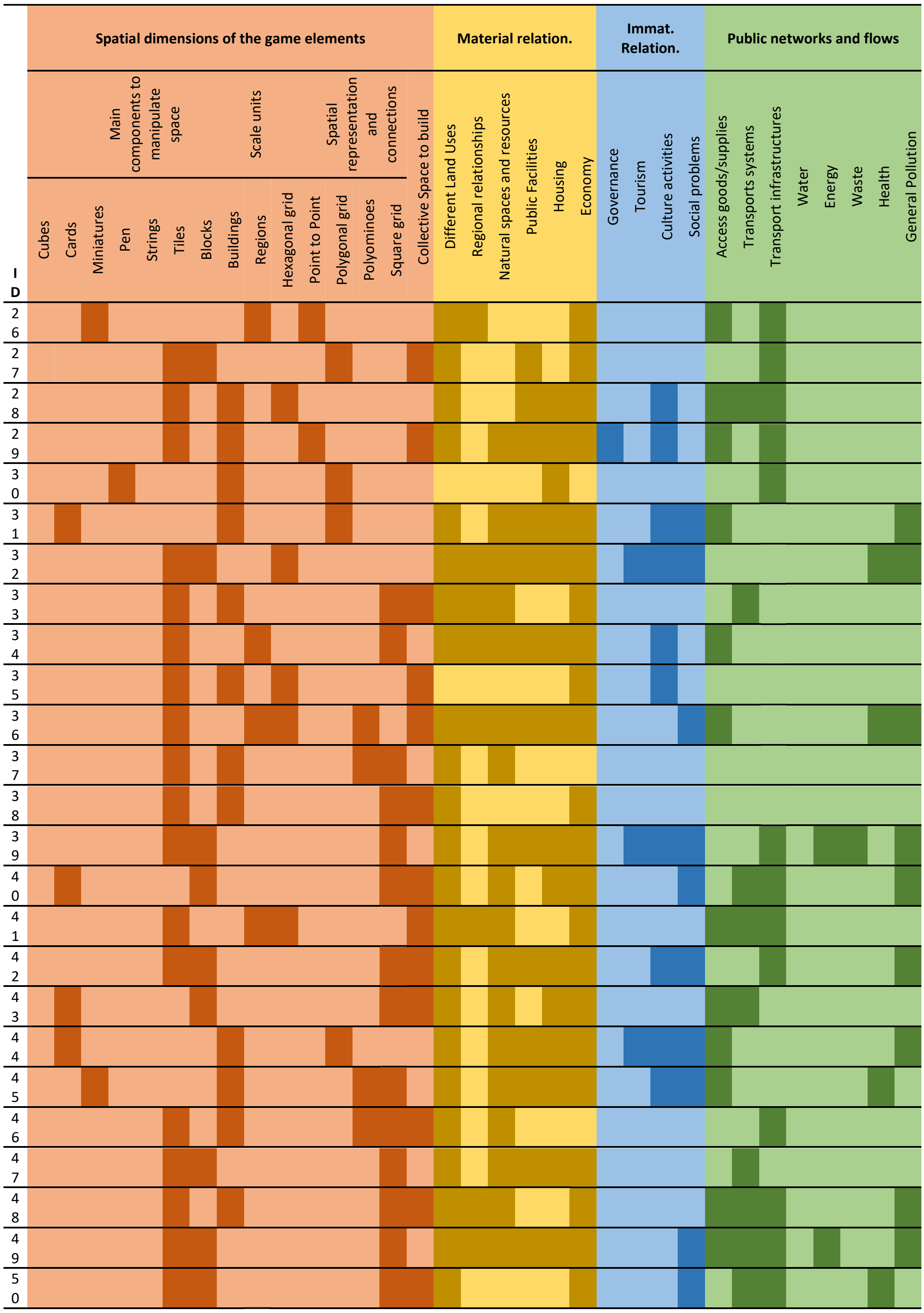


Figure 4.5 – Game components related to simulation of spatial dimensions (Games ID 26 to 50).

The manner how the games represent space and the material and immaterial relationships between players is highlighted in Table 4.3 (showing the total values). Tiles allow including more information (text and pictures) to represent more complex building or territory features. Cubes, blocks, and miniatures reinforce the tangibility, densities, and volumes of built fabric. The grid format assumes two tendencies. Square grids tend to represent urban sections of cities due to the orthogonal road systems, while large scale territory tends to be represented by hexagons. Hexagonal grids permit more freedom to connect and interact with adjacent sections (six adjacent possibilities). More complex games approach the material and immaterial relationships between the physical representations and their land uses, effects, and flows. Different land uses are common in almost every game (40), represented by tiles and components of different colours and shapes that can be piled up or overlayed to simulate densities. As stated before, the complex games go beyond adding buildings and changing land uses. These games try to simulate the flows of people, resources, energy, and waste (transportation games). Tracks and tech trees are auxiliary mechanisms to record these effects. A minority of games also tries to include governance effects, namely the power to change and decide how the territories are managed (special player powers and voting processes).

Table 4.3 – Game components related to simulation of spatial dimensions (total values).

Game representations			Total
Spatial dimensions of the game elements	Main components to manipulate space	Cubes	5
		Cards	5
		Miniatures	4
		Pen	2
		Strings	1
		Tiles	33
	Scale units	Blocks	18
		Buildings	23
		Regions	9
	Spatial representation and connections	Hexagonal grid	7
		Point to Point	6
		Polygonal grid	9
		Polyominoes	10
		Square grid	28
	Collective Space to build		32
Material relationships	Different Land Uses		40
	Regional relationships		18
	Natural spaces and resources		38
	Public Facilities		31
	Housing		34
	Economy		41
Immaterial Relationships	Governance		9
	Tourism		5
	Culture activities		18
	Social problems		19
Public networks and flows	Access goods/supplies		23
	Transports systems		24
	Transport infrastructures		32
	Water		7
	Energy		8
	Waste		5
	Health		16
	General Pollution		16

4.4.2. General game characteristics

The 50-game sample revealed 43 different game mechanisms. As expected, they are abstract elements that appear in many different games (Table 4.2). To understand in detail what each mechanism is in practice, BGG offers information that can be complemented with the tabletop mechanisms encyclopaedia (Engelstein & Shalev, 2019). Considering the sample, BGG identifies 174 mechanisms directly. But a detailed analysis of each game rules and gameplay led to the inclusion of 232 additional mechanisms (Figure 4.6).

The sample highlights that the most common mechanisms in territory and city building games often also appear in analogue games in general (Samarasinghe et al., 2021). This is the case of hand management, tile placement, and drafting. These mechanisms tend to be abstract ways to provide players with ambiguous decisions, which is demanding and meaningful. This decision-making effect is an engaging game design principle (Burgun, 2019; Pulsipher, 2012). From a participatory and collaborative planning perspective, these mechanisms reinforce the power to choose and affect the planning outcomes. But other mechanisms also do this in city and territory building games.

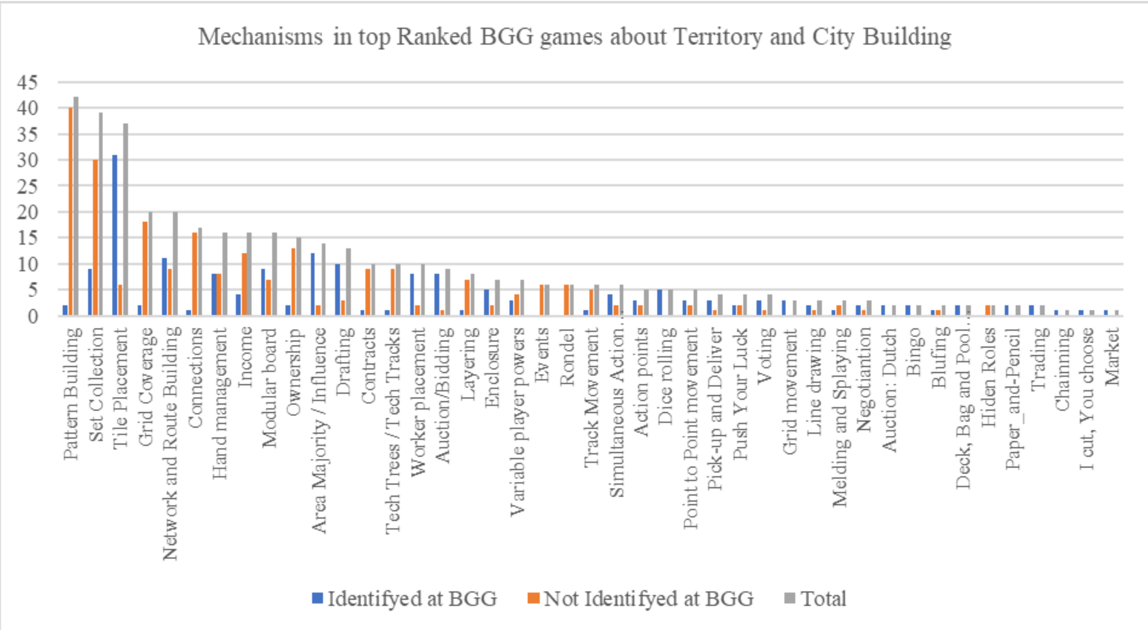


Figure 4.6 – The sum of the game mechanisms of the selected city and territory building games.

For practical purposes, it is useful to show how the game mechanisms can be applied to build interactive and engaging simulations where decision-making is meaningful. Figure 4.7 shows the 22 most used mechanisms related to spatial planning processes, space simulation and decision-making interactions. These mechanisms are:

- Spatial representations: Pattern Building; Tile Placement; Grid Coverage; Modular board; Layering; Line Drawing.
- Flows and relationships: Set Collection; Network Route Building; Connections; Tech Tree / Tech Tracks; Enclosure; Point to Point Movement; Pick-up and delivery:
- Economy and social dimensions: Income; Ownership; Area Majority/Influence; Contracts; Variable Player Powers; Events; Voting; Hidden Roles.

In Figure 4.7, each mechanism is presented through a scheme (graphical and descriptive) and a thematic implementation example. Figure 4.7 is amplified in Appendix B. The frequency of occurrence of these mechanisms is described in Figure 4.6 (total values).

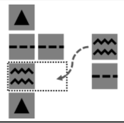
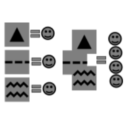
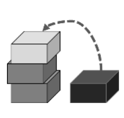
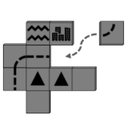
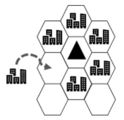
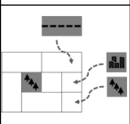
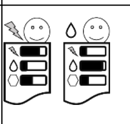
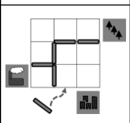
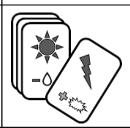
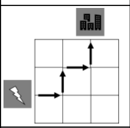
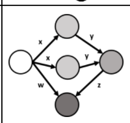
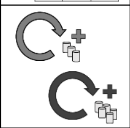
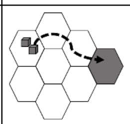
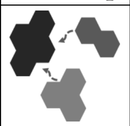
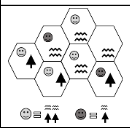
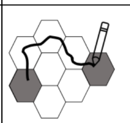
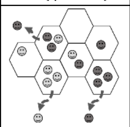
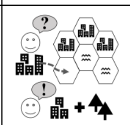
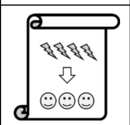
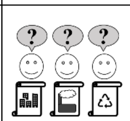
Mechanism	Scheme	Description	Spatial planning simulation examples	Mechanism	Scheme	Descrition	Spatial planning simulation examples
Pattern Building		Joining graphical elements to build complex entities.	Road networks, Land uses, Flows	Tech Trees / Tech Tracks		Connections of developments and powerups unlocked in sequences.	Technological development or Scale effects. Achieving sustainable thresholds and combinations.
Set collection		Combining elements in a way to increase their value and effect.	Mixed land uses, economic, social and environmental dimensions of development	Layering		Placing game components over other components.	Economic and resource accumulation, or waste and pollution. Urban densities effect and buildings height.
Tile placement		Adding tiles to build patterns and form graphic representations.	Urban growth, landscape development, environmental impacts.	Enclosure		Defining new areas in maps and board by adding game pieces.	Urban growth enclosures of buildings and natural spaces. Dominating land uses shifts and monopolies.
Grid coverage		Filling and covering predefined grids with different forms to change two-dimensional spaces.	Changing landscape, Adapting building areas to available space, limiting environmental land impacts.	Variable player powers		Each player has different abilities and actions they can do in the game.	Stakeholders roles and their political power and influence. Asymmetry of the demands and ability to claim them.
Network Route building		Adding elements to build a network over a map or grid.	A Transport network, branches, distribution, and routes. Network, site connections, and land coverage.	Events		Events that can be programmed or a random outcome that triggers changes in the game.	Political elections, weather, unpredictable and random natural cycles of catastrophes.
Connections		Connecting sites in the board map	Vehicles, water, energy and, and waste infrastructures. Any kind of flow.	Point to Point movement		Movement in defined routes with associated lengths and costs.	Public transport routes, logistics and cargo distribution. Travel costs and distances.
Income		Gaining resources resulting from predefined cycles.	Tax revenues, production cycles, and natural resources renovation cycles.	Pick-up and Deliver		Game components are transported from one place to another.	Transport network cargo capacities. Delivery costs are affected by nearby and distant areas.
Modular board		Map sizes can vary from adding or removing modules.	Urban growth or Shrinking. Landscape changes over time.	Voting		Players use their votes to decide something occur or not.	Elections. Political decisions. Public referendums. Citizens perceptions and evaluation.
Ownership		Represent player ownership of an entity to get their effects.	Urban inequality. Urban property and stakeholders claims.	Line drawing		Players draw lines to change maps, connecting, enclosing and filling spaces.	Connect infrastructures and define land uses.
Area Majority / Influence		Multiple players/entities can coexist in the same space (percentages and influences).	Populations, offer and demand effects, distribution of votes over the territory.	Negotiation		Making agreements that can be broken or not.	Political agreements. Collaborative compromises.
Contracts		Combinations of resources, achievements or thresholds to unlock rewards (checklist).	Infrastructures, population to attract investment, new developments or policies.	Hidden roles		Players have different roles (public/hidden), including objectives and victory conditions.	Politicians and stakeholders hidden agendas.

Figure 4.7 – Schemes representation of game mechanisms simulating spatial planning interactions.

Table 4.4 summarizes the types of mechanisms appearing in the analysed games. It shows how the mechanisms simulate realities that have spatial and territory representations (themes, meanings, and narratives). Knowing what to simulate helps to choose what game mechanism to use in a game-based approach. Some simplifications were considered in Figure 4.4 and 4.5. The form of the spatial units (e.g., squared, hexagonal) was a question of choice, working independently from the mechanisms like tile placement, grid coverage, and modular boards. Despite this, the hexagonal grid system tends to be the most adequate to simulate complex territories due to the six edges (allowing six adjacent land units of equal distance). These traits of every game were covered in Table 4.4, like the interrelation between mechanisms as observed in the analysed games.

Table 4.4 – Mechanical dimensions and relationships to meanings

Implementations and meanings		
Abstract mechanism	**Generic meanings**	**Practical examples**
Adjacency effects	Adjacent game components (cards, tiles, bits) unlock abilities. It represents combinations and distance effects	Offer near demand is efficient. Parks/public facilities increase housing attractivity. Industrial pollution reduces liveability but increases employment.
Adding tiles	Add cardboard tiles to change existing landscapes (defines or undefined board), representing building sites, infrastructures, or any material/immaterial event.	Tiles can represent buildings/infrastructures connecting other tiles. Tiles can be single buildings (houses) or part of complex constructions like zoning areas and road systems. Each tile has cost and effect.
Grids define space	Delimitation of divisions/space for game bits and restrains to change spatial representations. Geometrical grid units (squares/hexagons or other shapes) determine the number of adjacent units.	Grid delimitations represent available space for buildings and define patterns for different land uses. Grids help read the adjacency effects on maps without measuring distances. It clarifies if a facility serves a nearby building.
Adding pieces	Adding pieces is a visual form of tile placement. They increase meaningful representations of tridimensionality buildings, resources, and infrastructures. Pieces can be placed over tiles or next to other pieces to complete information.	The pieces can be miniatures of buildings and the trains of a railway network. Cubes of different colours can represent energy and resources to move along the map. Paws can represent habitats and passengers, with colours that help define origins and destinies.
Combining resources	Resources materialize the economy of a given space, in-out flows in a territory. Combining resources to add constructions establishes restrictions that demand decision-making and strategic planning.	Houses need supplies of water, energy, and transport. The urban system converts and transport resources, generating waste that must be moved. Growing cities consume even more resources and demand higher logistics.
Tracks	Tracks represent progress lines through player decisions or because of urban growth. Tracks represent the amount of something without doing bookkeeping or complex math. They are interactive graphics that highlight relative positions and define thresholds.	Money and other resources can be registered in tracks for players to manipulate freely, like cyclic income and population fluctuations. Track thresholds may define overgrowth limits. Multiple track systems may represent the urban indicators like crime and pollution that result from the planning choices.
Point to point connections	Point to point networks restrains paths and force flows, predefined options, sequences, and connections. Some paths can be more favoured than others. It enables thee and branching effects on decision-making processes. Provides a sense of movement.	Transport networks are a kind of point-to-point movement system. It can represent several alternatives to connect zones, each having different lengths and cost to build infrastructures. Flows of water, energy, and waste are modelled by passing from points on a map.

Staking	Staking several tiles, cards, and volume pieces generate a tangible sense of accumulation and higher density. Staking in a defined grid highlights the areas of influence of densities.	Staking cardboard building tiles represents construction and urban density. Pilling pieces like cubes and miniatures increase the 3D effect and simulate mixed land uses.
Adding cards	Cards are similar to tiles. But they are easier to shuffle (random effect), cost less to produce, and use less vertical space. Cards offer more area to write information, are easily handled in higher quantities, and be combined with miniatures. But staking does not provide tridimensionality effects. Card overlaying affects decision-making and invokes loss aversion because the overlayed parts disappear.	Squared cards can represent buildings or landscapes placed near each other (as cardboard tiles). The random effects of shuffling cards represent changing markets, offers and demand, and decisions for other entities. Standard rectangular cards symbolize actions and options players do, spending a card to add a miniature to the map. Card melding and splaying represent two-dimensional improvements of urban zone features.
Simulate roles	Player roles allow different powers to unlock options. Represent social systems that give variability and asymmetry to the game. Make players realize the different actors' behaviour in the simulation. It is related to game objectives, global victory conditions, and objectives of each role.	Cards, tiles, and game board action places are ways to define roles. The roles can represent different elected politicians, stakeholders involved in a planning process, and any other typified individual character or group. Roles have special powers and goals (hidden/visible), representing the participation, negotiation, and collaboration in planning processes.
Majorities and votes	Players can use their votes during events (one or multiple votes). Players can spend resources to vote, increasing their possibilities to influence bids or decisions. The players' influence in sections of the board, or issues at stake (cards or tiles), Adding colour cubes can represent votes.	An election event (a card from a deck), having things to decide (location of facilities, managing crises, investment opportunities). Players can spend resources (influence, money, time) to increase the number of votes, simulating population or stakeholders' representation (percentages associated with the number of game bits).
Drawing	Drawing connections, enclosures, and numbers. Defining priorities, densities, and land-use patterns. Using transparent paper over maps is easily erasable. Drawing over grids to establish distances. Colours can represent different things.	A line between two sites can represent a transport connection and the type of line the vehicle. Enclosure maps sections can define different land uses. Patterns and colours define land uses. The buildings, heritage sites and other landmarks are identified by icons.

Table 4.5 – Mechanical dimensions and relationships to other related mechanisms

		Related mechanisms																		
Abstract mechanism	**Appearing in games ID**	Pattern Building	Set collection	Tile placement	Grid coverage	Network Route building	Connections	Income	Modular board	Ownership	Area Majority / Influence	Contracts	Tech Trees / Tech Tracks	Layering	Enclosure	Variable player powers	Events	Point to Point movement	Pick-up and Deliver	Voting
Adjacent effects	43	●	●	●	●		●		●	●	●			●	●			●		
Adding tiles	33	●	●	●	●	●	●	●	●	●	●			●	●					
Grids define space	30	●	●	●	●	●	●		●					●	●					
Adding pieces	25	●	●	●	●	●	●	●	●	●	●		●	●	●					
Comb. resources	23		●			●	●	●				●	●	●				●	●	
Tracks	16						●	●		●	●		●			●	●			●
Point to point connect.	15									●			●					●	●	
Staking	8	●	●		●	●	●			●			●	●						
Adding cards	5	●	●	●	●				●	●	●			●	●					
Simulate roles	4									●	●						●			●
Majorities and votes	4	●	●		●		●			●	●						●			●
Drawing	3	●	●		●	●	●	●	●	●			●		●			●		

4.5. Building serious analogue games for planning

Approaching a game mechanism without context can be troubling. Having a solid game design culture helps to understand what a game mechanism is and how it can be explored. Knowing many games, how they are implemented, and the game design language makes game design easier. For the purposes of the present research, it was necessary to comprehend fifty different games just to have a representative sample of the state of the art of recent modern board games that simulate city and territory building. Tables 4.1 to 4.4 explore these games in detail.

Although the sample games are not serious games, they express game design traits useful for spatial planning. Indeed, they simulate different land uses, the relationships between buildings and facilities, urban flows, economic development, and even territorial governance. Tables 4.3 and 4.4 show how these simulations are conducted with practical game mechanisms.

Our proposal to identify game mechanisms related to a theme (Figure 4.2 and 4.3) does not assure immediate and effective results. The learning process and game exploration can be demanding and time-consuming. Using the outcomes from Figure 4.7, Tables 4.3 and 4.4 might enable spatial planning practitioners to start designing games and including games mechanisms in their processes to deliver gamification of serious games approaches. By no means it does define all the game mechanisms and ways to build games. These techniques are always evolving. There is a need for constant updating.

It was expected that BGG would have a more coherent mechanical description. Many mechanisms were absent from game summaries. This required an extra effort to fill the gaps to find the most relevant game mechanism. The available literature. (Kritz et al., 2017; Samarasinghe et al., 2021; Sousa et al., 2021b) warns about these BGG mechanisms inconsistencies. Nevertheless, it was possible to propose patterns because some mechanisms share similarities, and others are auxiliary in their effects and metaphors.

Despite these challenges, we found some game mechanisms that can support game experiences related to a planning process. Game mechanisms like area majorities and voting can engage and empower participants, while tile placement and adding pieces over maps with grid systems allow tangible interactions. The adjacency effects and connections reveal networks and efficiency. Tracks represent progress, thresholds, and accumulation to manage. Roles allow planners to represent claims and help understand different demands of the same reality. Participants can see the effects of their decisions and the maps changing according to their actions. Planning practitioners can measure these decisions, combined effects, and what leads participants to consider these options.

4.6. Conclusions

Game design is challenging, but it is approachable step by step. Planning practitioners can depart from simple game mechanisms added to maps and other features they use in their daily activities. Starting to design and test these game-based approaches enable new possibilities. Planning practitioners can help engage participants and collect data from ongoing planning processes.

Our proposal is both a process and a consulting guide whenever developing planning games. Figures 4.2 and 4.3 propose how to learn more about analogue games of a specific theme and type. Figure 4.4 and 4.5 show the most representative game mechanisms in popular modern city and territory building board games, detailing them with examples of game applications and the relationship between other mechanisms that are part of the same game system (same games). Planners can follow the process of Figures 4.2 and 4.3 to find new mechanisms and ways to develop games or use the identified mechanisms of Figure 4.7, Tables 4.3 and 4.4 to implement game-based planning approaches (e.g., gamification, serious games, etc.).

However, we did not analyse all the existing modern board games. Neither did we experiment with how to expose planners to our approach. Future knowledge about game mechanisms could benefit from organizing game development workshops, testing serious game prototypes that combined identified game mechanisms in our proposal, and evaluating which delivered the best results according to predefined goals. In our case, the game mechanisms better support planners' needs.

5. THE MECHANICS OF DRAWING: HELPING PLANNERS USE SERIOUS GAMES FOR PARTICIPATORY PLANNING[15]

5.1. Introduction

Planners need new tools to respond to the increasing demand for participatory and collaborative planning processes. There is a need to have interactive tools to foster participation in planning and capable of generating useful data. Planners need to develop and experiment with new tools of and for engagement (Ampatzidou et al., 2018; Fainstein & DeFilippis, 2015; A. Wilson & Tewdwr-Jones, 2020). Games can be a solution because they can be very diverse and engaging (Tan, 2017). Serious game approaches provide some supported frameworks for practical applications (Mayer et al., 2014). Through serious games is possible to engage stakeholders with different backgrounds and perspectives, allowing them to share their perspectives in meaningful ways to support negotiation and collective decision-making. This playable participation happens in meaningful and pleasant ways that support collective learning, negotiation, and decision-making.

Nevertheless, these are not unquestionable guidelines planning professionals can apply to implement serious games. Using interactive tools like games is not an easy endeavour for planners. Planners might not have the necessary game design skills and be far from mastering the appropriate facilitation techniques (Crookall, 2010). Planners need to also overcome some prejudices about game usage for serious purposes. Showing results from game-based planning processes help dismount these prejudices (Koens et al., 2020). In a recent experience, the local planning authorities of Marinha Grande (Portugal) were surprised by the easiness to engage participants and the outcomes of one fast serious planning game that approached the local transport system (Sousa et al., 2022a).

Planners require a guiding process to begin dealing with game-based approaches. Learning from modern board game design can be a solution to help planners start exploring the game-based approaches for participatory planning practices (Sousa, 2020a, 2021b). These analogue games are easier to adapt and modify to serious game approaches (Sousa, 2021b; Zagal et al., 2006). But the variety and quantity of modern board games are overwhelming. How can planners find game elements and design solutions to support their game approaches? Can focusing on a specific type of game or game mechanism be a solution?

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[15] This chapter, with slight adaptations, corresponds to the article: Sousa, M. (2022). The mechanics of drawing: helping planners use serious games for participatory planning. *plaNext–Next Generation Planning*, 12

We propose to use drawing games as core game mechanisms to help planners build their serious games for participatory and collaborative planning. Departing from these design principles (mechanisms to experiences/outcomes), we will focus on drawing games as core game mechanisms to help planners build their serious games for participatory and collaborative planning. Once the game mechanisms are the building blocks of game design (Engelstein & Shalev, 2019), focusing on one specific game mechanic could be a valid starting point to develop serious game approaches. Our work proposes to explore existing commercial ludic board games created for entertainment purposes. We focused on drawing, and how these games can help participants express ideas during the planning processes. We identify the characteristics of drawing games, looking at the most popular modern board game database platform (BGG). This search will allow to explore how the selected games, and their drawing mechanisms, can be transferred to participatory planning practices. We argue that professional planners can modify games to support participatory planning. By modifying core game mechanisms like drawing, planners can avoid some of the challenges of building new games. This way, planners can access and develop new instruments to refresh participatory planning methods, which help continuously engage stakeholders in an evolving and highly uncertain context.

Section 2 of this paper frames the participatory and collaborative planning approaches and relates them to serious game approaches, while section 3 introduces the benefits of drawing for participatory planning. Section 4 explains the methodology, data gathering and presents the results. Section 5 discusses the findings related to drawing games, also going beyond their core mechanics. Section 6 proposes a simple explanatory framework about the main findings, introducing the Modding Drawing Games for Planning Process (MDGPP) framework. Conclusion, gaps, and future research appear in the last section.

5.2. From participatory and collaborative planning to serious games

Citizens are willing to participate in the collective decision-making processes, mainly in processes that concern their daily lives and where local collaboration is achievable (Healey, 1997; Innes & Booher, 2018). Increasing the participation levels can help improve planning process and the ability address problems and formulate alternative solutions (Cilliers & Timmermans, 2014; Smith, 1973). But participatory planning is lacking processes and tools for citizens to express and affect decision-making (Legacy, 2017). Planning processes tend to be complex and difficult for citizens to grasp (Baker et al., 2007). Additionally, planners need new tools to help visualize and interpret the complexity of contemporary spatial systems (Rauws & De Roo, 2016). The unpredictability and emergent nature of game systems can be a way to overcome these problems, gather data and allow citizens to express their ideas and learn during interactive processes that are not scripted (Dodig & Groat, 2019a; Mayer, 2009). Game designers must let players decide their moves and actions, which can be unpredictable, especially in multiplayer interactions. Game designers define the game mechanisms and rules to balance these emergent behaviours and interactions, delivering experiences and outcomes according to predefined ranges of results.

Despite these opportunities, the unpredictability of games (Costikyan, 2013) can make decision-makers and planners suspicious about game usage for planning (Tan, 2016). Player agency in an interactive game system with multiple feedback loops (Fullerton, 2014) generate unpredictable outcomes. Allowing players to change the game state (e.g., information in a map) during continuous multiplayer dynamics generates unpredictable results. However, games can deliver and frame different levels of controlled environments (Salen & Zimmerman, 2004). The unpredictability of games resulting from players' agency in multiplayer game sessions can foster creativity and new ways of expressing ideas (Sousa, 2021b, 2020b), while the game designers have the power to combine mechanisms to control the game outcomes. Adding human expert mediation can increase the control and conduct the game dynamics for specific purposes (Brömmelstroet & Schrijnen, 2010). Defining game goals according to the purposes of each planning process is an obvious strategy to follow serious games principles. It also helps to evaluate a particular serious game approach.

Games are emergent systems that foster player agency (Salen & Zimmerman, 2004). This agency is a relevant trait of games to bring to participatory planning practices. Planners can design the game process and act as facilitators (Forester, 1999). In analogue games, the potential for fostering collaboration and players' agency is even higher. This effect results from the lack of automatization in analogue game systems (Zagal et al., 2006). The physical dimension of the components also helps participants and planners to nudge and bounding.

Exploring modern board game designs should allow us to benefit from their design innovations that engage new players every year (Sousa & Bernardo, 2019). Keeping up-to-date is hard, but planning with gamers in local gatherings, conventions and visiting BGG helps. Although these modern board games are becoming popular as entertaining games and a leisure pastime, using them for developing planning practice activities should be done carefully. Planners should analyse which game elements (e.g., mechanisms) are useful and which are not. Champlin et al. (2021) recommend delivering game-based planning activities that provide mediated structured dialogue between planning professionals and experiential knowledge of citizens in multiple ways. These requirements relay in following co-design approaches, which allow participants to critique and influence the ongoing planning processes. Co-design principles are a way to test the most adequate game elements for each planning process.

From the many game-based approaches and strategies to transform games into tools to achieve predefined goals, serious games have been a growing trend in planning (Dodig & Groat, 2019b; Tan, 2017; Vanolo, 2018). But few of these approaches profit from modern board game designs (Schouten et al., 2017). Planners can adapt these modern board games or use their distinctive game mechanics for their own games (Sousa, 2020a, 2021b). As Constantinescu et al. (2020) stated, the game mechanics can determine the effectiveness of serious games. Game mechanics can be defined as core elements of any game system (Adams, 2014). Core mechanisms are the primary way players activate the game system, generating interactivity and building emergent experiences that can be unpredictable (Costikyan, 2013), although framed according to the design options taken during the game development. Game mechanics are the building blocks of games (Engelstein & Shalev, 2019; Zubek, 2020). They are the blocks that planners need to combine to develop their games. For this work, we will use game mechanics and game mechanisms as synonymous. In the game design literature, it is common to use the two terms as synonymous. But in the analogue game industry and gamer community, mechanisms are the current standard term due to the concept of the building blocks of game design (Engelstein & Shalev, 2019; Sousa et al., 2021b).

In order to achieve a serious game, as those games developed to engage participants in pleasant and meaningful activities while delivering predefined goals (Dörner et al., 2016; Michael & Chen, 2005), defining correct game mechanics is of the most importance. Games have mechanical systems that define what payers can do and how the outcomes may emerge. Serious game frameworks like the Design, Play, Experience (DPE) (Winn, 2009), which depart from the Mechanics, Dynamics, Aesthetics (MDA) (Hunicke et al., 2004) framework, are based on the cascading effects of mechanics to deliver experiences. Despite its applicability, the DPE framework was adapted by Sousa (2020a; 2022) to incorporate the facilitator role, which is essential to teach, support and do the debriefing process with analogue serious games (Sato & de Haan, 2016; Sousa & Dias, 2020). The previous frameworks highlight the importance of the mechanics in serious games. They reinforce the mechanics/mechanisms as building blocks planning professionals must manage when modding or building their serious games.

From the many available analogue game mechanics, we will focus on the drawing mechanics. We will follow this approach because it is something planners are more familiar with. Drawing is a natural way to express and communicate. Plans have graphical elements, and they usually are the most tangible elements of a planning process. Arguably, graphic representations have a higher potential to establish relationships between planners and citizens in a given planning process. The tangibility and easiness to adapt an analogue game (Zagal et al., 2006) promises to deliver ways to foster flexible co-creation processes that fuel communication between planning professionals and stakeholders (Champlin et al., 2021). As Wilson and Tewdwr-Jones (2020) found, allowing citizens to draw and talk makes participation in planning more effective. These authors also found that other ways of interaction and expression are valuable for future participatory planning approaches. We argue that games can be these interactive complementary processes.

5.3. Let's draw

Drawing is a human enact ability. While children draw naturally without being afraid of judgement, some adults say they are proud not to draw at all (Whiteford, 2009). It seems that above a certain age, individuals lose the habit to express themselves through drawings. Adults tend not to consider drawing as a serious way to communicate (Anning, 1999). Adults tend to misdraw objects due to bias and accumulated experience about the shapes and forms (Matthews & Adams, 2008).

Drawing can communicate spatial ideas, essential in a planning process. Drawing mind maps and schemes can be powerful communication techniques and efficient ways to express complex ideas (Eppler, 2006). Even annotations and free sketching can improve communication and facilitate gathering useful data for process improvement (Eppler & Pfister, 2010; Tanaka et al., 2009). Drawing can support discussions and verbal expressions, ideas, and foster collaboration (Tang, 1991). Allowing participants to draw and sketch helps them to focus and express their ideas (Bly, 1988). Participants that might not be comfortable doing public speaking can express their insights through drawing. So, during a participatory planning process, allowing citizens to draw can be immensely important to make their ideas more tangible and meaningful for other participants and planning professionals.

Usually, planners try to engage participants by showing images of their planning proposals, but this passive communication can be ineffective. The 3D representations and simulations can be too complex for citizens to grasp (Salter et al., 2009). We can overcome some of these challenges by using simpler graphic representations and allow participants to represent themselves and their understanding of issues at stake by drawing. Drawing workshops can help participants to express ideas and learn from planning professionals (Goodspeed, 2016). Modern board games can deliver the mechanics to profit from the advantages of drawings and the engagement games provide. We consider engagement as the ability for citizens and stakeholders to invest time into a process, doing pleasant and meaningful activities that fits their preferences (Zagalo, 2020).

Before entering complex drawing activities, adults need to practice before in order not to disengage (Knight et al., 2016). Small "ice-breaking" games can be a way to train drawing expression and gradually immerse participants in the planning process. Adults might have some prejudices about game usage for planning (Ampatzidou et al., 2018). These introductory approaches might deliver a solution while showing elected decision-makers and planners that playful activities can deliver workable results (Nijholt, 2020).

5.4. Identifying games to learn drawing game mechanisms

The quantity of existing analogue games is overwhelming. It is necessary to find a game database to start from and gradually understand the state of the art of analogue game design. In order to find and identify drawing mechanisms, we consider Board Game Geek (BGG) (www.boardgamegeek.com) database because it is the primary source of information about modern board games, with more than 125.000 games registered and 3 million users from all over the world that fuel the website daily (Rogerson & Gibbs, 2018; Sousa & Bernardo, 2019). At BGG, we can find a list of game mechanics (or mechanisms).

5.4.1. Method for selecting games

In the browse section of the BGG website top bar, there are several grouping classifications. It is possible to directly choose the "Mechanisms" or the "Families" game typologies. We can find the "paper and pencil" and "line drawing" mechanisms which revealed games where players write and do schemes but do not draw any type of ideas. This unappropriated result leads us to find in the available game families a better match. The “drawing: mechanisms” revealed games where more free drawing was the core activity player do.

After obtaining a list of games that use this drawing mechanism, BGG allows organizing the list by rank, showing the games the BGG users play the most and provide the best experiences according. This process was tested previously for other serious game processes by Sousa et al. (2021a).

Although BGG provides extensive data and classification about the games, the abstraction of some game mechanisms could difficult a direct analysis. To select games where players draw ideas that can lead to complex representations each game must be analysed carefully. The rules of play of every game were analysed in detail to understand the gameplay, components, mechanisms, and other relevant traits. BGG provides links and files with the rules of the games and many explanatory videos. The criteria to consider the games resulted from the crossing of the highest rank, which proves the game is engaging, and the game mechanisms that allow drawing expression. The author selected the top ten rank BGG games with these features, reading the rules and directly testing each game. Ten games provided a sample of different game systems.

Exploring the games and the respective players' feedback at BGG confirmed that the games deliver the expected experiences: the ability to let players express and communicate ideas through multiplayer interaction and drawing.

Figure 5.1 expresses the process of selecting the game to analyse based on their core mechanisms and the appreciation rank. This process allows to identify the games by different core mechanisms and other features are necessary (e.g., complexity, duration, number of players) that deliver serious game objectives (e.g., allowing participants to express ideas).

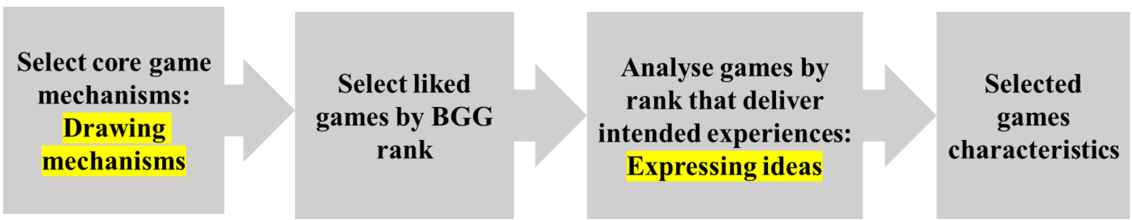


Figure 5.1 – Searching for game on BGG with specific core mechanisms that deliver predefined dynamics to find their characteristics.

5.4.2. The results

Table 5.1 shows the top ten games from BGG that allow free drawing expression. We did not consider games that were just about pointing to answers, highlighting objects, or drawing paths. Many of these games were related to the “paper and pencil” mechanism. We were looking for examples of games with game drawing mechanisms that lead players to express ideas by drawings with as much freedom as possible. This ability is valuable for planning professionals because they can use these game mechanisms to provide citizens and stakeholders with different ways of expressing themselves.

Table 5.1 – Characteristics of the Top 10 BGG games with "drawing: mechanism" that allow free drawing.

Game	BGG rank	Durat. (min.)	Player count	Platform to draw	Challenge
Telestrations	265	30	4 - 8	Individual notebooks	Interpret words and drawings to maintain the idea.
Fake Artist Goes to New York	660	20	5 - 10	One collective draw space	Add drawing elements and combine with storytelling to find the player that does not know the idea.
Pictomania	746	25	3 - 6	Individual draw spaces	At the same time, drawing and bet to guess other players drawings.
Duplik	1452	45	3 - 10	Individual draw spaces	Players draw described ideas and are evaluated by achieving predetermined criteria.
Pictionary	4700	90	3 - 16	One draw space	Teams try to guess words based on drawings made by teammates.
Artbox	6014	25-45	3 - 8	Individual draw spaces	Players draw pictures by using limited shapes and then try to guess each player drawings.
Subtext	6088	20-40	4 - 8	One draw space	A player deal cards to another player, but only one know the word also. All players will try to guess the objective. Only one player will successfully guess.
Luck of the Draw	8334	30	4 - 8	Individual draw spaces	Each player tries to represent a painting masterpiece in 45 seconds, and then all players vote to determine the best drawing.
What's Missing?	10215	20	3 - 6	Individual draw spaces	Draw above transparent paper to complement a given drawing. Other players must guess what is missing.

Table 5.1 reveals some common traits of the selected drawing games, which help to understand the game dynamics. The most enjoyable drawing games tend to be party games (Sousa & Bernardo, 2019). These party games allow higher player counts, on average from 4 to 8 players. But some like *Pictionary* (Angel, 1985), *Fake Artist Goes to New York* (Sasaki, 2012), and an alternative version of *Telestrations* (Användbart Litet Företag, 2009) for 12 players allow more persons to participate in the game simultaneously. The sample reveals low-complexity games according to BGG classification. Any person can play these games without demanding high game experiences. Only *Pictionary* requires more than 45 five minutes to be played. *Pictionary* is the oldest game of the sample (1985). All the other games were released after 2005. Since this sample gathers top-ranked games, it is relevant to state that there are two games from 2019 and one from 2020, which means that new games are engaging players. This BGG ranking system provides a selection of games that thousands of players enjoy (were engaged by the games). Considering

these game characteristics are valid indicators of enjoyment that can guide the development of other serious games.

Our sample shows games to play in less than 30 minutes, like *Telestrations*, *Fake Artist Goes to New York*, *Pictomania* (Chvátil, 2011), *Luck of the Draw* (Scott, 2006) and *What´s Missing?*(Sirieix, 2020). Three games rely on a simple draw space, and only one of this transform this space into a collaborative activity (*Fake Artist Goes to New York*). All other games provide players with individual drawing spaces. Although we must highlight that *Telestrations* provides each player with a notebook since the game generates sequences of words and draws to generate a logic chain. Most of the games rely on “guessing” as a challenge. The “guessing” is more a dynamic than a mechanism according to the MDA framework. These "guessing" games demand players to draw for others to understand ideas (this is the classic example of *Pictionary*). But more modern games like *Pictomania* and *Fake Artist Goes to New York* add other layers of complexity and excitement. Players do several simultaneous tasks, like in *Pictomania*, drawing while trying to guess other players drawings. *Fake Artist Goes to New York establish* a collaborative activity that fosters trust and distrust, relying on drawing exercises and storytelling. *Telestrations* build sequences of convergence and divergence ideas that fuel imagination (Sousa, 2021b). Besides the guessing, many games of the sample, directly or indirectly, establish democratic processes to do the decision-making process or demand to choose the best performance. Only *Pictomania* is not a turn-based game. All the other games determine turns for the players to activate the game mechanisms. In theory, all players have the same opportunity to participate and influence the game state in a turn-based game (Engelstein & Shalev, 2019).

Going beyond the ten selected games, we highlight other cases. *Railroad Ink: Deep Blue Edition* is a game where players express how they would create a transport network made of railways, roadways, and waterways (Figure 5.2). In this game, all players have the same resources, determined by dice rolls. But at the end of the game, every player board will be different. Players draw in their player board the dice images that represent transportation infrastructure. Players do the drawings following schematic representations of each type of infrastructure in a squared grid. This layout and options help players use meaningful graphic expressions and adopt the same scale. Games like *Railroad Ink: Blue Edition* (Hach & Silva, 2018) are not traditional party games. They are more like eurogames (Woods, 2012). Players are competing, avoiding direct confrontation, by choosing the best option to score the most points.

Figure 5.2 – Example of the result from playing Railroad Ink: Deep Blue edition (Source: author).

Another example of strategic drawing games is the "crayon series". *Empire Builder* (Bromley & Fawcett, 1982) is one of these games where players draw their networks over the board game maps, aiming to be efficient. *Roads and Boats* (Doumen & Wiersinga, 1999) is another game where players draw transport connections in a transparent paper over a territory. These are games more about efficiency, although they demand creativity to find solutions. Therefore, our selection of ten games based on the "drawing: mechanism" seems valid to foster creativity and expression on complex ideas.

5.5. Going beyond core mechanisms

Drawing mechanisms appear in several successful modern board games, those that many thousands of persons enjoy playing. Drawing is associated with party games, a type of game known to be simple and engage large groups of players simultaneously (Woods, 2012). Playing these party games deliver different forms of collaboration among players, by playing in teams, playing collaborative or just by the social contract that emerges from playing an analogue game (Duarte et al., 2015). But the transposition of these game mechanisms to participatory planning activities might not be evident. Planners need to have game literacy or to work with someone with this knowledge. Even simple and fast games like those presented in Table 1 can be challenging for inexperienced players (Sousa & Dias, 2020). Starting with simpler games that can be learned and played fast can be a successful strategy. The goal can be profiting from the engagement and creativity these games can bring to planning practices. These games could inspire ways to address bias and discuss important issues that emerge through the drawing expression. The drawing mechanisms help participants to express their ideas graphically, fostering creativity. It introduces challenges to the player (participant) that is drawing and to the other players (participants) that are interpreting the shared ideas. The available options the game system provide can help to frame problems and solutions in a language all can use and relate with. Games can define what shapes to use, how many lines to draw, predefine a grid to fill, define forbidden or mandatory words to represent and many other combinations of restrains or supporting tools. Drawings are compatible with storytelling as an expression of the author or as the interpretation from other participants in the game. Citizens and stakeholders can discuss in a positive, safe, and humorous environment, mediated by professional planners that can explore these drawing games. Table 5.2 expresses the features associated with the games that explore drawings as core game mechanisms.

Table 5.2 – Features of drawing games planners can replicate in planning.

Game	**Foster**			
	Expression though free drawing	**Framework to draw uniformly**	**storytelling**	**Participants' interpretation**
Telestrations	●			●
Fake Artist Goes to New York	●		●	●
Pictomania	●			●
Duplik	●	●	●	●
Pictionary	●			●
Artbox		●		●
Subtext	●			●
Luck of the Draw	●			
What's Missing?		●		●

The explored games allow players to express ideas, but the games we presented here rely on predefined concepts and words to be represented through gameplay. Guessing and having the most votes for a successful representation is the way players are engaged. In some cases, like in Telestrations, players may ignore the voting/scoring system and enjoy the funny interpretations and misleads. It becomes a humour exercise. This humorous mood may happen in most of these games. This kind of enjoyment is one of the reasons these games are classified as party games. When played in a planning process, these games can generate different data. Planners can use the drawings, the discussions, and the debriefing outcomes. At this stage, the challenge is how to organize this data. These methodologic limitations complicate, even more, the overall difficulty of transforming participation into fruitful enjoyment.

The survey revealed ten games with high potential but many others that seemed also relevant to inspire game-based planning processes should not be neglected. Maybe the focus on one core mechanism is just the starting point of the approach. Considering other mechanisms might bring new ways to build adapt and develop serious games for planning practice.

One way to profit from the drawing party games to support game-based planning dynamics is to modify them. Planning practitioners can do simple modifications to support citizens to express their ideas (Sousa, 2020b). But games tend to have more than one mechanism. We considered the drawing as the core game mechanism, but others are necessary to support the game dynamic, usually called auxiliary mechanisms (Sousa et al., 2021b). Drawing mechanisms allow expression, while other game mechanisms can help mediate the participation. The turn-based game mechanisms allow equality of participation. The game mechanisms can frame how players should do the drawings. This guidance can restrain freedom but can level player skills and allow all participants to draw their ideas. Limiting the available forms and time to make drawings can create tension and reduce the game duration. These limitations are some of the challenges that can engage more participants.

To benefit from the game usage for planning processes, we propose to follow the modding approaches (Castronova & Knowles, 2015; Sousa, 2021b, 2020c). Planners may replace the cards, dices, or other randomizing systems to predetermine the issues and subjects at stake. By doing this, planners can frame the process and conduct the participants to work and express ideas related to specific planning issues. For example, planners can define game-based planning processes to address urban sustainability problems (Sousa, 2020a). The guessing and voting systems led participants to analysed other players expressions. Acknowledging other participants claims is essential to enter a decision-making process that fits the collaborative planning approaches and collective decision making (Innes & Booher, 2018).

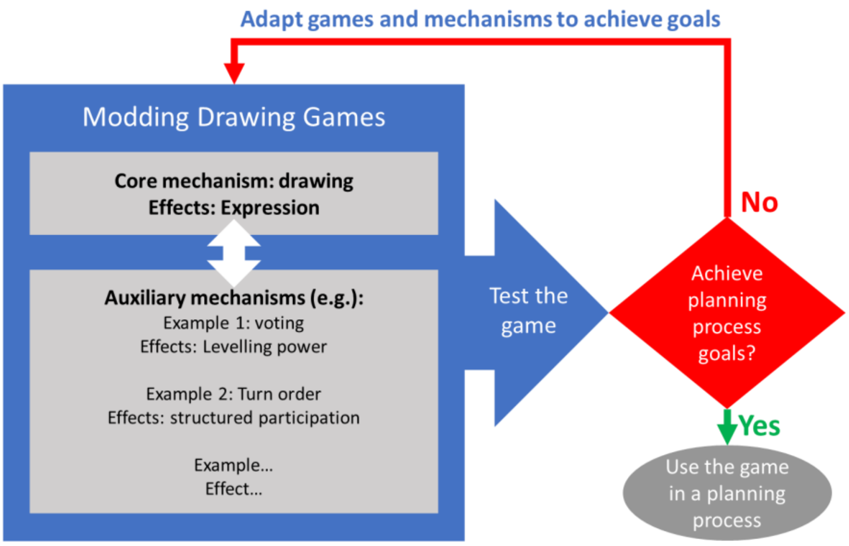


Figure 5.3 – Modding drawing games for planning processes (MDGPP)

Figure 5.3 proposes a simplified framework for modifying existing games that have drawing as the core mechanism as well as several auxiliary mechanisms. The proposed framework establishes the relationships between game mechanisms and effects applicable for participatory planning processes. Planning professionals can follow these recommendations, adapting and playtesting the games before using them in a planning process. This proposal is an interactive proceeding that simplified the Mechanics for Engagement Design Protocol (MDEP) (Sousa et al., 2021a). Our Modding Drawing Games for Planning Processes (MDGPP) framework reduced several steps of the MDEP, focusing on the effects of using specific mechanisms and the testing before using the games in practice. Even though the modding approach reduces the need for planners to master game design, aiming only on one core mechanism might not be enough. Using serious games might demand higher game design knowledge than initially expected.

Serious games also demand the game to help players achieve goals. In the case of participatory planning, the game must be engaging, support communication and data collection. Table 5.2 highlights four main features planners can use to develop games or simple dynamics to foster active creativity and interactions. The games that allow free drawing expression foster creativity and express ideas that might be difficult to emerge otherwise. Giving the participants time to do their drawings alone explore their individual participation. Constraining the things and how they can draw and where to draw helps uniform the language. Storytelling can be a complementary activity to enrich the drawings meanings, which can be done by the author of the draw or by the other players interpreting it. The last feature refers to the ability of players to interpret what other participants have done or added. The interpretation incentivizes players to understand other participants ideas, claims or concerns. This simple shift fosters active participation and considering others.

The selection of the ten top BGG games with drawing mechanics assures that engagement is achievable. By playing the game, participants should have a better experience than in traditional planning processes. The game should provide planners with relevant and unique data. These are the goals considered in the Figure 5.3 decision box. Failing to achieve these goals lead to new game modifications and testing.

5.6. Conclusions

Game design is hard to master but using existing analogue games can be a solution for planners to enter game-based planning. We dove into the modern board game design to find how drawing games could help planners use game-based approaches for participatory planning processes. Drawing mechanisms can be simple to use and fuel serious game dynamics that are engaging and support planners' activities.

Although using games demand specific knowledge, we proposed a method to benefit from simple game approaches, following a simplification of the MDEP protocol. Arguably, profiting from existing game mechanisms and successful game implementations are easier approaches than developing a new game. This proposal establishes a first approach that planners can undertake to explore modern board games. But continuous testing and experimentation are recommended as planners dive into analogue serious game usage. Analysing how other core mechanisms support a specific planning process seems a promising path. Despite being less complex, the modding approach demands planners to deal with some game design issues. The MDEP demanded searching for game mechanisms to develop new games, while the Modding drawing games for planning processes (MDGPP) supports modding existing games.

Knowing how to search for game mechanisms can help planners do their serious games. Core drawing mechanisms appear in many different games. These mechanisms are not rigid. They are implemented according to the way they are combined with other auxiliary mechanisms. We realized that focusing only on one core mechanism might be very constraining because a game has many mechanisms. Even the simpler ones have two or three auxiliary game mechanisms to build the playing experience. The concept of core mechanisms and auxiliary mechanisms help define what modifications to do and what effects to expect. Planners can adapt analogue games to their planning process, but playtesting is necessary due to the unpredictability of combining different mechanisms and how participants will react to them.

Despite the process of searching games by the "drawing: mechanism" and selecting a sample of the highest raked ones revealed a meaningful list of games to discuss, many other games were missing. BGG also define "paper and pencil" and "line drawing" mechanisms. There are several overlays in our sample, games that share these mechanisms. "Paper and pencil" and "line drawing" can be considered more abstract ways of doing graphical representation related to the drawing games.

Nevertheless, modding games is less expensive and time-consuming than developing new analogue games and digital games. Or, when aiming to create a digital game, analogue prototyping is a proven way to deliver the first steps for digital game development (Brathwaite & Schreiber, 2009). Despite analogue game potentials, these games have their own restrictions to achieve detailed simulation while demanding high facilitation (Sousa, 2020a). But mastering the analogue game mechanisms also allows planners to transfer the same dynamics to online game-based activities (Sousa, 2021c).

Drawing games are among the lowest complexity modern board games to play. Their party game nature allows fast engagement and low barriers of complexity to enter a ludic experience. Planners can use these game mechanisms to provide participants with multiple experiences: creative expression, debates, empathy, negotiation, and decision-making. Games can deliver these experiences, depending on how their mechanisms are combined and activated. We believe these games can provide valuable "ice-breaking" exercises for a planning process or to establish specific serious games that aim to be a planning process by themselves. These approaches are being used successfully during the development of *UrbSecurity* (www.urbact.eu/urbsecurity), an *Urbact* project. The literature on serious games for planning also shows that this is viable to some extent (Ampatzidou et al., 2018; Dodig & Groat, 2019b; Tan, 2017; Vanolo, 2018). Despite the notion that serious games have a high potential for planning applications, the specific traits of modern board games are far from being explored.

The analytical dimension of serious games is imperative to consider. Finding ways to analyse the data from the drawings, the discussions and debriefing processes is relevant. We recommended future research to deal with these challenges.

Games offer infinite possibilities for planners to use in their practices. Modern board games innovations are no exception and can allow planners to go beyond traditional game usage. The analogue dimension of these games provides tangibility and flexibility to adapt their mechanisms to participatory planning approaches. The drawing mechanisms seem to be one of the mechanisms with a higher potential for fostering creativity. Drawing allows participants to express themselves in multiple ways, generating tangible outputs, and comprehensive frameworks that help other participants interpretations (Table 5.2).

By modding games where drawing is a core mechanism, professional planners also need to deal with the effects of auxiliary mechanisms, gradually entering the game design. Using games demand specific knowledge of game development, like considering the users' experience. Besides this game design general challenges, developing serious goals obliges creating games that achieve specific goals beyond fun and entertainment. Departing from existing games can simplify these processes.

We believe the Modding Drawing Games for Planning Process (MDGPP) framework help planners find games and game mechanisms to develop their own serious game approaches. Drawing games and their specific core game mechanisms are among the most simple and flexible ones to use. Mastering these designs can lead planners to complex game approaches, especially when adding other auxiliary game mechanisms.

6. THE STAKEHOLDERS CLASH GAME: FROM BOARD GAME DESIGN TO ONLINE SERIOUS PLANNING GAMES

6.1. Introduction

The Covid-19 Pandemic affected almost all activities worldwide, and spatial and urban planning was one of them (Pánek et al., 2022; Song et al., 2021). During this period, the social distance restrictions demanded new solutions. Planners that worked in collaborative planning or other planning processes that foster public participation had new challenges to deal with.

Using online video streaming and collaborative software tools was common during the pandemic social restrictions (Dey et al., 2020). However, these tools were not designed specifically to support the spatial planning process. What other tools could planners use to overcome these difficulties and support online participation without requiring expensive and complex solutions?

We propose a serious game design method where analogue game design elements inspired a digital game to simulate stakeholders' interactions during a hypothetical planning process. For this purpose, we create *The Stakeholders Clash* (TSC) game as a team-based game, where players assume decisions in a team of stakeholders during a generic urban development process. Each player played in a team of stakeholders with their own options (available pieces to move) and objectives (scoring). Every player's decision could affect the score of all the stakeholders, not only their team, introducing an interactive experience. Players could move pieces representing different urban/land uses and transport route segments. Each player can only move one piece once during the game. However, each player could influence their teammates' moves during the rest of the game. Summarizing, players change the urban model and affect scoring by moving pieces into the game board (the simplified urban model in a grid format).

The proposed method to develop the TSC game allowed players to express their expertise level, one group in the spatial planning dimension (simulation purposes) and the other in the game design field (playability purposes). The game highlighted metaphors associated with each stakeholder group. To balance the meaning, simulation, and playability, we adopted a scoring system based on the urban grid size, the number of represented stakeholders and interconnected relationships. Three stakeholders (citizens) scored directly, according to the placed pieces on the game board. The other two stakeholders (the politicians) scored indirectly, depending on the result scores of the citizens. This scoring design option aims to simulate different claims among citizens and the politics of dealing with these claims. It deliberatively provoked players to reflect on the roles and the overall game’s relation to reality.

We used *Zoom* and *Google Slides* software in two sessions, first with planning experts and then with game design students. The final version of TSC serious game resulted from a development process where the feedback from players changed the game. The first game version was playtested solo (research team), then with spatial planning experts and finally with game design students. This process allowed us to develop a method based on moving objects over urban grid models. Players activated typical analogue game mechanisms that delivered a playable experience on simple-to-use software.

The first section of this paper presents the background of serious games for online planning and is followed by the methodology that supported the game development (action research). Next, we detail the development and adaptation process (graphical representations) of the TSC. Describing this interactive process shows in practice how unpredictable player behaviour can be and the pitfalls to avoid, only manageable through multiple iterations of game development and playtesting. The playable interaction section exposes the game results, and the discussion presents the generic method to replicate the experience findings, highlighted again at the conclusion. These serious games need to generate engaging options for participants, and the outcomes must connect to the thematic simulation and result from player interactions.

6.2. Online serious planning games

Games can be ways to engage and attract citizens, stakeholders, and experts to spatial planning processes (Constantinescu et al., 2020b; Mayer, 2009). However, game usages are not as widespread in spatial planning as it might be. It seems that practitioners have difficulties using game-based planning in practice (Ampatzidou et al., 2018; Constantinescu et al., 2017; Constantinescu et al., 2020a). Despite this, there is growing literature on the use of games for spatial planning (Sousa et al., 2022b). Authors like Tan (2016, 2017) are among the most cited for collaborative urban design, now also resorting to digital apps (Tan, 2022), which demand considerable resources to implement the required physical and digital support tools. Like in other examples of video game usage, developing the games can be complex and expensive (Poplin, 2012, 2014). These limitations partly explain why some researchers and practitioners have tried to explore existing orthogames (Elias et al., 2012), those games made for entertainment that somehow simulates city development. There are several cases of exploring *SimCity* and, more recently, *Cities: Skylines*. However, these games tend to be useful as teaching tools when combined with other activities (Kim & Shin, 2016; Minnery & Searle, 2014). Another example is the use of *Minecraft* as a game to deliver citizen engagement, enabling collaborative playing and defining public urban spaces. Although this is a successful orthogame, it is applied in urban planning as a creative tool with loose rules and without game-like objectives (de Andrade et al., 2020; Delaney, 2022).

Independently of the type of game, game-based approaches for spatial planning tend to fall into the gamification or serious game approaches. We define gamification as using game elements in non-game processes and serious games as playing complete games to achieve other objectives beyond entertainment experiences (Walz & Deterding, 2014). Developing or adapting/modding existing orthogames for planning, as in any context, are promising ways to build serious games. It depends on the purpose of playing (Dörner et al., 2016). TSC, according to the previous definitions, is a serious game.

Another alternative is exploring analogue games, as they are easier to adapt and develop (Brathwaite & Schreiber, 2009; Fullerton, 2014; Ham, 2015). Several examples appear in books that aim to disseminate game-based techniques for urban planning and democratic decision-making (Dodig & Groat, 2019b; Kasprisin, 2016; Lerner, 2014; Tan, 2016). These games can be simple, a result of using some game mechanics and planning over maps with coloured cubes, bits and strings (Sousa, 2020a; Sousa et al., 2022a). Although they might seem simple, the selection of game mechanics influences the output of a serious game and the users' experience (Ampatzidou & Gugerell, 2019a; Constantinescu et al., 2020a). Using the same flexible approaches of analogue games in digital online tools seems promising. These design solutions provide inexpensive games while implementing codesign techniques like those recommended by Champlin et al. (2021) that would engage users and adapt the game to efficient participation and results. Sousa (2021a, 2022d) tested similar online solutions for decision-making and collaboration exercises. However, they did not involve complex sets of rules, game outcomes like win-and-lose conditions, or using graphical urban models.

6.3. Game development Methodology

The game TSC resulted from several design stages (black numbers) and playtest sessions (white numbers) defined in a sequence in Figure 6.1, following Champlin et al. (2021) recommendations. The first game ideas, from the first stage of development (DS1), were playtested solo by the research team (PS1), delivering the first playable version through several interactions of trial and error until the game elements (mechanisms, pieces, and game economy/scoring) emerged. Then, the game was tested with professional and academic urban/spatial planners (PS2), followed by a development correction stage (DS3). At this stage, if the game delivers experiences suited to approach the serious game goals it can advance to the playability development and test. After PS2, the game was corrected again (DS2). PS2 revealed the need to improve the decision-making experience by having more options and adding new constraints to the game setup (urban grid and pieces to move). The next steps focused on the playable dimensions (tested with game design experts in PS3). Game design graduation students participated in the third test (PS3), helping to analyse the game and propose the final modifications for DS4.

Our proposal specifies the need to establish several stages of development (DS) after playtesting sessions (PS). We recommend at least one playtest focusing on the content and serious game purposes (in this case, urban planning) and another on the playability, selecting users (players) that focus on each dimension of the serious game. We present the methodology into two subsections, one regarding the game design process and the other the playtesting, as they are the two core dimensions of the establishment of a serious game. Figure 6.1 presents the sequence where de development/correcting alternated with the testing.

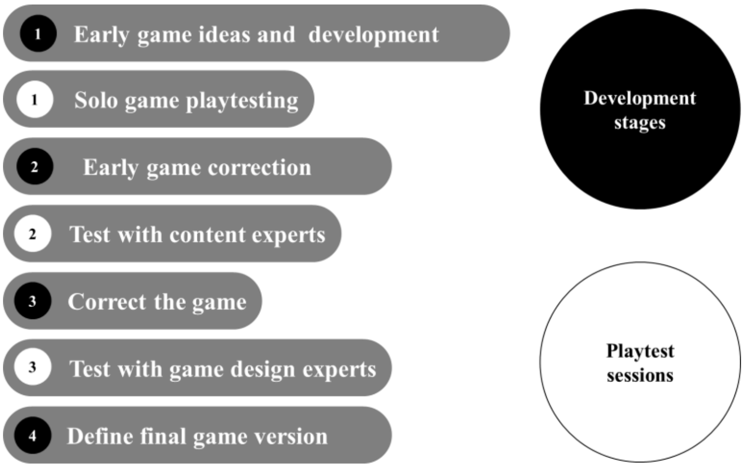


Figure 6.1 – Proposed development process for TSC serious game, Development Sessions (DS) and Playtest Sessions (PS)

The game was played online by combining an online video tool (*Zoom*) and an online file presentation tool (*Google Slides*). Each session generated data about game effects and outcomes, allowing us to propose guidelines for game design concepts and how to transform modern board games into online digital serious games.

Because this paper aims to contribute to identifying game design patterns, the serious game design process is described as an action research sequence, learning from the playtest sessions and development modifications. Preparing the sessions (online meetings) demands other specific concerns that we will detail for future replication and discussion.

6.3.1. Serious game development process and early game concepts

As in any standard serious game process, there is the need to balance the engagement/ entertainment dimension with the other, arguably, more serious objectives. The purpose of the TSC game was to deliver an experience where players assumed typified roles of stakeholders that would work together and make decisions to change an urban space. Each stakeholder had different options to affect the game state, which defined their scoring and the scoring of the other stakeholders. These conflictual scores were one of the game elements that simulated stakeholders' different claims and preferences. However, all stakeholders could collaborate to maximize their scoring since they benefitted from other stakeholders' actions.

From a mechanical point of view, we adopted a combination of game mechanisms from modern tabletop games like:

- Tile placemen: moving the pieces that represent land uses or transport segments.
- Set collection/connections: combining transport pieces to connect land uses.
- Tableau building: available options for each player in each stakeholder team.

These previous game mechanisms are described in detail by Englestein & Shalev (2019) *Building Blocks of Tabletop Game Design: An Encyclopedia of Mechanisms* book. Figure 6.2 exemplifies the abstracted move of a player during the game. It is a two-step example of combined game mechanisms. A player moved an available game piece (representing a land use or transport segment) to change the map (urban grid model).

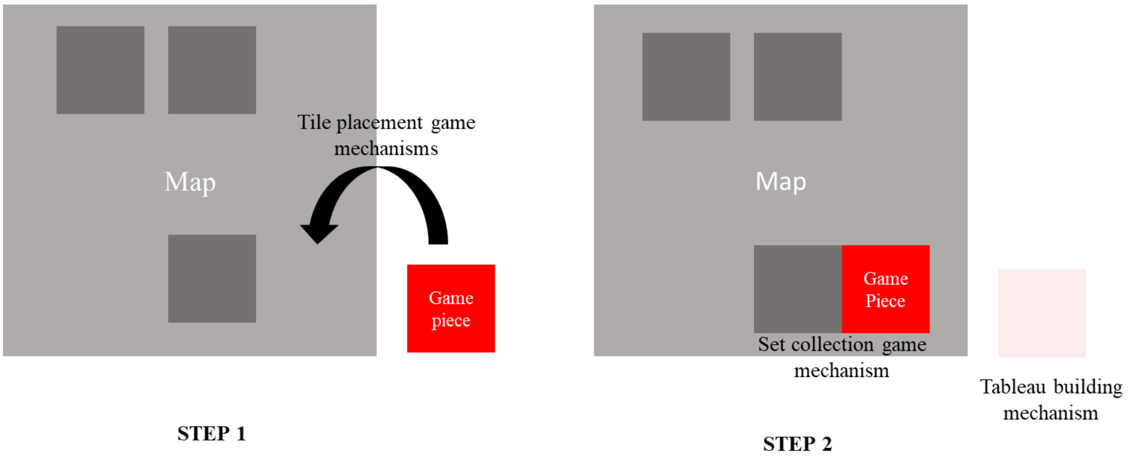


Figure 6.2 – Exemplification of the game mechanisms to use in the TSC serious game.

During a fixed number of rounds, players activated the game mechanisms to move pieces over a conceptual map of a city (grid model of an urban zone) that defined the game board. Tile placement was implemented digitally by allowing players to move geometric elements (land uses and transport pieces). Tableau building helped to track stakeholders' options (representing those already used and those still available). Adjacency and connection of the geometric elements (land uses and transport) defined the scores through set collection mechanisms. Players could move the game pieces to overlay the map. Figure 6.3 shows the conversion of an urban map into a simplified urban grid map for the game. Figure 6.3 represents how the blocks represent different land uses and transport segments, using the same dimension (d) of the blocks from the game board and specific colours for each land use (see also Figure 6.6). The light brown squares, inside the dashed grey lines (Figure 6.4) represent empty or non-defined urban blocks. These squares are the places to overlay the game pieces representing land uses (green, yellow, blue squares and triangles), while the black frames with dashed white lines are the road system. As players overlay the land use pieces over the light brown squares, they can also overlay the red rectangles over the roads to define the transport network.

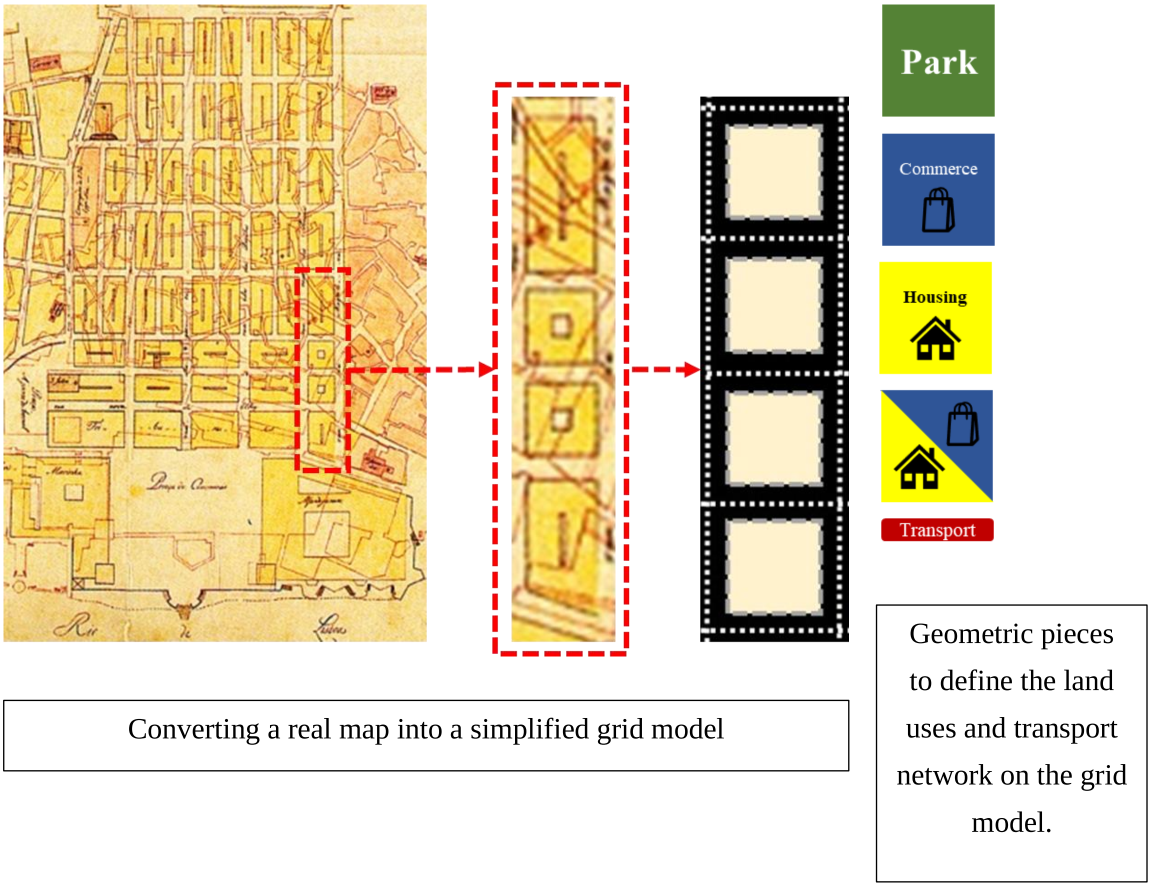


Figure 6.3 – Converting a real map (Lisbon Downtown from 1755 Eugenio dos Santos and Carlos Mardel Plan) to an urban simplified grid model (Left) and the representation of the urban block by land use (geometric pieces that players an move over the urban board) (right)

6.3.2. Learning from the playtesting sessions

The game's first version (from DS1) was playtested by the game developers (members of the research team), calculating the number of pieces necessary for a minimum and a maximum number of players (PS1). The number of different stakeholders (five) defined the minimum number of players. Adding more players required playing with teams of stakeholders. More than four players per stakeholder team introduce confusion to the debate and increase waiting, downtime and break the game flow. The game was turn-based (each player must wait for their turn to play). These requirements determined that 5 to 20 players could simultaneously participate in the same game. As stated before, each team of stakeholders had its scoring system (asymmetric mechanisms), resulting from the pieces over the map. Players could move different pieces into the collective game board (Map), improving their score for their stakeholder's team while also affecting the score of the other stakeholders. These positive and negative interconnections provided feedback loops that foster players to influence other players' moves and establish overall negotiation and collaboration dynamics.

The game was planned to have a duration of 60 minutes, considering a maximum of 20 players (maximum of 4 per team of stakeholders). Each player would take 2 minutes to move one of the pieces. Teaching the game took 10 minutes and another 10 to discuss the dynamic (debriefing).

The final minutes of each playtest session (PS) should be extended if the discussion keeps contributing to the serious goals of the game. A facilitator is needed to ensure the natural flow of supportive tasks. The facilitator explains the game, controls the time and helps players with their moves/decisions. Finally, the facilitator conducts a debriefing to consolidate the outcomes of the play.

6.4. The stakeholders clash game description

TSC is a serious game that delivers experiences of conflict and collaboration. Several players assume the choices of a team of stakeholders. The game was developed following a sequence of playtesting and development corrections to deliver a meaningful experience to players when trying to simulate decision-making according to stakeholders' claims. It was done from scratch, combining board game mechanisms into a virtual game environment that simulated a generic urban model (game board). Next, we describe the overall development.

6.4.1. Finding a basic graphical and mechanical model to build the game

Finding a way to represent urban maps is described in Figures 6.3 (showing the generated distortions). For the TSC case study, we defined a squared 4x4 grid with 16 blocks (Figure 6.4). The block delimitations generated 40 road sections. Figure 6.5 also represents the type and shape of available pieces players can move to overlay and change the map, as well as the type of interactions with the tile placement game mechanism (move and/or rotate).

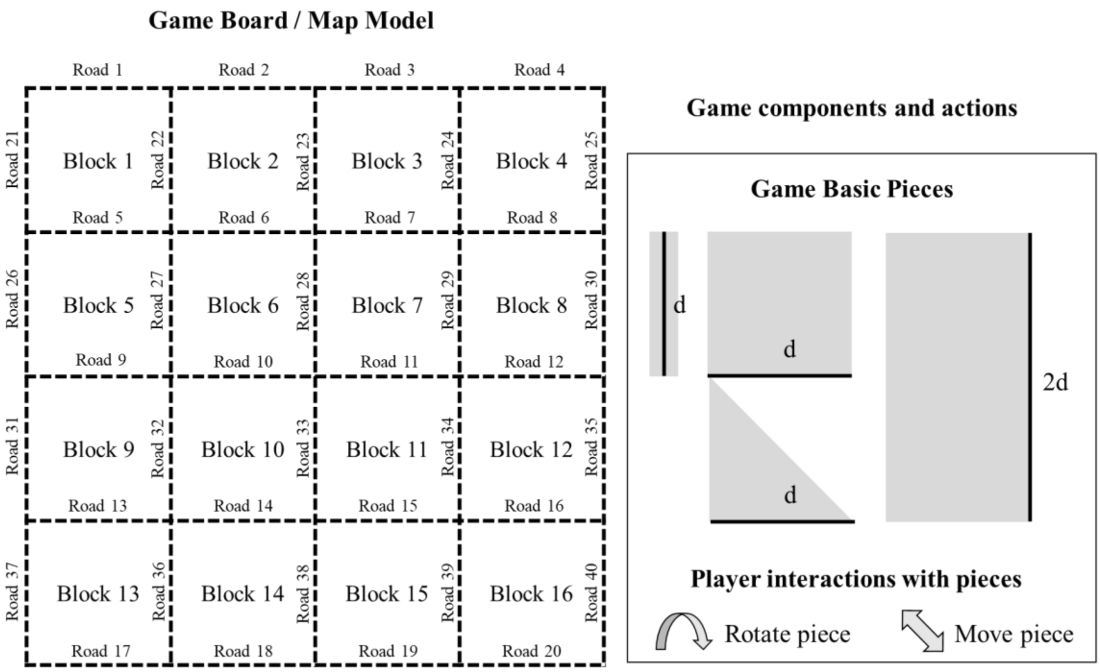


Figure 6.4 – Basic models to simulate an urban map, pieces for players to interact

Defining the game's pieces to move/rotate as squares and isosceles triangles with the same dimensions (d) of the blocks allows the simulation of single (square) or mixed (two triangles) land uses. This design and layout help players to know where to move the pieces on the game board (map). The rectangles represent constructions (land uses) that occupy more than one block. Players interact with the game by locating and moving/rotating a piece from the available pieces for their stakeholders' team to the game board (Figures 6.5). The overlaying of the pieces on the board changes the game state, meaning that a block has a new land use, or the transport system is reaching new urban blocks. Rectangles are the only pieces that can overlay the roads. The modular dimension of the game board and game pieces also allows adaptations to more realistic models. For example, using rectangles that occupy more than a squared block and inner roads creates more realistic models. It is possible to change the grids and the pieces according to the need of the urban reality to model. However, game designers/planners following our proposal must consider the players' ability to understand what game pieces to move and where, the geometric dimensional (lengths and areas) and topological (place to locate on the game board) relationships at stake, how it will affect the game state and scoring. Because we are dealing with orthogonal grids, distances are measured following Manhattan distance principles (orthogonal horizontal and vertical edges of the grid). Figure 6.7 shows how the game set distances.

Next, it is necessary to set what the players can do in the game and their available options. At least there must be a piece per player to move, which provides the first player with more options. Other players of the same team that play after seeing their options reducing as the game progresses, forcing the last players to influence the first choices of their teammates. It delivers a sense of urgency and information about the game's progression toward the endgame state.

The generic interface layout appears in Figure 6.5, with a column per type of stakeholder (team of players). As the grid model in Figure 6.1, the player interface can be modified for more players, demanding a minimum of one player per stakeholder (column) (1). The game facilitator can distribute players evenly, writing each player's name per line in each column (2) and forming teams that will act as a type of stakeholder (1). At the bottom of each column, associated with stakeholders, players can see the game pieces (geometric shapes) they can move and rotate to place over the game board. These game pieces are the options players have to play and the only moving pieces in the game (3). In the virtual implementation of the game, the graphical interface and game board are the background in Google Slides. The game pieces (squares, triangles and rectangles) are all added as interactive (customizable) objects in the software. Each team have different game pieces (3) to change the game state and affect the score (4).

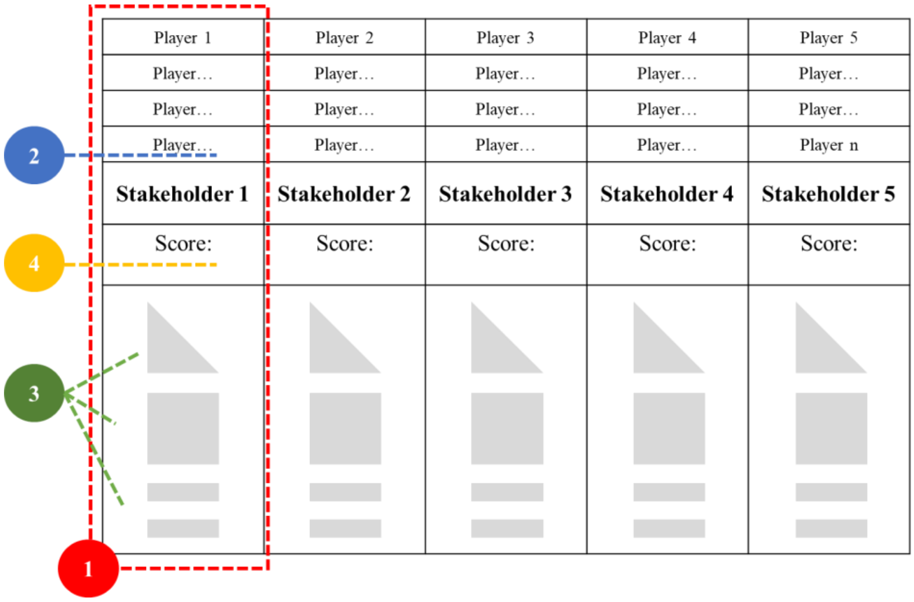


Figure 6.5 – Interface layout: 1 – Stakeholder Team (column); 2 – Line per player of the team (name of each player); 3 – Available pieces per team (pieces players can move to overlay on the game map); 4 – space to track the score (changes according to the game state and the way game pieces are placed over the game board); 4 – space to track the score of each team of stakeholders.

The scoring represents the game objectives for each stakeholder. Considering the number of available pieces and what stakeholders supposedly desire, represented in the game by how game pieces are connected by transport (set collection and connection mechanisms), we obtain the maximum score (four in the first version). The scoring threshold is associated with the grid dimension (4x4), set initially as 4 (first game version).

6.4.2. Finding meaningful play to build meaning interactions

We found the need to define which stakeholders to represent in the game, their options (pieces to move) and objectives (score). These traits must represent what real stakeholders' roles might be, contributing to avoid the ludonarrative dissonance. The game mechanisms players activate during play, and the graphical representation of the changes in the map, must represent the stakeholders' roles players are assuming. Aiming for meaningful play demands a coherent game system, all game elements, mechanisms and intended metaphors towards a theme. A geometric piece is recognised as a land use or a transport segment through metaphoric association. The words and iconography might not be enough to achieve meaningful simulation. Here the theme of the game was the development of a new urban zone (different land uses) near a heritage site and the respective sustainable public transport network. We defined the following stakeholders with a colour coding (Land uses: commerce was blue, housing was yellow, parks/heritage sites were green, and schools representing public facilities were grey; Transport system: transport segments were dark red) and scoring principles:

- Stakeholder 1 (St1): Shop Owners (blue) score according to the placement of geometric elements.
- Stakeholders 2 (St2): Environmentalists (green) score according to the placement of geometric elements.
- Stakeholders 3 (St3): Residents/Habitants (yellow) score according to the placement of geometric elements.
- Stakeholders 4 (St4): Elected Politicians (no colour) score according to other stakeholders' scores.
- Stakeholders 5 (St5): Opposition Politicians (no colour) score according to other stakeholders' scores.

Figure 6.6 presents the shapes, colours, and iconographic symbols used to reinforce the meaning of each geometric piece. Transport pieces (dark red) placed on orthogonal connections over the roads represented the transport system that allows land uses to be connected (all the different land uses connected to the transport network are considered adjacent).

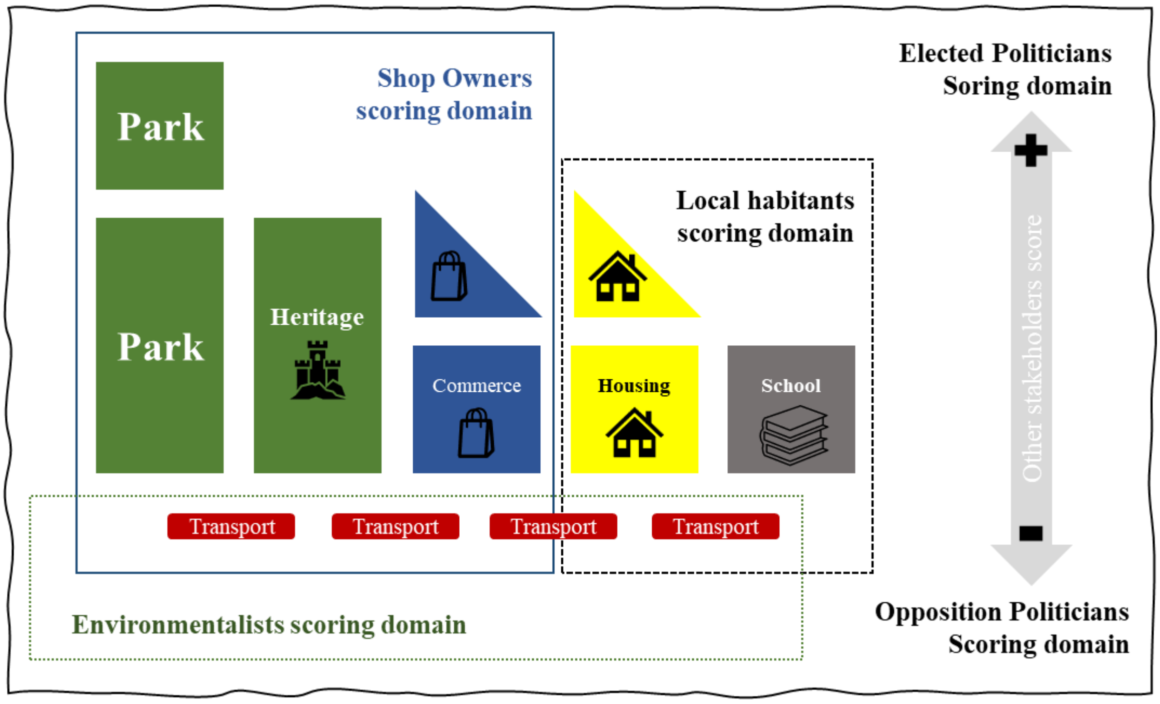


Figure 6.6 – Scheme of all Available pieces for players to move, colour codes and scoring domains per stakeholder. The quantity of pieces is set according to the scoring opportunities and game economy balance. Introduction to rectangular shapes for parks and heritage sites to generate asymmetry in the game board.

Giving meaning to players' choices also relates to scoring as the positive feedback that will incentivize a stakeholder to move a game piece to a specific place. For game purposes, adjacent/connect happens when land uses pieces share edges or when the transport network passes through the edge of the block. In figure 6.7, the School (block) connects to Housing 1 (block) through the transport network (Manhattan distance). Housing 2 is orthogonal adjacency to the school. Both Housing pieces score for St3 (see below).

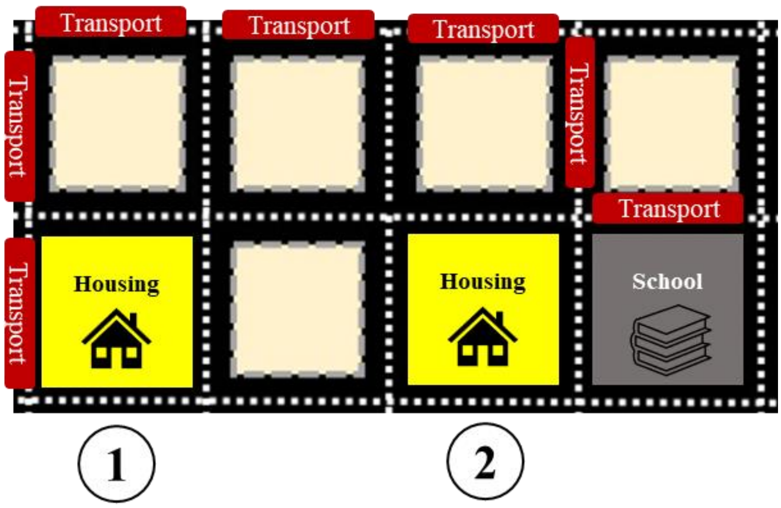


Figure 6.7 – Example of the connections by transport network or by adjacency for the case of Schools and Housing in the game board.

The previous scoring options deliver a similar/balanced opportunity for all stakeholders to win the game while trying to represent what stakeholders might claim in a real-case situation. The scoring metric was set for a maximum of 4, related to the 4x4 grid dimension of the game board. Our proposal departs from the urban model (defined as a game board) to set the scoring system for stakeholders. Stakeholders scored in the following manner, according to the placement of pieces on the game board and the number of stakeholders in play:

- St1: One point per commerce connected/next to a park/heritage.
- St2: Two points per horizontal/vertical continuous path of transport that crosses the game board.
- St3: One point per housing connected.
- St4: Start with 5 points and get negative points per stakeholder below 4.
- St5: Gets 2 points per stakeholder below 4.

The citizen stakeholders (St1 to St 3) scores defined the overall reference system. St1 and St3 score their points directly (1 point per connection). During the PS1, we realized they need to double the scoring for St3. The available transport game pieces were not enough to reach a maximum score of 4. This constraint made us double their score per continuous horizontal/vertical complete transport path. The politician stakeholders scored differently from the citizen stakeholders, although their scoring was interconnected. St4 started with 4 positive points (the maximum score any stakeholder could achieve) and lose points per other stakeholders below the maximum. St5 scores in an oppositive way to St4 (zero-sum game principles). The PS1 also revealed that the St5 must score the double to have equal chances to win the game.

From a thematic and metaphorical perspective, we adopted the following interpretations. Shop Owners (St1) desire to profit from the transport system passengers and access to parks and heritage sites. Environmentalists (St2) demand effective collective public transport to cross the city without constraints (horizontal and vertical connections from top to bottom and left to right of the game board). Local Residents/Habitants (St3) want schools near their homes. Elected Politicians (St4) start with public approval, wanting to please the stakeholders to continue their job. Alternatively, the Opposition Politicians (St5) might win the next election if stakeholders are not pleased. They are the only stakeholders that do not place new pieces on the map. Instead, they rely on political debates. They can call for voting to change a previously placed game piece. If they get the majority of the votes for stakeholders (1 to 3), St5 can change that piece.

Addressing the players' options and interactions for each role, the citizen stakeholders (St1, St2, and St3) can use/move pieces to increase their scoring and affect other stakeholders positively or negatively. St4 play differently. St4's available pieces (options) help the citizen stakeholders to score. When they reach the maximum score, St4 do not lose points. The success of St4 affects the St5 score. St5 only propose changing the previously placed pieces. Deliberately and despite the balancing requirements, the St4 role is easier/simpler to play than St5 because we decided to highlight the positive collaboration in political behaviour. These political dimensions emerge from the collaboration purposes of our serious game. The game intentionally promotes discussion of decision-making and its impact on the urban system. Players should recognize this during gameplay and endgame. If not, the facilitator must refer to this during debriefing as part of the serious game experience. Otherwise, the game fails to achieve its serious purposes.

6.4.3. Set up the game for the first session with players

After the first solo playtesting described previously, we completed the game board (grid map) to set the challenge equally for each stakeholder (all could win the game as in modern board games). We added black roads and set some existing land uses (one heritage site occupying two grid spaces, one school, one entire block of housing and another of commerce, and one mixed urban block with housing and commercial land uses). This setup provided equal distances for the scoring of the shop owners and local habitants stakeholders (Figure 6.8). We added additional text information and several crosses to mark the call for votes of the opposition stakeholders and marked with a dashed red line the game space player could interact (move the pieces from). This setup reinforced the metaphors and thematic representation of the game.

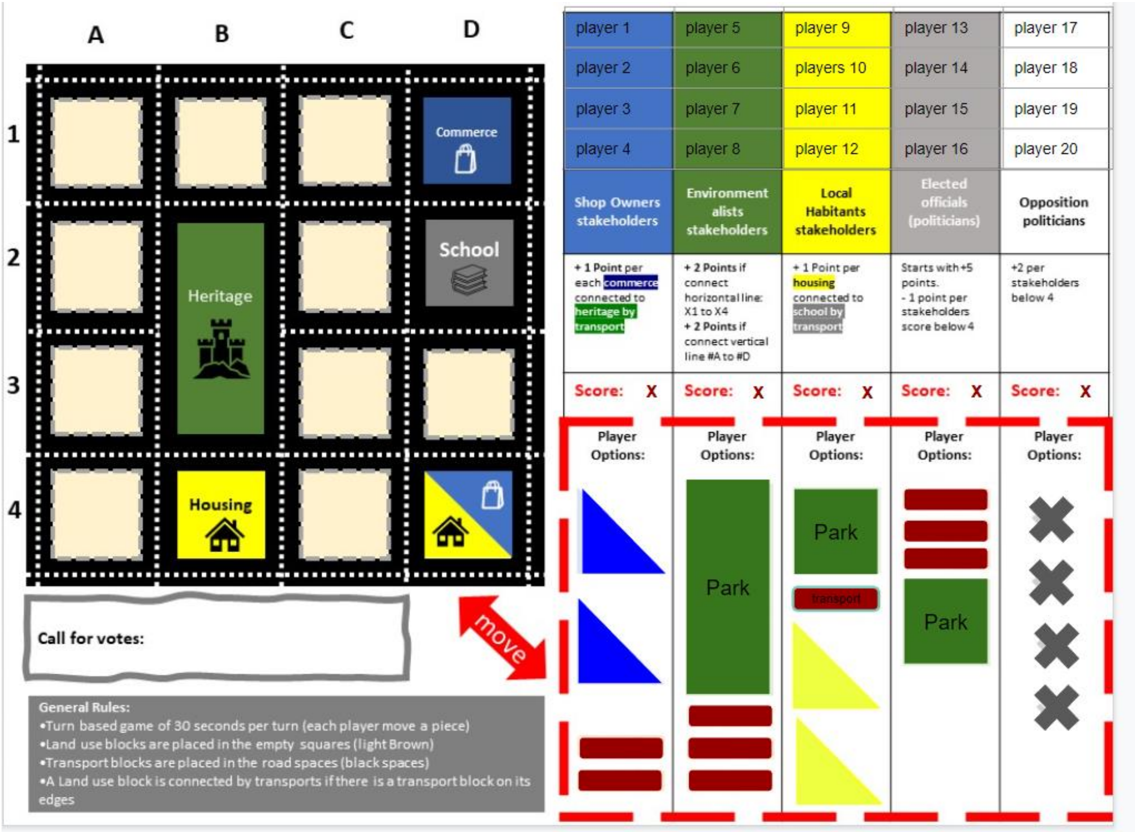


Figure 6.8 – Game set up for the PS2 with players.

6.5. Game playable interactions and results

6.5.1. The practical sessions implementation

The session with planning experts (S2) occurred during an academic spatial planning academic conference in 2021. The session with game designers (3) happened during a graduation class in game design (PS3) in the same year. The two sessions occurred in very different academic backgrounds. PS2 players (n_{ps2} = 9) were PhD candidates, researchers, and university professors working on spatial planning with no game design and/or serious game experience. PS3 background was different, played by graduation students (n_{ps3} = 14) that were studying game design and involved in game projects for entertainment (orthogames) and serious games (games for purposes). However, they were not experts in spatial planning like in PS2. PS2 tested was intended to test more the simulation side (the content of the serious game) and PS3 the playability and game engagement (decisions, interactions, and challenges of games). Both sessions had a similar duration of one hour. The facilitator used *Zoom* software to communicate with the players. *Google Slides* was the game platform where players moved the game pieces to change the game state over a predefined background (grid board and interface with available game pieces).

6.5.2. Comments and players' perceptions and game adaptation

Besides the game outputs, the pieces over the urban map and the scoring, the conversations and informal commentaries recorded during gameplay are relevant to examine the game experience in each game. Because the game comprised 20 moves, it was possible to classify collaborative behaviour per move. During both sessions' gameplay, more than 75% of the players asked other team members for suggestions before placing a piece. Simultaneously, more than 50% of other players tried to influence these moves, including players from the other teams (Table 6.1). In PS3, this tendency for player influence and interactions was higher.

Table 6.1 – Player collaboration behaviour during moves (decisions) of play.

Play Session	Collaboration with teammates	Trying to influence other teams
PS 2	15 moves (75%)	10 moves (50%)
PS 3	16 moves (80%)	12 moves (60%)

During PS2 commentaries, some players argued the game was easier for Elected Politicians (St4) because they only needed other stakeholders to score well. As expected, the effective placement of the transport tiles beneficiated the first three stakeholders. Achieving goals was easy for the three first stakeholders. During DS3 we introduced more pieces for each stakeholder, adding more options (higher player agency) and reducing the threshold for successful votes for Opposition Politicians (St5) (only one-third of approvals, not the majority). We added more pieces and park rectangles (occupying two continuous squares) that can block more road paths. The setup included a new school on the game board (initial setup). These previous changes obliged us to alter some of the scorings for other stakeholders. Elected politicians started with 6 points (St4), and Opposition Politicians (St5) scored 2 points per stakeholder below scores of 3 because playing this role was even more difficult than expected. We realized that players only understood the effects of the call for vote action (move previously placed pieces) in the final rounds of the game. This affected St5 score.

However, even during PS3, players stated that playing as Elected Politicians (St4) was still easier because it demanded straightforward decisions. Elected Politicians only needed to respond to the other stakeholders' claims without the same level of manipulation that Opposition Politicians (St5) were required to score well. During PS3, Opposition Politicians approved a voting call, which impacted Local Habitants'/Residents' scoring (see Figure 6.9). During PS2, the opposition vote call never passed (never approved by a majority of stakeholders 1 to 3). Regardless of this apparent failure, when the Opposition Politicians proposed voting for a change, the interactions changed (in both sessions). The discussions were much more vivid than in the turn of other players. The loss-aversion effects (Engelstein, 2020a) were notorious for players' behaviour because approving the proposal of the Opposition Politicians could make some stakeholders lose points.

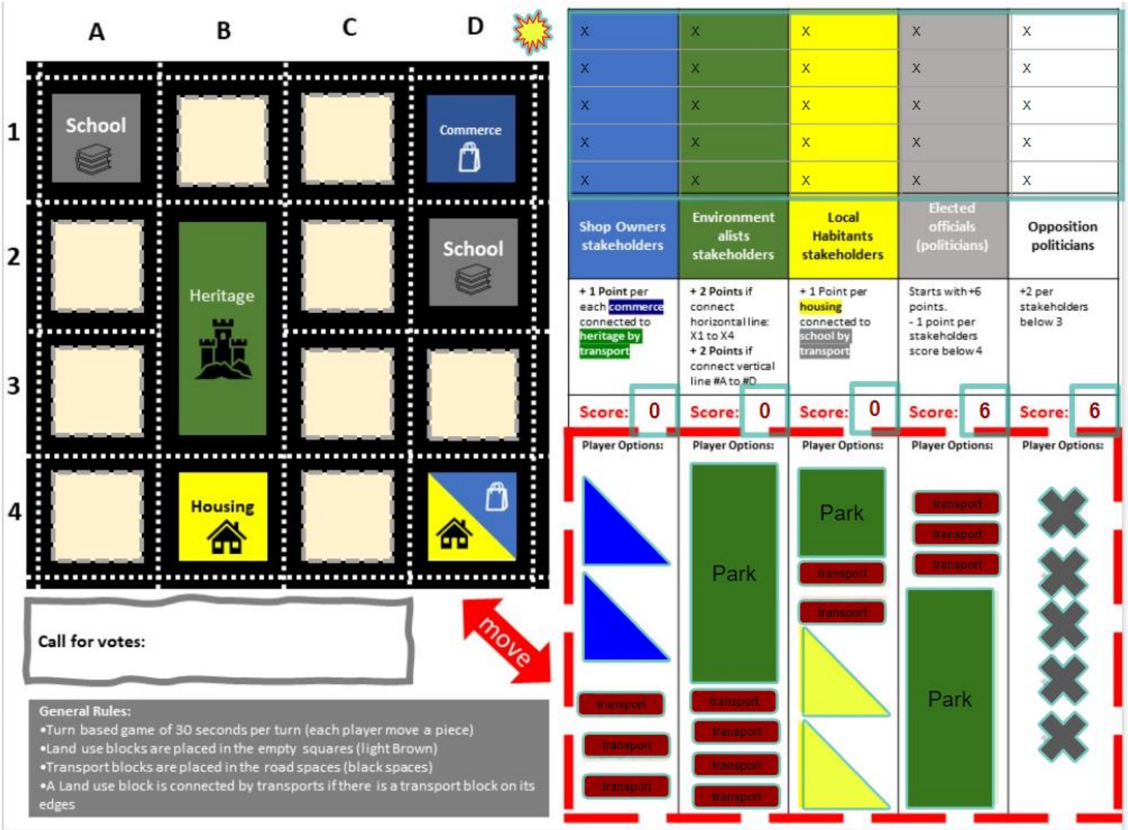
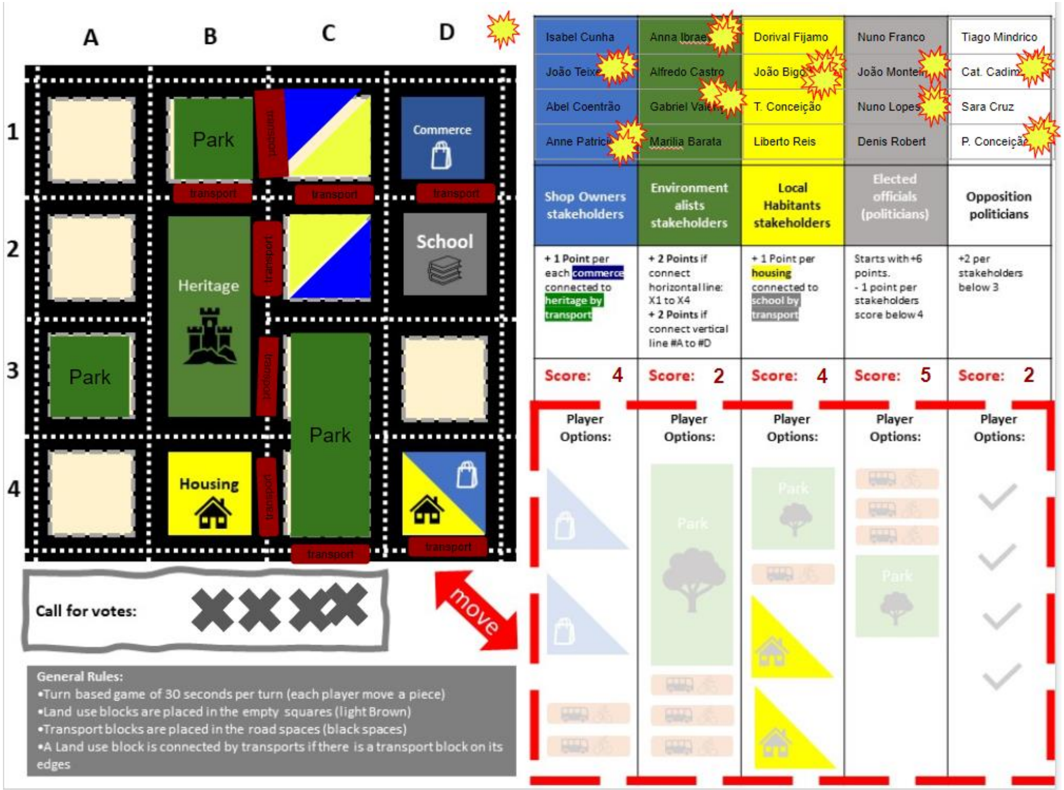


Figure 6.9 – Game set up for the seconds session with players (PS3)

As noticed in Figure 6.10, there is an explosion icon above the game board. This improvisation was necessary to signal each player's turn and those that had already played. Every time a player decided their move, the facilitator placed the explosion icon near that player's name in the stakeholder column. Another unpredictable occurrence was the Internet connection problems. Some players lost their connections or could not use *Google Slides* with their devices. To deal with this problem, teammates played assumed their moves. Although the players previously signed up for each session, fewer players attended than we were expecting. This limitation forced some players to play more turns (a total of 20 play moves, 4 per stakeholder), which tested the flexibility and adaptation of our game model.

6.5.3. Game results and perceptions

Considering that the PS2 and PS3 games were slightly different, comparing their results brings additional information (Figure 6.10 and 6.11). Besides the changes in the initial setup and the additional pieces for stakeholders to move, the results were different, mainly due to players' behaviour. We can see in Figures 6.10 and 6.11 the selected pieces and the places on the game board where players decided to put them. The explosion icons beside the players marks the moves. In the PS3 gameplay session, it is possible to see the options not taken by the players since they had more options than available plays.



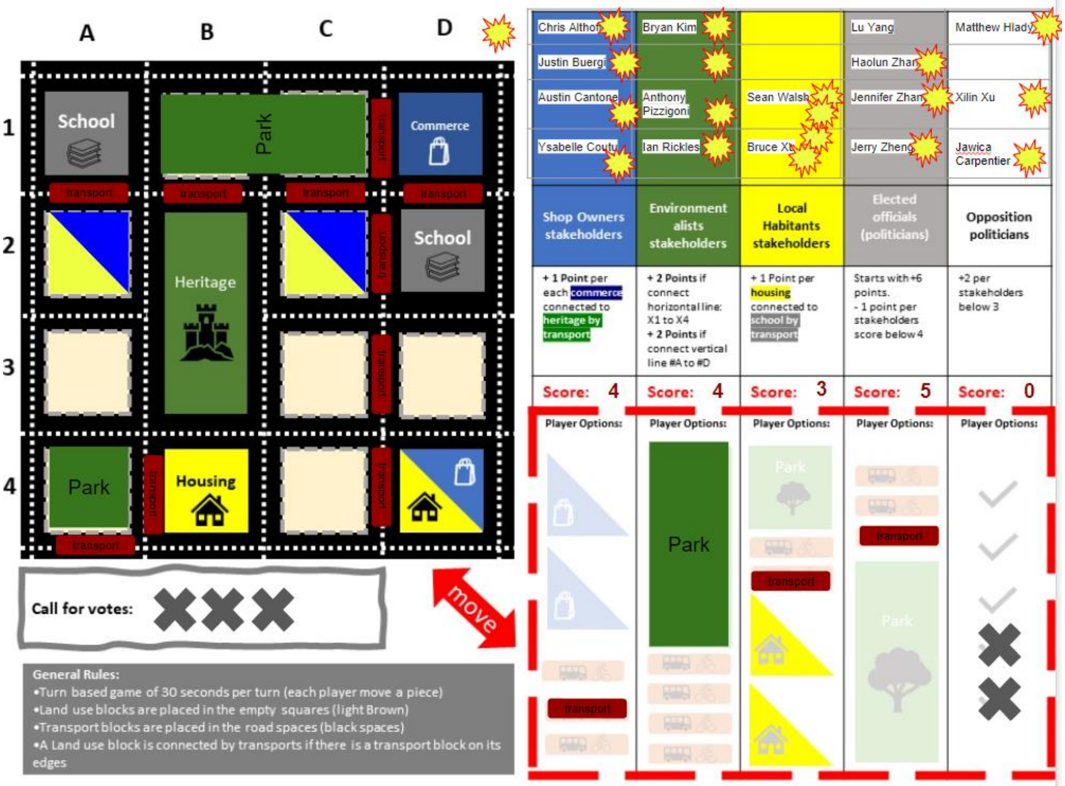


Figure 6.10 and 6.11 – Game results for PS 2 (top) and PS 3 (bottom).

Table 6.2 gathers groups of commentaries players made during gameplay and the final discussion. We grouped the comments by typology of issues, considering the commentary made by at least 50% of the participants, both orally and written in the chat. The list appearing in Table 6.2 is ordered by the number of statements and comments regarding the typologies of issues. Despite the evident subjectivity, this data helps frame the outcomes.

During gameplay, the game facilitator used the *Zoom* survey tool to get immediate feedback, according to a Likert scale from 1 to 7 (1 – low, 7 – high) about the following dimensions: "Classify the game fun/engagement"; "Classify the quality of the planning solution"; "Classify the simulation accuracy of the stakeholders' roles". We highlight the following data from Table 2 because it is coherent with the different participants' backgrounds in each session. S2 players considered the fun and engagement dimension higher ($\bar{x}$=5.88; σ=1.27) than S3 players ($\bar{x}$=4.67; σ=0.47). PS3 participants considered the game delivered a more coherent planning solution ($\bar{x}$=5.17; σ=1.07) than PS2 participants ($\bar{x}$=4.75; σ=1.39). And finally, PS3 players believed the game better simulated the stakeholder roles ($\bar{x}$=5.50; σ=1.00) that PS2 players ($\bar{x}$=4.67; σ=1.25).

Table 6.2 – Final players' perceptions about advantages and disadvantages recorded during gameplay sessions (# - number of comments; % - percentage).

PS/n	Advantages			Disadvantages		
	Typified Statements	#	%	Typified Statements	#	%
PS 2 n=9	•Collaboration and collective synergies.	9	100	•Prejudice and bias about game usage.	8	89
	•Interaction between citizens and/or practitioners.	9	100	•Difficult to implement in practice.	8	89
	• Learning about issues and claims	8	89	•Improper solutions and decisions.	6	67
	•Data collection and opinion assessment	6	67	•Oversimplification of reality and idealism.	6	67
	•Engagement that increases participation	6	67	•Engage all participants simultaneously	5	55
PS 3 n=14	•Collaboration and collective synergies.	14	100	•Balancing simulation and gaming.	10	71
	•Engagement that increases participation.	14	100	•Oversimplification of reality and idealism.	9	64
	•Simulation of the situation and feelings.	13	93	•Prejudice and bias about game usage	8	57
	•Explore different roles.	10	71	•Forcing to play when users do not like games	7	50
	• Imagination and informality	10	71	•Available resources	7	50

Participants in both sessions considered the game engaging and able to represent the decision-making dynamics that can happen during a stakeholders' participation process. They expressed this feeling during the final comments. However, participants pointed out that using these methods can have some disadvantages, like over-simplification and improper solutions or non-optimal decisions. From a design point of view and implementation, having the necessary resources and game design knowledge to balance the game can also be limiting.

Some game advantages were perceived similarly in both sessions, like the establishment of collaborative and interactive synergies between participants and the engagement that leads to growing participation. Other positive dimensions were noticed more by one group than the other. PS2 players underlined the effect on learning issues and understanding conflictual stakeholders' claims, data collection, and opinion assessments. Alternatively, PS3 players focused on the simulation of the situation and the playable experience (personal feelings).

The identified disadvantages were more heterogeneous and varied. Despite this, both groups stated that prejudice about using games for serious purposes and oversimplifications of the game-based models could jeopardize the process. PS3 players were more concerned about the game design challenges, like balancing contents and playability (balancing simulation and gaming), and the effects that available resources might not be enough to build the desired serious game. PS2 players were concerned about the applicability and quality of the outcomes.

6.6. Game results discussion

As expected, each group perceived the play session based on their backgrounds, knowledge, and previous experiences. PS2 players were planners that considered serious game approaches surprising and with the potential to use in practice but were concerned about the practical application and challenges of using games. PS2 players considered the game more engaging and less like a simulation. PS3 players were game design students, comfortable at playing, analysing, and designing games. Their perception of the playability potential was lower, even though they played a modified version that delivered a more playable approach (more options that could affect the game state and scores). However, the PS3 players considered that the game addressed the urban planning exercise (learning and decision-making) better than the PS2 players.

The experience results reinforce the challenges of developing a serious game concerning the balance between simulation and engagement (playability). As noticed, the perceptions depend on the users and their backgrounds. We believe that this dual effect (serious objectives and game playability) is not unsolvable. We can address this with flexible game design techniques like those proposed in the experimental process. Designing the solo/team prototype, testing it in practical sessions, and adapting it for the next session and its users makes the process flexible and applicable to many different realities. Sessions should include groups of users (players) focusing on the simulation ("serious" side) and others on playability (engagement and motivation).

Using board game mechanisms in digital platforms like *Google Slides* and other software that allows users to move objects in collaborative digital environments can deliver playable solutions. We argue that the proposed method can be replicated for spatial planning processes demanding low resources and development time. This option addresses the serious game challenges identified by Sousa et al. (2022b) for spatial planning if we acknowledge that games may demand high resources and a long time to develop.

We propose a method to replicate the TSC serious game for other spatial planning processes done online. This method is presented in Figure 6.12, consisting of a five-step sequence for a game of moving pieces over a map. In step 1, planners must decide what platform(s) they wish to use. Step 2 is the first game idea and playable model. Then, the game should be tested multiple times with different users. For the first game model, it is necessary to define the map (game board), the rules and mechanisms of the game, what players can move (options) and the scoring to determine the results. The following steps identify the playtesting and the adaptations to fit the serious game goals and the playability to engage users (players).

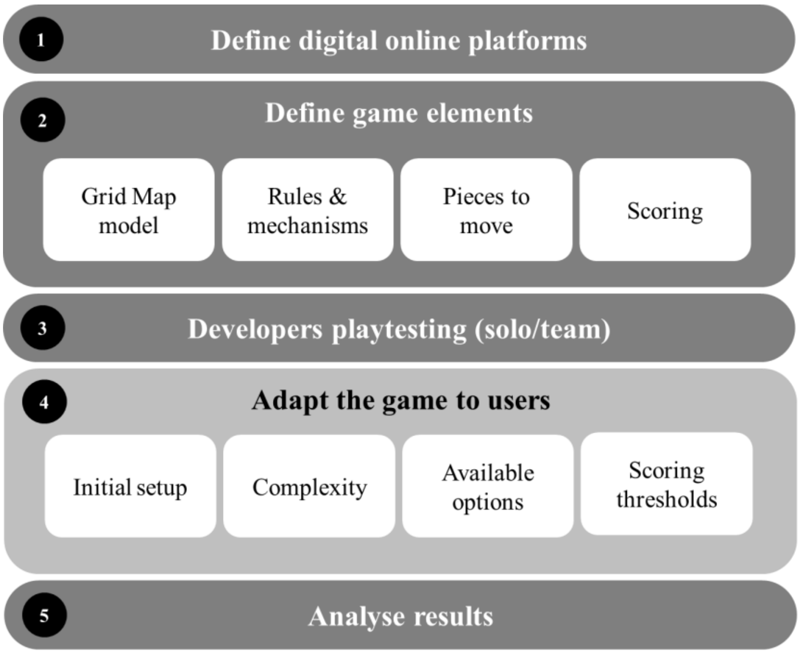


Figure 6.12 – Method to develop serious planning games (of moving pieces) in digital platforms.

Our proposal is bounded to board game mechanisms and based on moving objects like geometric pieces that represent different elements of an urban system. In step 2, game developers define the grid map to model the urban environment at stake. After having the game board (grid map), the time comes to set the general game rules and the game mechanisms that players will use to move objects and define scoring. The number of stakeholders is part of the rules, affecting the mechanisms and objective (scoring thresholds) definition. Finding adequate game mechanisms can be an iterative process of trial and error (Sousa, 2022c; Sousa et al., 2022b). However, game mechanism encyclopedias can help (Engelstein & Shalev, 2019; Sousa et al., 2021b). Finishing step 2 generates the first game model for solo/team playtesting (step 3), desirably including game design experts and planning professionals. Step 4 defines the subsequent game testing, where planners must adapt the game to users, tweaking the game and making the necessary adaptations to fit players' backgrounds. Players may demand the game developers change the complexity of the rules, the number of options, and the scoring thresholds. Available time and resources to implement the game might affect the changes also. Defining the initial setup has an impact, influencing all the previous game dimensions. Step 5 is when the final game analysis occurs. Planners can use several metrics to verify the serious game impact and complement the evaluation of the previous iterative development process (Silva et al., 2019). We can follow Meyer et al. (2014) framework as an example, evaluating the engagement elements and serious game outcomes (before, during and after playing the game) as in any serious game.

Also important is to state that serious game developers' ideas and ideological biases might affect the game product, the playable experience, and the purposes of playing a game. This consciousness is relevant to address during debriefing since neutrality in a political simulation like the one simulated in the TSC game is complex. During the play sessions, this was approached during debriefing, challenging the players to debate the stakeholders' options and scores defined in the game. In the case study, the stakeholders' scoring and, specifically, the relationship between elected and opposition politicians were not neutral representations. Playing the different roles provided different experiences to players.

6.7. Conclusions

Serious games are growing in popularity among urban and spatial planners. However, there are several difficulties in implementing these methods in practice. Planners can use analogue or digital game solutions, both with advantages and disadvantages. Analogue ones can be cheaper and faster to implement, fostering unique collaborative and tangible experiences. Digital ones might be expensive but enable the participation of a larger quantity of participants, distant from each other, which was very important during the Covid-19 Pandemic.

We proposed a method based on *The Stakeholders Clash* (TSC) game that planners can use in practice, requiring low resources and allowing fast adaptation, even in real-time situations. The proposal replicates analogue game design to be played over digital platforms, opening new ways to profit from hybrid platforms. The principles of moving objects into maps and change planning solutions are simple enough, yet able to simulate complex spatial realities, decisions, and interactions. Our experience revealed that users' backgrounds and experiences affect their perceptions of a serious game. The test groups have shown that experts in the simulation (planners) value more practical uses of serious games. On the other hand, game experts are more concerned with the playability of the product. This duality is the perfect metaphor that serious game projects must fulfil, a balance between these two dimensions.

7. A PLANNING GAME OVER A MAP: PLAYING CARDS AND MOVING BITS TO COLLABORATIVELY PLAN A CITY[16]

7.1. Introduction

Creating a game is not an easy process. Developing a serious game to apply for education purposes or to be used as a support for participative and collaborative planning processes, where budget, time constraints, or even expert skills are lacking (Ampatzidou et al., 2018), can be even harder (Crookall, 2010). The collaborative planning approach in the spatial planning field of research aims to include as many stakeholders as possible in the processes to deliver better plans, suited to individual and community needs (Healey, 1997). A long debate opposing the rational systemic planning to the collaborative planning seems to be fading as the main authors try to establish some bridges between them (Innes & Booher, 2018).

This research intents to contribute to developing new game approaches, addressing this tendency of integration between the rational systemic approaches and the collaborative planning ones. This was done through the usage of analogue tabletop/board games, tested during a practical lecture with civil engineering students, at the class of regional and urban planning. The game exercise consisted of two different games that happened in a sequence over the same map of the city. The two games had very different components and game mechanics but formed a logical sequence, although they were played over the same map.

The first game was designed to establish some common knowledge and communication among players, essential to the start of a collaborative process (Healey, 1997). The second game implemented a concrete planning process, based in a game model, where players could manipulate the urban environment.

The main objective of this experiment was to provide an example of a prototype inspired in commonly known modern board game mechanics, that can serve as practical implementation for daily usage. Planning students, teachers, and practitioners following this approach, supported by the Design Play and Experience (Winn, 2009), should be able to use games inspired in these methods for their public participation and collaboration processes.

Analog games were tested in this session because they are easier to construct and adapt, while naturally fostering collaboration among users (Rogerson et al., 2018; Rogerson & Gibbs, 2018; Xu et al., 2011; Zagal et al., 2006). These games can fill the gap identified by Ampatzidou et al.

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[16] This chapter, with slight adaptations, corresponds to the article: Sousa, M. (2020). A planning game over a map: playing cards and moving bits to collaboratively plan a city. *Frontiers in Computer Science*, 2, 37.

(2018), where planning practitioners recognize the potential of games but say that they do not have the resources and knowledge to use them in their daily work.

7.2. Methodology

The practical direct objective of the testing session was to create a flexible and simple game dynamic to apply in a class with a duration of 2 hours. The game dynamic considered the importance of the game mechanics (Järvinen, 2008; Sicart, 2008) in an approach related to the Design, Play, Experience model (DPE) used for serious games processes (Winn, 2009), where the game designer creates a playful dynamic system to generate experiences, through the use of game mechanics, considered more broadly. In this game experience there was the need to do some adaptations, relating to the analogue nature of the game and to the need to include a facilitator.

Although the potential of game mechanics is known for serious games (Dörner et al., 2016; Michael and Cheng, 2006), the specific game mechanics present in modern board game are not yet fully explored and established in the literature as the recent work from Engelstein & Shalev (2019) shows. The innovations of modern board games, mostly eurogames, and their main game mechanics typologies and distinctive gameplay (Woods, 2012) are yet to be explored for practical usages in academic literature (Sousa & Bernardo, 2019).

The inspiration to conduct this new game approach of planning game over a map departed from the City Game experience, firstly developed by Portugali and Tan (2012), following the complexity theory, where individual agents could collaboratively plan with minimal rules a coherent urban design. This game approach was tested during the 18th meeting of AESOP: Games for cities, also employing some notions of money management to create restrictions and forcing players to collaborate by joining their budget to build the desired projects.

To go deeper into the simulation dimension, game design elements from modern board games were used, allowing to build the game approach dynamic over a satellite map retrieved from Google Maps (www.google.pt/maps), with the scale of 1:2.000. The game *Spyfall* helped to build a common understanding of the urban territory, in this case, the city of Leiria in Portugal. Then, after this first game, a new game, developed especially for this session, was played over the same map. This second game was inspired by the game mechanics of *Town Center* (Viard, 2012) and *City Game* (Portugali & Tan, 2012). This last game pretended to establish a collaborative game approach to plan land-uses, transport infrastructures, and the economic balance between public services, employment, housing, commercial activities, and the reduction of pollution and social negative impacts from land-use interactions in the city. The usage of a printed Google map allows the adaptation of the game approach to any given territory.

Before the experiment, a pre-test inquiry was given to the players, documenting the participants' previous experience with games, serious games, and board games in general. After the game dynamic, including the debriefing, another inquiry was filled by players to document the final game experience. The data gathered in the inquiries followed the Mayer et al. (2014) framework, mostly addressing the experience during gameplay, the complexity of the game, game flow, immersion, fun, and satisfaction with the learning, and simulation process. The data collection intended to understand the previous experience of players with games and their reaction to the game dynamic of the play dimension of the DPE framework (Winn, 2009), as it was considered in the prototype testing (see Figure 7.1). The debriefing process followed Ledermen's (1992) prescriptions, with a facilitator making an overview of the gameplay and fostering players' self-analysis and collective understanding of the game experiments.

7.3. The Rationality Through Collaboration in Planning

From a rational systemic traditional point of view in planning, planners should deliver planning solutions based on mathematical modelling and previsions about housing, transportation, facilities, and other needs for collective land usages (Taylor, 1998). With these given options politicians should decide, according to what they believe is the public interest. As the democracies strengthen and tended to be more participative models the lack of shared decision making, including citizens and stakeholders, became unacceptable (Innes & Booher, 2018). The rational approach seems to be incapable of addressing the complexities of contemporary societies, where undifferenced solutions failed to address properly people's needs (Healey, 1997). The way to solve problems of coexistence in today's multicultural societies, globalized and with free active citizens, appears to be through direct broad participation and co-creation. Nonetheless, the rational systematic approach is still essential to provide information and make plans coherent (Allmendinger, 2017), even in collaborative approaches.

Several movements, providing alternatives to more participative and collaborative solutions in planning, emerged mostly since the 1980s (Margerum, 2002). Four main influences can be identified:

- The rational communication premises from Habermas (1985), considering that the individual demands could be rational if communicated with equality, truth and based on facts and information;
- The network society effect in the age of information, that allows citizens to live in parallel societies outside the territorial restrictions (Castells, 2011);
- Structuralism according to Giddens (1984), departing from the notion that agents are influenced by the structures and can influence the structures at some degree;
- Theory of complexity, following Portugali (2016) approaches of complex systems where conscious agents plan while participating in incomprehensible and complex collective planning dynamics of higher scales.

These influences inspired many different approaches and testing of new methods. The most common is the collaborative planning processes where planners act as facilitators, engaging with citizens and stakeholders, and providing arenas for free discussion and co-creation, supported by technical knowledge and following some established rules, guidelines, and theoretical influences, as previously quoted. However, the rational systemic approach was not compatible with these dynamics based on focus groups, non-linear processes, and other similar methodologies.

Ines and Booer (1999b) assumed that role-playing games could be a solution to create engaging methods for generating discussion related to the planning topics of a concrete planning problem. Tan (2016) started role-playing in the “*generative city game*” experiments, concluding that the games required more elements to reach systemic simulation. Resources, real restrictions, and visual modelling helped to understand the planning problems and provided more coherent plans through the game planning approach.

Departing from this acknowledges an alternative approach, following modern board game design elements, was tested through a sequence of two games. The first game had minor adaptations to generate the common ground for players, allowing them to know the territory and themselves first. The second game, inspired in the cube placement mechanics, created a strategic and fully collaborative simple planning process, generating an urban solution. The game elements of design and their playable dimensions and experience generation are expressed in Figure 7.1.

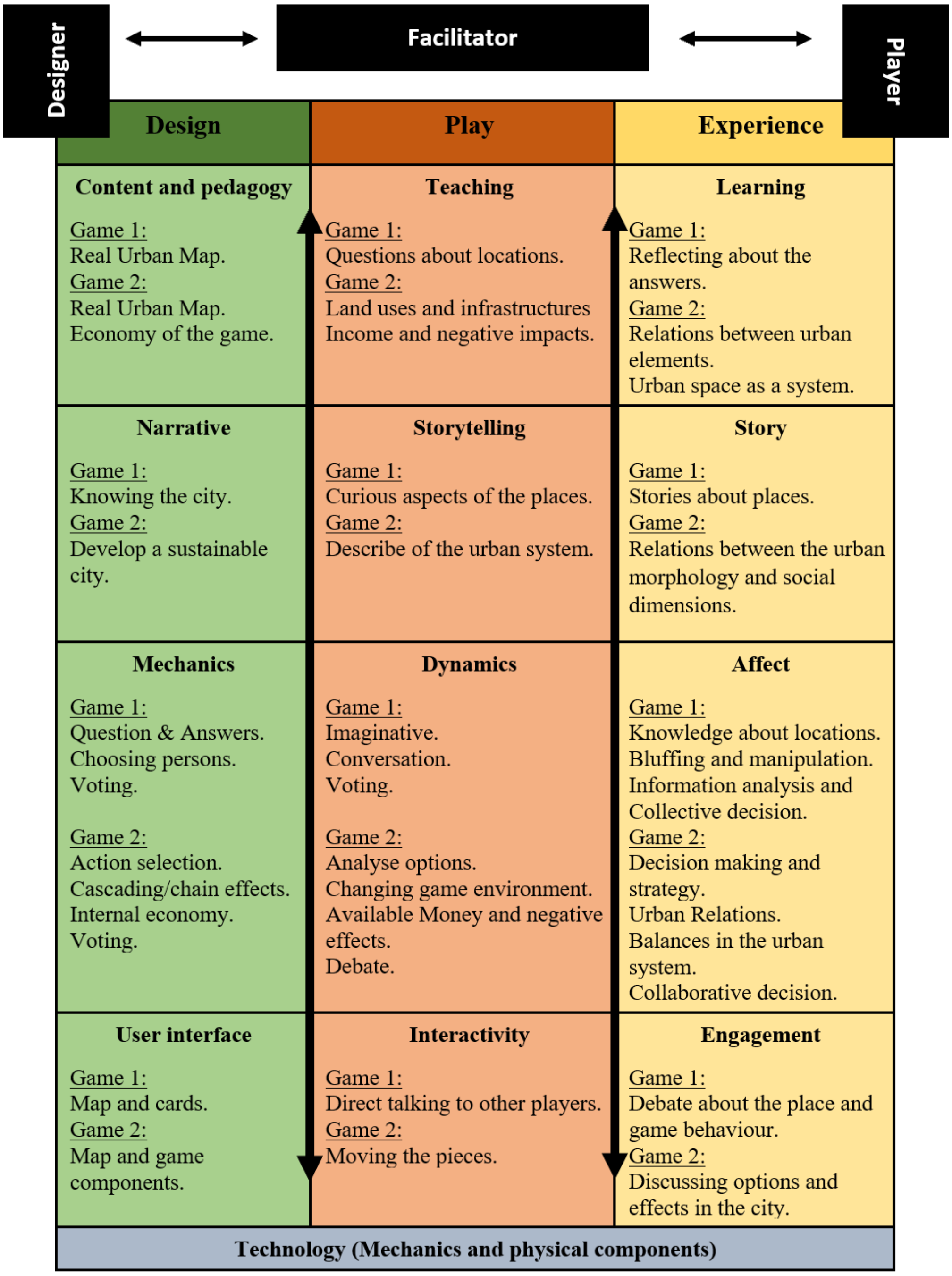

Figure 7.1 – DPE framework adapted to the serious game process of analogue games.

7.4. Modern Board Games

Board game design continued to evolve somehow in the shadow of digital games over the last years. However, some authors consider that we are living in a golden age of board game culture and industry (Arnaudo, 2018; Booth, 2015). Although this is highly questionable, the proliferation of new games and gaming communities all over the world is a fact, related to hobby board game design trends, known as modern board games (Sousa & Bernardo, 2019).

Since the 1980s the board games created and played mainly in Germany defined a new type of product, the eurogames (Woods, 2012. These games updated the design standards in a way that

influenced worldwide game production since the start of the 21st century (Donovan, 2017). Departing from the *Eurogame* board game designs unique elements, new board games, done professionally and innovatively, are influenced by them, also supporting new solutions for serious game purposes. Eurogames provide balanced games that can engage adults, with innovative and elegant game mechanics, low luck dependence, controlled gameplay duration, and, in summary, game systems that can provide medium-weight complexity models to simulate reality (Woods, 2012). Considering these characteristics, adding to the knowledge that board games provide intrinsic collaborative forms of play (Zagal et al., 2006), that the materiality of the game systems provides multiple forms of fun and helps the learning process (Xu et al., 2011), and playing a board game is a voluntary act of collective learning, a new game solution was tested in a lecture of regional and urban planning. As Parlett (2018) referred, the new games transferred the game dynamics from the board to the players, which suits collaborative planning approaches.
The elegance of the eurogames mechanics, able to simulate realities while maintaining a playful and engaging dynamic, with simplicity and reduced gameplays (Woods, 2012) will be tested in the explored prototype. The exploration of these design features is not yet been fully explored in gaming and serious games literature (Sousa & Bernardo, 2019).

7.5. Modern Developing the Game Approach Experience

Castronova and Knowles (2015) argue that creating a new game is difficult, being easier to use and adapt existing commercial games to generate serious games solutions. Following this suggestion, some well-known board games were tested and adapted to create a planning experiment. Considering also that any game can be adapted to be a serious game (Dörner et al., 2016), the selected games were modified to simulate a small urban planning process. Taking into account that a serious game is a game used to deliver other objectives besides fun (Michael & Chen, 2006, Winn, 2009) while maintaining the fun of it, the proposed game approach was constructed to help students of the civil engineering graduate, from the Polytechnic of Leiria, to understand the collaborative planning approach, and how it could be implemented through games. To achieve this, two commercial board games were adapted to create the game solution learning tool, also considering the City Game (Portugali & Tan, 2012) tests.
In a serious game approach, the balance between simulation and playfulness is difficult to achieve, which reinforces the need to profit from modern board game established designs, mostly from eurogames. Departing from well-tested games this experiment intended to offer an example for planning practitioners, showing how they can reduce the complexity of developing from scratch new game approaches. It is a pragmatic way to respond to the lack of simple and ready to use game tools for planning (Ampatzidou et al., 2018).
The game experiment had a total duration of two hours. Initially, for 40 minutes the students played an adapted version of *Spyfall* over Leiria city map, using *post-its* to signal the names of the location. Like in the original game, players received random sets of cards that determined their

roles. The first game was played in a competitive way, although played in teams. Instead of the illustrated original cards, the locations and cards were marked with numbers (see Figure 7.2).

Figure 7.2 – Gameplay of the first game (Source: author).

The second game consisted of a city building game with cubes, cardboard, and rope. The game mechanics were inspired in *Town Center*. However, many modifications were done to simulate different land usages, facilities, green parks, public transport lines, economy, and pollution. This game was fully cooperative (see Figure 7.3, Figure 7.4, and Figure 7.5).

Figure 7.3 – Gameplay of the second game (Source: author).

Figure 7.4 – Final visual result from the second game (Source: author).

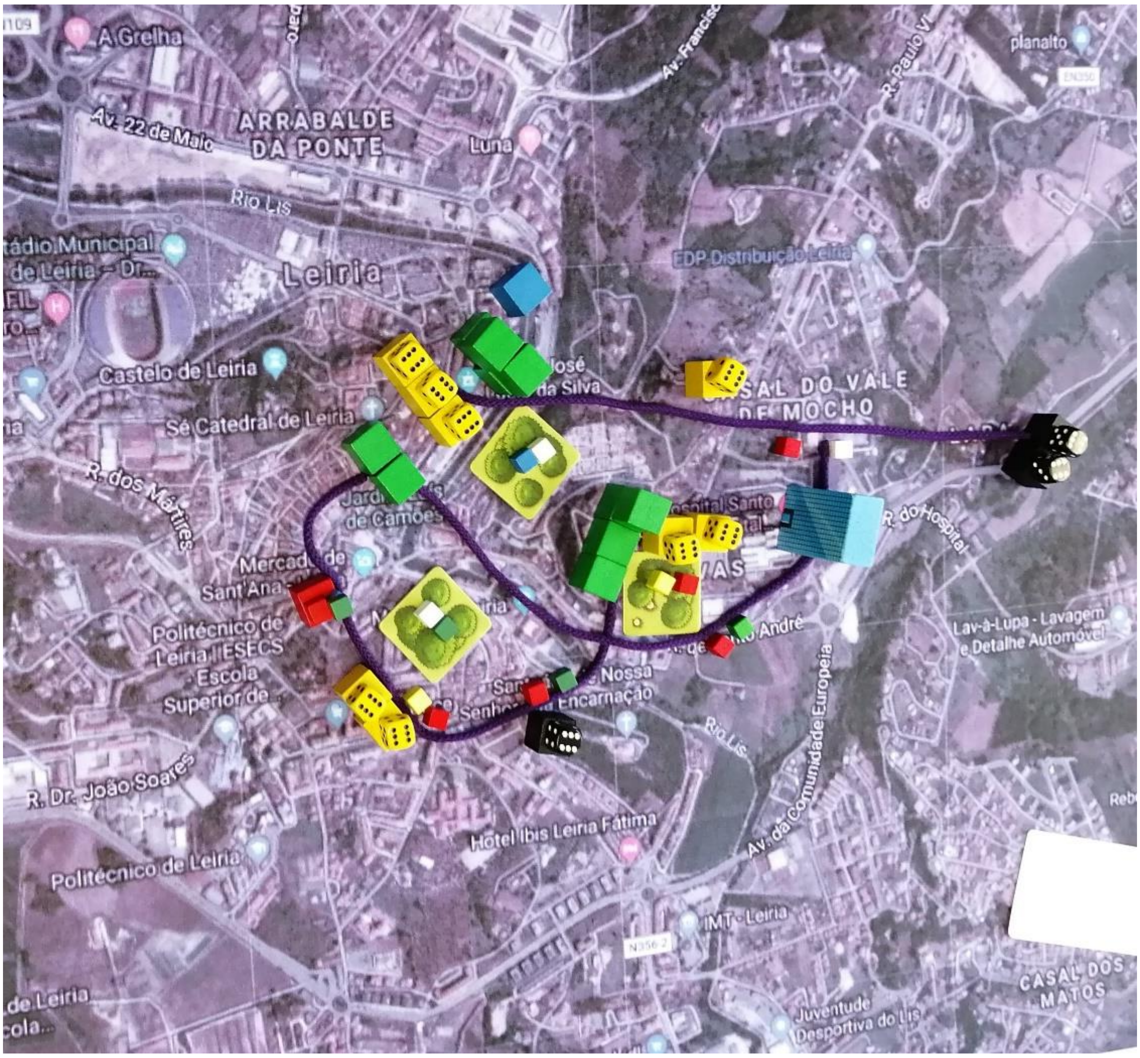

Figure 7.5 – Final visual result from the second game (Source: author).

The experiment ended with a debriefing process (Lederman, 1992) regarding the planning results, discussing the model created collaboratively by the students during the gameplay, starting from a general overview conducted by the facilitator, continuing to the self-evaluation of each player actions in the game and their consequences, ending in a collaborative conclusion about the game learning outputs. This was done by the game creator that acted as a facilitator during the entire session, helping to understand the rules and taking note to address in the debriefing process. This final step is of great importance, because, as Crookall (2010) mentions, the debriefing can be more important than the game itself to establish a serious game.

The games sought to address a real case study and not only an abstract urban landscape. The game design elements from modern board games provided the components and mechanics to establish the game system. The final model, constructed during the second game, should provide a clear understanding of the players' decisions and their interactive effect. But the real board was missing. The solution rested in using a printed plant from *Google Maps* with an approximate scale of 1:2.000 to serve as the game common board. This enabled the simulation of the land use typologies for the city of Leiria, which was the real city to address in the lecture. This scale allowed the use coloured of cubes with approximately 1.5 cm per edge, which is a component from *Town Center* and fitted the natural block scale of the morphology of the city. It also permitted to stick small post-its (1cm x 4cm) to write the names of the places for the first game, related to *Spyfall* (Ushan, 2014).

7.6. Games that inspired the approach

The game session was divided into two separate games but connected by the main objectives, regarding how to develop collaborative approaches and develop a simple sustainable urban model through games. The two games were inspired by several other games, by their mechanics to activate the game system and their consequent dynamics and experiences, related to the land knowledge and to the possibility to build a simple interactive city model. Physical components from several other games were also used to express a meaningful relation to the reality they intend to represent to players during the game state.

The *City Game* (Portugali & Tan, 2012) inspired the second game, mostly the freedom to play any game component, in turn-based game sequences where blocking was not allowed. The *City* Game version tested during the *18th meeting of AESOP*, developed by Sara Encarnação and her team from the Nova University of Lisbon, was vital for the definition of the actions table (see Table 7.1).

Table 7.1 – Available actions to players during the second game.

Actions	Cost to build (money units)	Profit generation (money units)	Pollution/social negative impacts	Available quantity
Housing unit (large green cube)	0	0	+1	24
Commercial/light industry/services unit (large yellow cube)	0	+1 x Surround housing unit	+1	8
Heavy Industry unit (large black cube)	0	+3 + 1 x Surrounding commercial unit	3 + 1 x Surrounding unit	4
Green Park unit (cardboard tile)	-4	0	-2	4
Police/Fire department unit (large red cube)	-10	0	-3	2
School unit (large blue cube)	-20	0	-4	2
Hospital unit (*Suburbia* player markers)	-30	0	-6	1
Public transport line unit	-5	0	-2	4

Spyfall consists of a party game of bluffing and deceiving where roles are randomly determined in each play. In a game of *Spyfall*, there are two teams competing: the spy that needs to guess the correct location; and the team of the remaining players that know what role they have but ignore the roles of all the other players. The accusing of the spy occurs through voting. The roles are determined by the cards that must be secret, except to the owner. The locations are represented in a large compositive map in the centre of the table with the same images appearing in the cards of the player's roles, apart from the spy. The adaptation to the serious game experience consisted in using the *Google Map* of the city of Leiria, firstly allowing the players to choose 12 locations, identifying them with numbers and names marked in *post-its* over the map. The numbers in the map matched the cards, staked in small decks. This adaptation maintained the essence of the original game and the fun of it while players created common knowledge about the city. The objectives of identifying the spy and the correct location in the city, only in 5 minutes, was done through direct "yes" or "no" questions about each place. To accuse a player of being the spy a vote needed to be approved by the majority. This created a brief deliberation process. The game used the question mechanics in a deterministic way to generate information players can work with. The absence of random effects in the question mechanic is influenced by *Eurogame* deterministic designs.

The influence of *Town Center* in the second game was less than the one from *Spyfall* for the first game, although the game mechanic of piling and automatically generating effects from the proximity of neighbour cubes and components was important. This allowed the production of an organic growing simulation model. The big cubes used to simulate land use and facilities came originally from Town Centre game, except for the hospital and parks. The main mechanic brought from modern board game was the cube placement and the cascading automatic effects in the economy of the game (Engelstein & Shalev, 2019).

The game components of the first game were all handmade. To create the second game more components were needed. The strings came from *String Railways* (Hayashi, 2009), the small cubes from *Rajas of the Ganges* (Brand & Brand, 2017), the dices from *Panamax* (D'Orey et al., 2014), the green parks from *Agricola Farmers of the Moor* (Rosenberg, 2009), and the hospital from *Suburbia* (Alspach, 2012) first player marker. The coins to simulate the money came from *Villagers* (Gaarder, 2019).

7.7. Generating the City Model to plan the city through collaboration

The first game was already explained, being very close to the original game of *Spyfall*, but the second part was very different. This second game, inspired by the *City Game* and *Town Center*, was played also over the google satellite map of Leiria (scale of 1:2.000), having only this component in common with the first one. Players started with 3 money units and played in a sequence of turns, forced to pick a game component that simulated land use license in the city, a public facility, a green park, or public transport line to put in the map. Some of these options had monetary costs, others generated revenue to the city common budget as some pollution/social negative impacts (see Table 7.1).

As can be observed in Table 1 there is a lot of simplification in the costs and the effects. The game should be simple so it can be played almost instantaneously. This was only possible because the facilitator continuously explained the game during the session, clarifying the options and consequences to players.

The values in Table 7.1 were obtained through a spreadsheet, balancing the positive and negative inputs and outputs. In this way the sustainable growth could be achieved, but only if the players balanced their actions, generating money, and choosing actions to reduce the negative effects as soon as they had the required money. Players could not pass, because they were forced always to choose something to build. The free actions generated negative impacts and the ones able to reduce these impacts were expensive, only activating their benefits for the surrounding areas. This city building game exercise was done through collaboration, generating discussion, and debate in each individual decision. When players proposed to use the common city budget to place an expensive facility a vote was called. The players only had 3 personal money units which were not enough to build any of the actions that reduced the negative impacts, essential to achieve the game objectives. To build them they needed to use the common city budget. The inspiration to this limitation came from the *City Game* tested during the 18th meeting of AESOP, and the transposition of the economic systems from *Eurogame* mechanics (Woods, 2009) transposed to a spreadsheet.

The pollution and social negative impacts were represented by small cubes, disposed near the building that generated them. Coloured dices marked the profit from commercial/services and industry cubes, being limited to 6 for each one. This limit established the balance of the game system, determining available components and options to achieve a sustainable city. In this manner growing the city should be possible, while also controlling the pilling of the negative cubes throughout gameplay in a clear and representative way. The negative cubes, when absorbed by the positive effects of the facilities, parks, and public transport lines, were placed in the top of those components to represent that they had exhausted their positive capacity of absorption. The public transport lines made any buildings near and along them to be considered as adjacent.

The game session, considering the two games, is expressed in Figure 7.1, according to the adaptation of the DPE framework (Winn, 2012) to an analogue serious game. In this adaptation, developed by the author of this experiment, there was the need to add the facilitator role, since analogue serious games have the need to be explained to players and to conduct the debriefing part of the experiment. The technology, in this case, is the mechanics and game components. The DPE adaptation was organized considering the two games in each of the flows:

- learning (content and pedagogy, teaching, and learning).
- storytelling (Narrative, storytelling, and story).
- gameplay (mechanics, dynamics, and affects).
- user experience (user interface, interactivity, and Engagement).

From these flows, in a summarized way, the design intended to generate a play experience where players could learn more about the urban space (first game) and act over it by changing the urban system in a collaborative way to achieve sustainability (second game). The facilitator acted as a mediator between the designer and player, being present during play to observe the experiences. This knowledge plays a major role to support the debriefing process.

7.8. Data collection

The quantitative direct data collection was gathered with inquiries before and after the games. The observation was done by the facilitator and recorded in a small report during gameplay, which was useful to the debriefing process.

Six students participated in the whole gaming session (*n*=6). The inquiries had "yes/no" questions, and a five-point Likert scale to measure preferences and perceptions from players (Appendix C). In Table 2 the game preferences from players are shown, highlighting the strongest preference for digital games and a massive appreciation of sports. Although a small number of players participated in the experiment, modern board games are usually played from 2 to 6 players (Rogerson & Gibbs, 2018; Woods, 2012). This type of small groups is common in focus groups and other group working and collaboration technique (Bishop, 2015).

Table 7.2 – Gaming preferences from players.

Player's Game preferences (classification from 1 to 5)	Do not like (1)	Avoid play (2)	May play (3)	Like to play (4)	Like to play a lot (5)
Analog games	0	0	1	4	1
Sports	0	0	1	1	4
Digital games	0	0	1	3	2
Traditional games	0	0	3	3	0

Only one student answered saying that he never participated in a learning or training session with games. Half of the students ignored the existence of modern board games, but they admitted playing games at least once per week. One player admitted playing every day and one several times per day. Just one of the students said to play once per month. We can say the students were interested in games and played regularly.

Table 7.3 reveals the low levels of anxiety and frustration, the high levels of immersion, motivation, and fun felt during gameplay. Students also highlighted their ability to be flexible and adapt themselves to the game and other players' interactions, considering also that the level of challenge was recorded as high, although the difficulty was average. The observation from the facilitator corroborates these perceptions.

Table 7.3 – Experiences and perceptions during gameplay of the gaming session**.**

Experiences and perceptions during gameplay (classification from 1 to 5)	**nothing (1)**	**A bit (2)**	**Moderately (3)**	**A lot (4)**	**Totally (5)**
Fun	0	0	0	2	4
Difficulty	0	1	3	1	1
Immersion	0	0	0	3	3
Challenge	0	0	2	1	3
Anxiety	1	3	2	0	0
Adaptation ability	0	0	1	4	1
Surprise	0	0	2	2	2
Empathy among players	0	0	0	3	3
Frustration	3	3	0	0	0
Motivation	0	0	1	2	3

Concerning the serious game effects, players considered the experience to be positive, referring to the seriousness of game applications, skill and knowledge testing, surprise, and fun side of the games played. Only when asked if analogue games could perform better than digital games as experiences and simulations the answers revealed values apart from 4 ("a lot") to 5 ("totally/always"), although 4 of the students considered that an analogue game could be totally/always better than digital games to fulfil the objective of implementing a collaborative planning playable process. This may be surprising but can be biased since the students answered just after playing analogue games. All this data is available in Table 7.4.

Table 7.4 – Questions about the serious game dimensions of the tested games.

Questions about the seriousness of the games and future applications (classification 1 to 5)	Nothing/ No (1)	A bit (2)	Moderately (3)	A lot (4)	Totally/ always (5)
It was possible to test skill and knowledge in the game?	0	0	0	3	3
Games could be applied to other contexts and cases?	0	0	0	2	4
Games fulfilled the serious objectives?	0	0	0	3	3
Would you play these games just for fun?	0	0	0	2	4
Were you surprised with the game approach?	0	0	0	2	4
Analog games can provide better experiences and simulations solutions than digital games?	0	0	1	1	4

The inquiries before and after the games had one recurrent question: "how would you classify the learning and simulation potential of games?". The results are exposed in Table 7.4. Four players improved the perception of the maximum classification for the potential of serious uses of games for learning and training.

7.9. Results discussion

7.9.1. Board Game Results

The first game established the communication and required empathy that helped players passing to the negotiation and co-creating of the second game, although it was a competitive game played in teams, spy versus all other players (see Figure 7.2). Players wanted to play more; however, the second game needed more time and only 2 hours were available.

Players cooperatively played the second game (see Figure 7.3). Each player received 3 money units and Table 7.1 was visible to all players during gameplay. The individual turns happened in clockwise sequence, without the possibility to pass, because the city should continue to grow. This rule intended to address the thematic objective of sustainable urban growth. The map served as guidance, but it was not mandatory to follow the road systems, although the river and hills should be considered. Nevertheless, players felt influenced by the represented morphologies.

The 6 players played a total of 30 turns, each one 5 turns. They used in the game (see Figure 4):

- 10 housing cubes (green).
- 8 commercial/services cubes (yellow).
- 3 industries (black).
- 3 green parks (green token).
- 1 school (blue cube).
- 1 police office (red cube).
- 1 hospital (tall blue building).
- 3 public transport lines.

These options resulted in an income to the city budget of 75 money units, considering the contribution from the commercial/services and industry cubes, all taken to the maximum revenue capacity, represented by the 6 face value dice at the top of each cube (see Figure 7.4). Each time a player proposed to use the common city budget a vote should be called. Only one time the voting was negative because players discussed previously each voting. All the used buildings that reduced pollution and negative social impacts cost 87 money units in total. Although the player's decisions produced only 76 revenue, they used their personal money to help build those facilities. In the end, only 2 players remained with some personal money, one player with 1 money unit and another with 2. The city budget had 3 money units remaining. However, at the end of the game, 2 cubes representing pollution and negative social impacts persisted on the board. All the other cubes were removed but put near the components that reduced them, so players could make track of the ones remaining and the capacity of the buildings/components to absorb negative impacts.
During the second game, students started to do some parallel role-play, creating a narrative for the housing zones. Players naturally started to go beyond the symbology and meaning of the components, as expected in the DPE adapted model (see Figure 7.1). For example, the housing zone near the hospital, between the 3 parks and with a direct public transport line was considered the expensive habitational zone of the city, while the one, most to the right, was the poorer where residents lived packed and, in the periphery (see Figure 7.4).

7.9.2. Inquires and observation results

Players enjoyed the games (see Table 7.3), with low levels of anxiety, low frustration, and high levels of fun and motivation. Players wanted to continue playing but there was no more time available. Their opinion about the potential of learning and simulations though games increased greatly at the end of the experiment (see Table 7.5). When trying to make some correlation, although the data is small (*n*=6), the correlation between the preference for digital games and the perception of the added value of analogue games over digital games (0.56) is higher than the correlation between the preference for analogue games and the perception of the added value of board games over digital games (0.17).

Table 7.5 – Players' perceptions about the potential of serious games.

Players' classification the learning and simulation potential of games	Nothing/ No (1)	A bit (2)	Moderately (3)	A lot (4)	Totally/ always (5)
Before the games	0	0	0	5	1
After the games	0	0	0	1	5

Through direct observation by the facilitator, some information was gathered in the observation notes of the experience. Players had little doubts about the games during gameplay, and those players that understood the game faster explained to other players the decisions they could do and the expected impacts in the game systems. This rule enforcing helped the collaboration process. Theses interactions allowed the fast pace of the game with little downtime and due to the small number of participators all players were engaged in playing the game. No reports of smartphone use or parallel talks were reported during gameplay (2 hours).

7.10. Conclusions

The application and adaptation of the DPE framework helped to define the game session and the objectives for each game, their relations, and also considering the role of the facilitator as an actor that knew the design objectives and helped players to participate in the game experience to achieve the desired goals by themselves. The implemented design, in its multiple flows, created a gameplay that players enjoyed. The game results (see Figure 7.2 and Figure 7.4) express the debate about the urban map in the first game and the collaborative decision making that generated a coherent new urban model during the second game.

Players entered the game without knowing what to expect. They felt engaged, considering the results from the inquiries (see Table 7.3), in loco observations, and the result of the city model (see Figure 7.4 and Figure 7.5). The first game contributed to understand and share knowledge about the territory, empowering students through the question mechanic. The second game allowed students to discuss and implement, in a collaborative way, general guidelines and ideas to plan the city, receiving real-time feedback from the chain/cascading mechanics of the cube placement. No downtime between plays and turns was registered. The decisions were proposed by the active player, but all others participated with their opinions and easily contributed by giving their money to build expensive buildings and facilities. There was no record of non-collaboration or game disengagement in general (only one call to vote in nine failed), enforcing the notion that a city model can be planed collaboratively with few rules, despite being important to generate the debate and the consensus-building to activate and profit from the cube placement and cascading effects in the city economy.

The debriefing moment was fast and easily supported by the second game results, materialized in the game model itself, which acted as examples to remember decision and the process of urban growth. By playing the second game players expressed the potential for this game system to help deliver general guidelines to plan the urban space. This model helped the facilitator to address the subjects of sustainable growth and the urban interactions of land use, facilities, and infrastructure. The discussion with students happened through the game itself as mentioned, with moments of collective reflection and decision that allowed to continually grow the city, generating income, and progressively reducing the negative outcomes through gameplay. In the final debriefing, the students agreed that they could have reduced all the negative outcomes if they did not focus mainly on the income, although only two negative cubes remained in the map (see Figure 7.4 and Figure 7.5). This was used during debriefing as a metaphor for the prevalence of efficiency models that promote mainly the economic outputs in most plans. The game system engaged the player to the point that narratives emerged naturally. Players enjoyed and established meanings to the game dynamics, which is a proof of success for general game design objectives (Salen & Zimerman, 2004) and, in this case, of a serious game (Win, 2009) to promote participation in a playable planning process. It can be concluded that the game achieved its serious objectives, because players played in collaboration, discussing every play since the first and only collective action rejection. The objectives of sustainability were also reached due to the existence of only two negative cubes remained on the board, while having a positive money surplus for the city's common budget.

This experiment showed it is feasible to implement a serious game experience to simulate a simple urban model, using modern board game components and mechanics to establish collaborative planning, following the DPE adapted framework. The use of the printed Google map and the simple spreadsheet is flexible enough to simulate simple planning game approaches and compliant with modern board game mechanics. Students did not know the lecture would be done with games; they just knew it was about collaborative planning. This promises to be an approach with the potential for usage in other planning processes, profiting from the innovation and flexibility of these new game designs and the continuous development of serious game frameworks.

7.11. Gaps and future developments

Although the second game seems balanced, with a tight economy between the costs of the actions and their positive and negative outputs, more testing should be done to truly balance it in all the situations. Nonetheless, the results seem promising, showing that applying innovative mechanics and other design elements from modern board games, supported by a simple spreadsheet table, can help players understand the economy of the game in a fun way. The game system can be played over a map, opening possible new adaptations to other different urban realities.

With one play it was possible to plan a new urban solution, but the continuous plays of the game by the same players would improve the relation with cost and effects, just like the knowledge of the played city map.

The application of the DPE framework proved to be useful, and the possibility of adaptation opens new paths for future uses of analogue serious games. This approach provides more tangible design support to non-game designers that may what to start a serious game planning process.

Some difficulties in understanding the proximity effects during gameplay were felt. In future tests some transparent reference grid, with squares or hexagons should be used over the map, assisting in undoubtedly read the neighbour land units, the shapes, places to put the cubes, and the distances between all game components. The design of wargames and eurogames maps, with their hexagonal shapes, could help improve this. The capacity of the public transport lines should also be defined and marked in the board, just like their precise length.

The effects of over-concentration should also be considered and produce extra negative outputs. This was obvious to players through the narrative they created. Players also understood the effects of the heavy industry location. They used the public transport lines to put it away from housing but connected to them and to the commercial/services to generate the expected income.

The tracking of the income through the dices was efficient, easily related to the source of the revenue due to the colour of the cubes above them, although limiting it to 6 units (the pips of the D6 dices). In the future other types of dices can be used, easily increasing the pips value to 20 if necessary (with the D20 used in role-playing games).

In future tests, some formal role-play should be introduced because players showed a natural will to establish narratives associated with the city morphology. This could transform the game in a semi-cooperative game, having different roles and some hidden victory conditions to every player, simulating in this way stakeholders' and citizens' behaviour as well as hidden agendas in a participative and collaborative planning process. This could be easily done giving different profile cards to each player. More testing with more students and other city maps are also important for future developments, that now are possible following this approach.

Another possible development consists of using digital technology and devices to read the game components' disposition and automatically generate information about the component's interactions.

8. FAST SERIOUS ANALOGUE GAMES IN PLANNING: THE ROLE OF NON-PLAYER PARTICIPANTS[17]

8.1. Introduction

Can analogue games help foster participation in spatial planning?

People are eager to participate in spatial and urban planning matters. However, the traditional top-down decision process (Latour, 1987), related to the rational systemic planning approach, may not respond adequately (Dryzek, 2002; Innes & Booher, 2015, 2018). Despite many attempts, the effort to make planning more participative and engaging is still ongoing (Ampatzidou, 2019; Margerum, 2002). Planning practitioners feel unpowered to deliver suitable solutions for the growing complexity of contemporary planning problems (Innes & Booher, 2018; Portugali, 2016) (Innes & Booher, 2018; Portugali, 2016).

Participative and collaborative planning practices can humanize, constructively address contemporary conflicts, and better address citizens' and stakeholders' demands (Amin, 2011; Innes & Booher, 2004; Juraschek et al., 2017). They can generate reasonable solutions (Bächtiger et al., 2018) based on different knowledge and experiences (Berntzen & Johannessen, 2016; Mueller et al., 2018; Parker, 2015). Thus, citizens should have support and see their insights valued (Farinosi et al., 2019; Mueller et al., 2018). We consider participation in planning to be the ability to engage citizens and stakeholders to influence the planning process (Margerum, 2002) (Margerum, 2002). Therefore, engagement is the ability for the participants to freely invest and care for the process and its outcomes (Zagalo, 2020).

Unfortunately, public participation gatherings and events might become hate battles between citizens, elected officials, stakeholders, and experts (Innes & Booher, 2018). Citizens may fail to see the purpose and the consequences of their participation (Osmani, 2008; White, 1996). The absence of engaging and consequent participatory opportunities that address citizens' needs, particularly the youngsters, is a real issue (Cammaerts et al., 2014). We know that traditional planning processes can be overwhelmingly complex for non-experts (Fung et al., 2003) and tedious for less engaged participants (Innes & Booher, 2018). There is a need to deal with complexity, uncertainty and promote flexible solutions built on knowledge and shared decision-making (Callon et al., 2011).

[17] This chapter, with slight adaptations, corresponds to the article: Sousa, M., Antunes, A. P., Pinto, N., & Zagalo, N. (2022). Fast serious analogue games in planning: the role of non-player participants. *Simulation & Gaming*, 53(2), 175-193.

Games might provide solutions to prepare citizens, establish collaboration, and foster shared knowledge to integrate rational and collaborative approaches (Ampatzidou, 2019; Mayer, 2009; Sousa, 2020a; Tan, 2016). Games deliver tangible arenas of testing, highlighting the cause and effects of decisions (Salen & Zimmerman, 2004). These relationships can improve communication between experts, citizens, and elected officials (Moore & Elliott, 2016). Levelling the power structures is automatic when players follow the same rules (Ansell & Gash, 2008; Thiel et al., 2016). Game progress should enable participants to negotiate, share and build collective knowledge (Ampatzidou & Gugerell, 2019b; Baldwin-Philippi et al., 2014).

Serious Games (SGs) are powerful tools because they provide engagement (Zagalo, 2020), pleasant experiences (Sicart, 2008), and the content and simulation dimension (Dörner et al., 2016; Winn, 2009). Yet, SGs are hard to implement due to the balance between playability and simulation. Facilitators can support the SG experiences and guarantee the necessary debriefing (Crookall, 2010; Lederman, 1992). Game facilitators are also needed when learning analogue game (Sato & de Haan, 2016; Sousa, 2020a, 2020c). However, overcoming the prejudices that games are useless can be the biggest challenge (Koens et al., 2020; Thiel et al., 2016).

Adopting analogue games seems promising because they are simpler to build and learn, and are flexible to adapt (modding) to almost any circumstance and purpose (Abbott, 2018; Castronova & Knowles, 2015). Analogue games with their physical and mechanical dynamics foster collaboration among players (Zagal, 2020; Zagal et al., 2006), producing unique forms of engagement (Rogerson et al., 2016; Xu et al., 2011) and social conscience (Lee et al., 2011). These games rely more on the players' autonomy and have lower barriers of entry due to the absence of interfaces beyond the game components (Booth, 2020). It also allows adaptations to introduce newcomers to complex planning problems (Ampatzidou et al., 2018).

These games can foster participation even when people are not playing them directly, allowing the emergence of Non-Player Participants (NPPs). We present in this paper the testing and evaluation of the use of a fast SG to support a participation process (including NPPs) in the context of a conference on urban mobility. The case study we developed there allowed us to consider three levels of engagement: the Playing Participants (PPs) that experienced directly the decision-making process involved in the game; the NPPs that participated in the game by interacting with the PPs; and general attendants (from now on simply called attendants) that observed without participating or interacting with the game.

8.2. Intervention

We tested our game approach during a public conference about sustainable mobility. It was the context for testing the role of fast analogue games as tools for collaborative planning with public participation. We acted as a game facilitator and deployed a fast analogue game tailored for a case study located at Marinha Grande municipality (Portugal). During 30 minutes, it was possible to verify the engagement of PPs and NPPs, testing different options and game outcomes.

Several speakers discussed the theme of sustainable development and urban mobility. The audience of approximately 90 participants was composed of high school students, local citizens, local planning and transport officials, experts on planning and mobility, and city councillors, including the mayor of the municipality.

After a presentation regarding collaborative planning and SGs, the game facilitator invited the audience to play while planning the local transport system. The game combines several board game mechanisms (Engelstein & Shalev, 2019). Game development followed the Design, Play and Experience (DPE) framework (Ampatzidou & Gugerell, 2019b; Winn, 2009), highlighting the effects of changing game mechanisms to achieve SG goals. We adapted the DPE to consider the facilitator role (Sousa, 2020a) and the concept of NPP in a public game session.

The game proposed a simple economic system where infrastructures could be purchased and placed over a city map. PPs could freely use their money to decide where to locate infrastructures, like bicycle ways, bus routes, tramway lines, a new ring road or parking areas. Coloured strings represented the infrastructures. PPs could consult the table of infrastructure costs displayed for all conference attendants. The facilitator was there to invite players and explain the game while managing the money flow. The game map stayed on the theatre's stage floor, strategically placed in front of the first lines of chairs and the speakers at the stage. The conference attendants seated near the playable area should be engaged in the game dynamic, even indirectly.

The expected planning outcome of the game was a new local transport plan.

8.3. Method

The main objective of this research was to test the engagement of different planning stakeholders with a fast, low-complexity, and low-tech (Spagnolli et al., 2016) SG. In particular, we wanted to verify if the game could engage PPs and NPPs, fostering participation and collaboration. The experience also explored if existing modern board games could inspire a playable collaborative transport planning process.

8.3.1. Serious game design process

Our game simplified the game experience of Sousa (2020a) and focused only on the transport dimension through simple game mechanisms found in modern board games (Micael Sousa & Bernardo, 2019). The game board was a satellite image map with a scale of 1:5.000 that included the urban centre, printed in an A0 paper format. Although the game complexity was low, the game was still challenging for players due to the context and the limited available time (Dziedzic & Włodarczyk, 2018).

The game delivered a collaborative experience without any formal turn order. There was no clear win or lose condition besides collaboratively generating the best possible plan, with the limited available time and resources. The development process was inspired by other tabletop modding approaches (Abbott, 2018; Castronova & Knowles, 2015), reducing the game complexity to the minimum (only one action: spend resources to add a piece, see Figure 8.1). The transport routes were the coloured strings from *Spaghetti* (Gołębiowski, 2016) game because they are resistant, flexible, and easily handled. The string-laying mechanic came from *String Railway* (Hayashi, 2009) game but without scoring in order to lower complexity and allow instant play. The string laying mechanism from *String Railway* allowed the establishment of action costs and effects of network-building over the map. Since the purpose was to consider a sustainable transport system, green strings represented bicycle lanes, highlighting their low environmental impact on the urban system. Yellow strings represented bus routes, red the trains, and black the highways (an analogy to asphalt). The white cubes were easy to see over the map and represented parking. Poker chips represented the money. Each bicycle lane infrastructure was composed of two attached green strings (80 cm, 4 km in reality). The bus routes (75 cm) resulted from gluing three separate yellow strings pieces. Two red string pieces glued formed a tramway (70 cm). Finally, another three connected black strings represented a highway (135 cm). Previous playtesting allowed to adapt the game's internal economy (Table 8.1) to accommodate no more than 20 players and be playable in about 20 minutes. This game design solution relates to a low-tech persuasive approach (Spagnolli et al., 2016). Gluing the available strings was the modding that fitted game components to the city map scale. Limiting the number of new transport infrastructures restricted the players' behaviour and options, forcing them to generate a transport system with different types of interconnected transports modes.

The game experience resulted from the DPE framework (Winn, 2009), simplifying the game mechanisms of String Railways, introducing the map, and allowing dynamics between PPs and NPPs. The DPE model was adapted to consider more roles, the facilitator (Sousa, 2020a), the content creator, and the NPPs. The map was placed near other attendants, allowing the emergent NPPs to share their technical expertise and local knowledge. The facilitator helped players learn the game fast and enforced the rules during gameplay (Sato & de Haan, 2016; Sousa, 2020a), supporting player decisions and managing the game state economy. In the experiment, the content and pedagogy creator, the game (re)designer, and the facilitator were the same person. These highlighted roles are directly associated with the DPE global dimensions (first line of Figure 8.1). We considered the game's physical components and the facilitator skills as technologies.

Design	Play	Experience
Roles directly involved: • Game designer • Content creator • Facilitator	Roles directly involved: • PP • Facilitator • NPP	Roles directly involved: • PP • Facilitator • NPP
Content and pedagogy: • Real Urban Map. • Transport infrastructure options. • Economy of the game. • Collaboration principles.	Teaching: • Distances. • Locations. • Impacts of the transport system. • Mediating collaboration.	Learning • Transports as a system with different modes and impacts. • Decision making. • Resource management. • Effects of collaboration.
Narrative: • Developing a sustainable transport system. • Use different types of transports.	Storytelling: • Analysing options. • Association by participants to real cases and experiences. • Changes in the transport system.	Story: • The process of planning. • Describing the final solution, how it would change the city and the way people and cargo move around.
Mechanics: • Action Selection Restriction. • Exchanging. • Negotiation. • Automatic resource growth. • Voting. • Tile (strings and cube) placement.	Dynamics: • Options analysis. • Available money. • Emerging transport system. • Reducing action availability. • Debate. • Collaboration.	Affect: • Strategy implementation. • Collective understanding. • Trust building and empathy. • Sense of accomplishment.
User interface • Map and limited game components. • Table of the game economy in the screen. • Nearby people.	Interactivity • Moving bits, strings and cubes. • Exchanging money. • Talking, asking help from speakers and politicians nearby.	Engagement • Using the game components to represent the planning solution. • Combining the different components to build the network. • Engage in debate with other participants and nearby people.
Technology (Game mechanics, physical components, and personal skills of communication)		

Figure 8.1 – DPE adapted the framework to the game session.

PPs played on the floor of the stage where the conference took place. This display allowed a top-down view of the map and the placement of PPs close to the NPPs. The game map location, displayed between the speakers and the first line of chairs, induced NPP behaviour for the experience.

PPs could freely enter the stage, discuss with other players and spend money resources to define transport solutions. Young players, mainly students, should be incentivized to participate by peer effect (Wang et al., 2016). The facilitator invited students to play the game, stating they were in charge of the decision-making. Nevertheless, they could listen to the advice of the speakers, elected officials, experts, and other conference attendants. PPs should be the only ones actively playing the game (making decisions), while speakers, elected officials, and other participants could become NPPs if they wanted. After the 20 minutes of play, the facilitator should analyse the game results during debriefing (Table 8.1).

During gameplay, any player could propose to play an action, which consisted of laying a string representing a type of transport line/infrastructure or a cube for a parking lot over the map (Table 8.1). But the two monetary units per player were not enough to perform any possible actions (Table 8.1).

Table 8.1 – Game economy table to support gameplay.

Type of infrastructure/circuit	Colour	Cost	Availability
Bicycle	Green string	3	3
Bus	Yellow string	4	3
Tramway	Red string	6	3
Highway	Black string	10	1
Parking lot	White cube	6	4

The only option for each player was to agree with other players on using their money together, thus forcing collaboration. The arrival of new players to the stage or giving more money to existing players should maintain the game dynamic. The theatre projector displayed Table 1 to support the decision-making process, showing action cost and components availability Figure 1 presents the setup, facilitation, gameplay (loop between actions and dynamics) and final analysis/debriefing. It also represents the collaborative relationships between PPs, NPPs and the other attendants as observers (not interacting with the game). Figure 8.2 highlights that NPPs can learn, help, and discuss but not play directly and make decisions as the PPs can. Any attendant could become an NPP or a PP if they like.

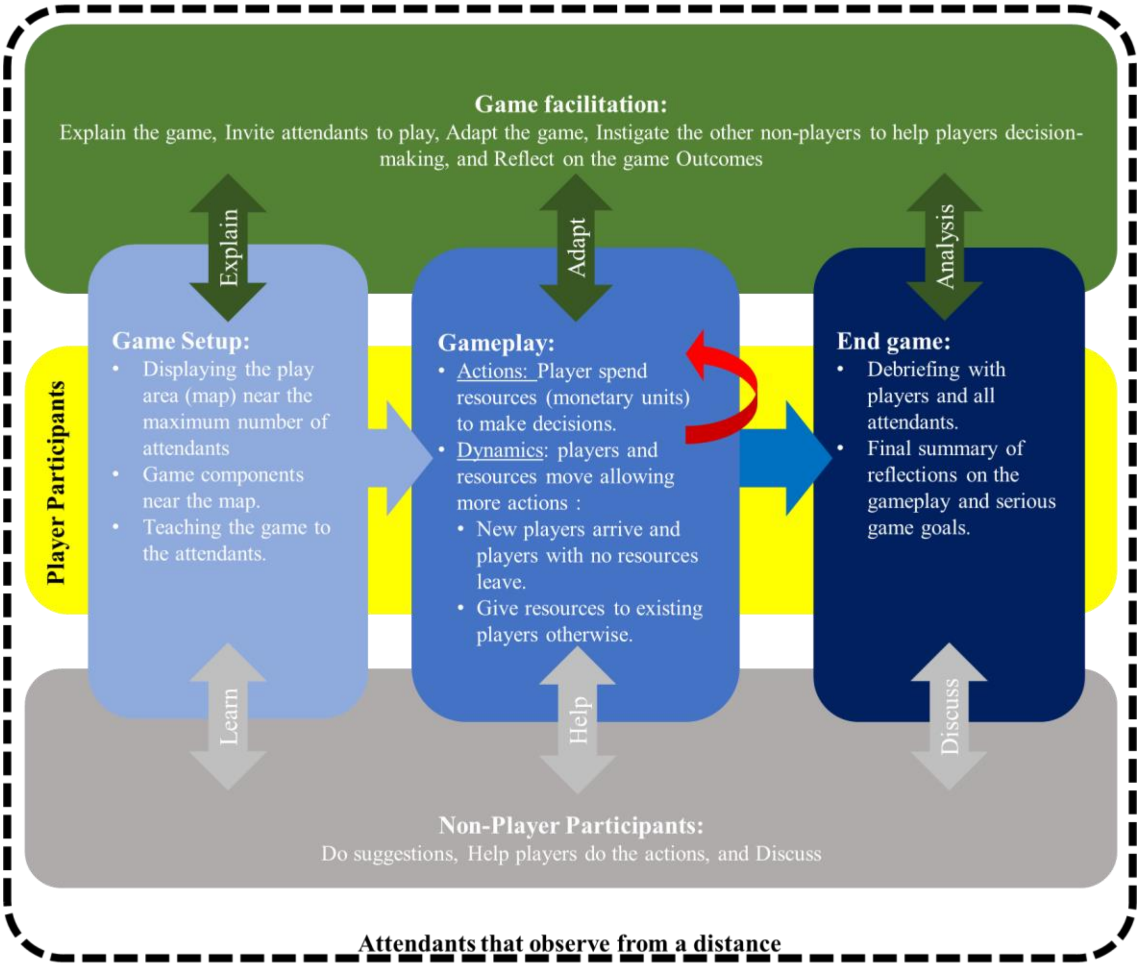

Figure 8.2 – Game process and the different participants involved.

8.4. Data collection

After the conference NPP answered a survey, with the questionnaire designed following Mayer et al. (2014) (Appendix D). We recorded NPP game experiences, expectations, and game outcomes. We collected at least two answers from each type of NPP: speakers, elected officials, experts, teachers, and citizens. The grounded theory approach (Charmaz, 2014; Farkas et al., 2020) provided the method to organize and interpret the answers to the questionnaires. We compared all the answers, grouping them by ideas and concepts, in a gradual, hierarchic, and coded way. This method produced quantitative results to evaluate the SG experience.

8.4.1. Game results

Eight individuals played the game. It started with a group of six PPs, all secondary school students. The first four spent their money quickly, defining the first two bicycle lanes, which took less than 5 minutes. After spending all their money, these four players left the stage. The two remaining PPs took longer to decide. They kept facing the map with money to spend. They were there alone for two minutes because no other student wanted to go on the stage (Figure 8.3). But an older citizen joined them, and then also a teacher. The facilitator gave these new players two money units and the same amount as the other players (students), reinforcing the initial budget (total of 20 monetary units). Seeing this impasse, the conference speakers started to help the players, focusing on the most sustainable solutions. The NPP role in the game emerged by supporting the active players' decision-making. The rest of the audience began reacting to the dynamics by clapping their hands and cheering when players played a piece on the map. The discussion increased and was very vivid at the end of the game. At this point, the game unfolded without additional facilitation. The mayor and the councillors tried to help the PPs.

Figure 8.3 – Game play with PPs being assisted by NPPs (Source: Municipality of Marinha Grande).

Players spent a total of 19 monetary units on the local transport system. They chose to place three bicycle lanes, one bus route, and one tramway, leaving one monetary unit unspent. PPs discussed the NPP suggestions for the need to connect the existing train station to the city centre and industrial park, which they did. NPPs even moved the game components to the exact locations on the map when asked by the players. PPs considered that the bicycle network strategy should be a priority. Citizens could travel by bicycle to the coast, located less than 10 km to the West. Although PPs could not connect all these places to form a network during gameplay, they drafted it (Figure 8.4).

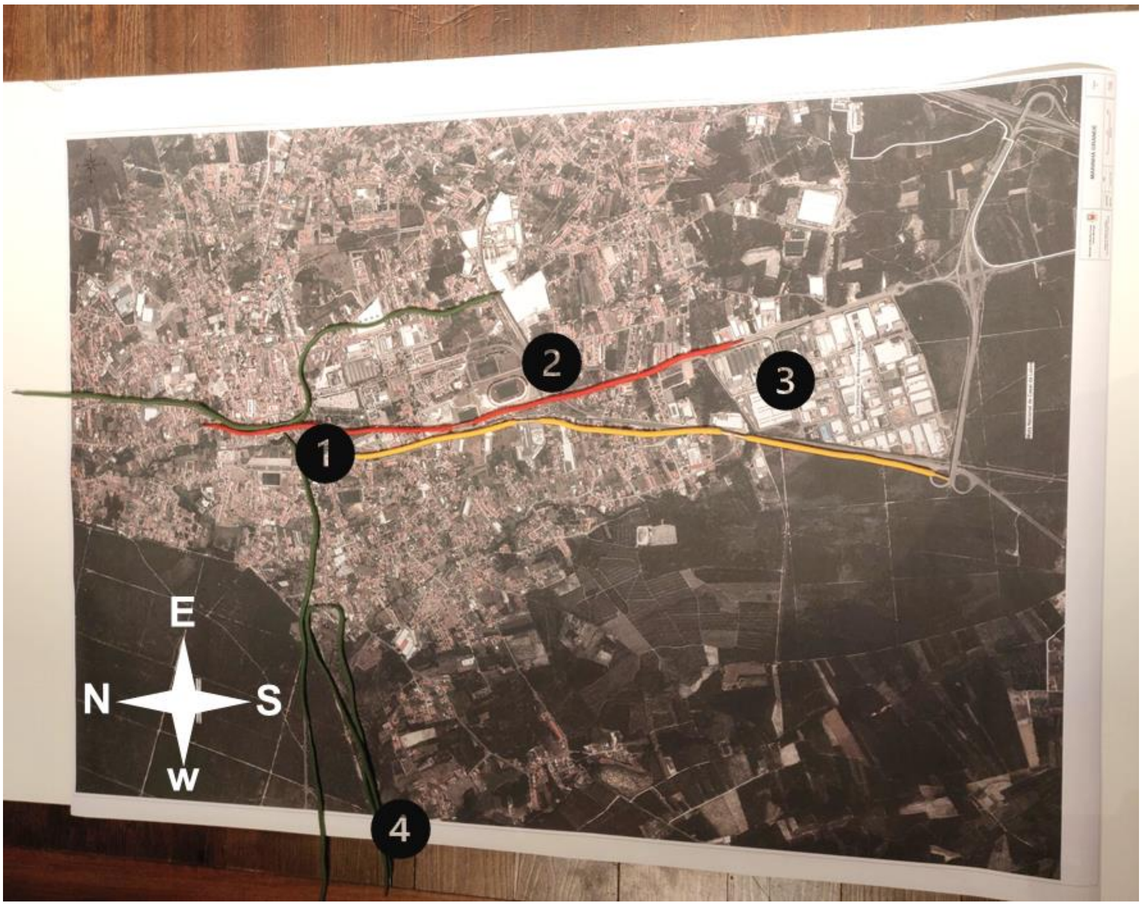

Figure 8.4 – Game Result: 3 bicycle lanes (Green); 1 bus route (Yellow); 1 tramway line (Red). Locations: City Centre (1); Train Station (2); Industrial Park (3); Coast (4) (Source: Author).

8.4.2. Post-game survey results

A questionnaire surveyed the NPPs with 14 Questions (Q) (questionnaire in Appendix D). We obtained nine NPP answers, involving roughly 10% of the session attendants. Three were speakers (NPP2, NPP3, NPP9) and two elected officials (NPP 5, NPP 6). Two other NPPs considered themselves experts in the planning and transportation fields (NPP1, NPP8), and the remaining two admitted having no specific knowledge (NPP4, NPP7).

The nine NPPs answering the questionnaires were on average 49 years old and had a higher education degree. Six were female, and three were male. The gaming habits were measured through a Likert scale from one to five, from “never play” to “play daily”. The majority of the NPPs said they played, on average, one time per month or less. Less than half of the participants (NPP1, NPP3, NPP6, NPP7) had never participated in any SG session before.

On their experience in public participation (Q1), only NPP4 said that citizens had some ways to participate in planning processes related to their communities, and another said it did now know (NPP2). All the other seven agreed that citizens do not have available or engaging options to participate. The remaining seven NPPs highlighted the boredom and bureaucracy of existing participatory methods (NPP6), the focus on individual issues (NPP9), the lack of follow-up of proposals (NPP3), as well as intangible results (NPP9) to their answers.

On the issue of participation (Q2), NPP referred that increasing the opportunities to participate would increase the general participation levels (NPP3, NPP7, NPP8, NPP9), others stressed the need to have engaging (NPP1, NPP3, NPP4, NPP5, NPP6, NPP9) and innovative (NPP3, NPP4, NPP5, NPP6, NPP9) participatory opportunities. Only NPP8 mentioned the need for more education investment to increase participation. NPP2 said that civic participation should be mandatory. Four NPPs stated that the obligation to address concrete issues and consequent solutions was necessary to increase participation (NPP1, NPP3, NPP8, NPP9).

On the gaming experience (Q4), NPPs identified several issues that surprised them, as expected, because five NPPs had never experienced SG practice (NPP2, NPP4, NPP5, NPP8, NPP9) (Q3). Six NPPs (NPP1, NPP5, NPP6, NPP7, NPP8, NPP9) were amazed by the easiness players generated solutions. Five NPPs were impressed by the immediate PP focus (NPP3, NPP5, NPP6, NPP7, NPP8). Five NPPs also classified as positive the instant engagement and active participation that the game delivered, highlighting the easiness to foster collaboration among players (NPP1, NPP4, NPP5, NPP7, NPP9). Keywords like innovation (NPP6, NPP8), equality (NPP3), and knowledge (NPP3) also appeared in some answers.

When asked about game complexity (Q5), NPP7 said it was medium, while the others considered the game easy. Some referred that the game was well explained (NPP3) and was fun and didactic (NPP2). But that the game required knowing and understanding the map and the local reality (NPP9).

The majority of the NPPs were surprised by the engagement level and PP active participation (six answers). But, when asked directly about the players' engagement (Q6), only five considered it to be high (NPP3, NPP5, NPP6, NPP7, NPP8) while the other four said it was average (NPP1, NPP2, NPP4, NPP9). Four of the answers stressed shyness as the reason for less involvement (NPP1, NPP2, NPP3, NPP4). Nevertheless, three of them stated that engagement increased as the game unfolded (NPP1, NPP2, NPP3). One NPP directly said that he also would have liked to play (NPP8).

Five NPPs considered the PP performance to be high (NPP3, NPP5, NPP6, NPP7, NPP9), and four to be average (NPP1, NPP2, NPP4, NPP8). Three stated that the time to play was short (NPP1, NPP3, NPP4, NPP9), contributing to a superficial outcome (NPP1, NPP3, NPP9).

All NPPs considered the game session useful, teaching planning and civic participation to all attendants (Q8). Four said that it was relevant for learning about collaboration (NPP5, NPP6, NPP7, NPP9), four for decision-making and solution finding (NPP3, NPP5, NPP6, NPP7), and three for resource management (NPP3, NPP5, NPP6). All NPPs also considered that the SG allowed PPs to express their ideas while reducing the fears about participation (NPP7, NPP9) and helping understand the effects of collective decisions (NPP2, NPP8).

When asked directly if the game fostered participation among PPs (Q10), all NPP answered “yes” in their perspective. But when asked if the game was helpful to plan the local transport system, six participants said it just had some potential, other two directly said it had no potential (NPP1 & NPP4), while one said it was inconclusive (NPP2).

Concerning game improvements (Q13), six participants mentioned the need for more time (NPP1, NPP3, NPP4, NPP6, NPP8, NPP9), four stated the need for more preparation from the players (NPP1, NPP3, NPP6, NPP8), while three suggested doing a session dedicated to gaming (NPP4, NPP6, NPP8). Two NPPs considered it would be better to use a formal planning problem (NPP2, NPP7). One NPP said it would be better without public observation (NPP8), and another one suggested the use of a virtual platform to support the game (NPP9).

All NPPs stated the importance to develop these SG approaches to foster more participation in planning (Q13). Final commentaries about the session (Q14) are presented in Table 8.2, showing very positive feedback.

Table 8.2 – Final commentaries from NPPs

NPP	Commentaries
NPP1	"For the general purpose and goals, the initiative was adequate"
NPP2	"We still have few people willing to participate. This game can be a toll to change this."
NPP3	"I started to see games differently, and now I also want to use their potential"
NPP4	"Nothing to add."
NPP5	"I had a lot of fun"
NPP6	"Excellent"
NPP7	"I would like to see it closer, maybe filming and live streaming would solve it"
NPP8	"Very interesting. Please invite me for the next session."
NPP9	"I want to congratulate the author for this original idea about participatory planning. Many territories need to explore these participatory approaches. I am excited to see this being applied in other real case studies and with broader participation.

8.5. Discussion

Although with only 20 minutes of play, it was possible to observe some interesting behaviours. The event's speakers and even the elected officials helped the game to be played. The adopted design options and game setup engaged NPPs connecting them to the game and the actual PPs. This interaction allows sharing knowledge and experiences related to the issues at stake in the game. These techniques provide a comfortable way out for those participants that distrust SG results or do not have the time to play the whole game. They can participate by giving inputs and watch the game development without being forced to play. It is a way to change perceptions about the results of SGs. This game process can be explored in other practical participative and collaborative dynamics. Facilitators can propose games played over existing maps as a context (i.e., changing land uses, facility locations), adding simple game components and mechanisms to build the interactions that lead to engagement, increasing participation and fostering different forms of collaboration.

The game approach positively surprised the NPPs. The game engaged the PPs, although they demanded help to understand the map and decide their moves. One of the main findings was the influence and importance of the NPPs to deliver informed playability. NPPs acted as informal facilitators and experts. PPs adopted most NPP suggestions, like connecting the city centre to the train station and industrial parks with public transports. The PP fragilities and gaps of technical and local knowledge fostered involvement of the NPPs and the general collaboration between PPs and NPPs.

Despite the many conference attendants, only eight persons played the game: six students, one older citizen, and one high school teacher. Because the game was designed for 20 players, it would become unplayable without a fast adaptation done in real-time (providing more money to players). This analogue flexibility allowed the session to achieve the SG goals. NPPs and PPs were engaged and delivered a collaborative planning solution.

Although the game generated a simple transport system (Figure 8.2), it supported discussion among PPs and NPPs. It showed how players valued bicycle lanes and the influence of the speakers. Having a limit of three bicycle lanes forced the players to select other transport infrastructure. Adopting this limitation fostered the emergence of a multi-modal transport system, which was one of the SG goals.

This experience demonstrated how unprepared citizens might be to get involved in public participation processes. Just inviting them to play a simple planning game might not be enough to motivate citizens. Finding ways to engage participants in effectively affecting the planning outcomes is one of the goals of participatory and collaborative planning approaches. Allowing attendants to participate how they wish can be a valuable strategy. In the experience, the attendants could become NPP or PP if they wish anytime. The game session highlighted the difficulties that non-experts have to understand complex maps. However, better preparing PPs and NPPs for the game experience would jeopardize the objective of the game experience. In planning practices, due to the lack of time and resources, using low-tech, simple, and speedy games like the one presented before can be relevant to spark more participation in spatial planning processes.

8.5.1. Limitations and suggestions for further future research

Using a camera to project the gameplay on a larger screen in the room for all participants is recommended. Supplementary digital tools like tailored mobile apps could share the game state and rules to increase the overall engagement of all attendants.

8.6. Conclusions

Using simplified and adapted analogue games as SGs proved to be viable for the case study. It allowed engaging participants, directly and indirectly, building a growing engagement dynamic even for non-players. A planning facilitator can adopt this analogue game approach to address collaborative planning, having limited time and resources. It also allows benefiting from non-player participants (NPPs) that are experts or have relevant local knowledge about the issues at stake. The NPPs are an active type of participants, even if they cannot play the game directly or the whole time. Attendants can be engaged in different roles: watching the game, indirect support to players, or actively playing the game. Attendants can participate at the level of involvement they feel more comfortable with. Participating without playing is possible, as NPPs contributed to the different game outcomes.

This experiment shows how flexible and efficient analogue game design can be, demanding little time and resources. The proposed game approach proved to be adaptable to an event where the number of participant players (PPs) and NPPs is uncertain at the outset. The game facilitator can easily adapt the approach during gameplay to deal with practical restrictions and uncertainties. Low-level complexity games allow immediate engagement, which also benefits from the knowledge that all participants bring to the game and from the propensity of facilitators and NPP to help players. NPPs that have knowledge and expertise in the subject at stake are naturally incentivized to interact with PPs, helping them more. The feeling that NPPs are providing relevant help is expected to increase NPP engagement in the game. Figure 8.2 proposes a process that can be applied for other participatory and collaborative dynamics and serve as a guiding framework. Adding some digital tools could have engaged even more participants.

We believe that analogue games can support other processes, profiting from the adaptation of the game according to the context, delivering engaging experiences that foster participation and collaboration.

9. BUILDING URBAN SAFETY WITH PARTICIPANTS: IMPLEMENTING ANALOGUE SERIOUS GAMES TO SUPPORT A COLLABORATIVE SPATIAL PLANNING PROCESS FOR THE URBSECURITY INITIATIVE IN LEIRIA (PORTUGAL)

9.1. Introduction

We live in an age of urban complexity, and finding solutions to address all issues and claims related to urban realities is difficult (Portugali, 2016). Even the most evolved technologies associated with smart city trends struggle to deal with it, especially human factors (Goodspeed, 2015). These planning problems are "wicked" since there is no optimal or perfect solution to deal with all the claims and constraints (Innes & Booher, 2016). The increasing complexity of urban affairs results from interconnected societal domains, different values, and perspectives of those using the same space (Loorbach, 2010). Solving these problems is not easy when it seems to exist a crisis of participation, disengagement, and inefficiency (Legacy, 2017). Traditional rational-systemic panning approaches might not be enough to deal with these problems (Albrechts, 2013; Innes & Booher, 2018). What other options do planners have to deal with complexity? And can these techniques be applied to other fields that deal with human needs?

Collaborative planning (CP) seems to be a way to deal with complexity, aiming to generate collective decision-making that can reach a consensus. For CP to be effective, planners need to engage the stakeholders to be active. CP processes must be representative and have as diverse participants while providing learning, experimentation, and building proposals (Healey, 2013; Innes & Booher, 2018). Games share many of these characteristics (Elias et al., 2012; Salen & Zimmerman, 2004), and there are many cases of Serious Games (SG) approaches successfully applied to planning (Dodig & Groat, 2019b; Sousa et al., 2022b; Tan, 2017). Despite this, developing planning-based approaches is not easy. It demands resources and knowledge, as the openness to try new methods, including codesign practices that can make them more effective (Champlin et al., 2021). There have been many game-based approaches for planning, all revealing weaknesses and strengths (Sousa et al., 2022b). Although analogue games are as old as civilization (Parlett, 2018), they are a possibility for planners to use . Is it possible to use simple and flexible game-based approaches (analogue) to support CP in a way the participants recognize as a useful approach?

We propose a codesign method to develop a serious game through several stages and play sessions. In the first session, stakeholders identified problems while interacting and fostering empathy and collective awareness. We propose using modified versions of modern board games (creative party games) to identify the urban problems of the zone at stake (played by the participants in workgroups), followed by voting stages where all participants voted on the results from the work groups. This new design framework helped the research team (RT) and the planning officials (PO) from a municipality to have data to create a new board game. This new game (stage 3) was the tool for the participants to make decisions collaboratively. The board games for stage 3 resulted from using the collected data, combining it with modern board game mechanisms and urban maps of the zone at stake. Our method aims at providing simplicity and flexibility to the participatory process, supported by the board game, focusing on the users and the urban issues at stake. We applied this proposal to the city of Leiria (Portugal) within the scope of the *UrbSecurity* (*Urbact*) initiative. UrbSecurity aimed to increase the urban security of the historical city centre through a participatory and collaborative process.

The main contribution of this paper is testing the serious game codesign process: the codesign stages and the collected data that allowed the PO to propose an action plan for UrbSecurity. Through this example, we expect that planners can replicate and adapt this design process to their practices, being aware of the existing limitations (e.g., balancing the playability and the simulation). Our proposal can deliver playable planning games. However, this requires game design knowledge, and the proposed game tends to be a planning support system (Bellotti et al., 2011; Geertman & Stillwell, 2012), but not the planning solution itself.

The paper is organized to describe the co-design process of an analogue serious game that establishes a collaborative planning process for the city of Leiria. After the introduction, which includes the case study presentation, we present three sections regarding collaborative planning and co-design principles, serious games for planning, and the specific dimensions of analogue games. Then, in the methodology section, we explain how our serious game was developed, and the data collection methods applied in the case study. The serious game characteristics are detailed in the following section. Finally, the results and discussion explore what we have learned from the process, summarized in the conclusions.

9.1.1. Presenting the Leiria case study

The Municipality of Leiria (ML) selected the Historic City Center of Leiria (HCCL) as the study zone for the UrbSecurity initiative (Urbact, 2022) (Figure 9.1). HCCL include historical heritage sites like the Leiria Castle (1) (dated 1135). The most iconic street is *Rua Direita* (4) (a sinuous and narrow street, a section that allows only a car to pass), connecting the cathedral (3) to the *Terreiro* plaza (2), where most of the local noble families lived until the XIX century. The most import plaza is *Praça de Rodrigues Lobo* (5), which resulted from an XVI-century urban renewal process, aiming for urban modernization, and boosting the commercial activities in the city. The hydraulic work to prevent the city flooding diverted the River Lis (6) away from the Praça Rodrigues Lobo in the XVII century (Sousa, 2018). The HCCL has a population of approximately 6.000 habitats, living on 70 hectares (Sousa, 2018).

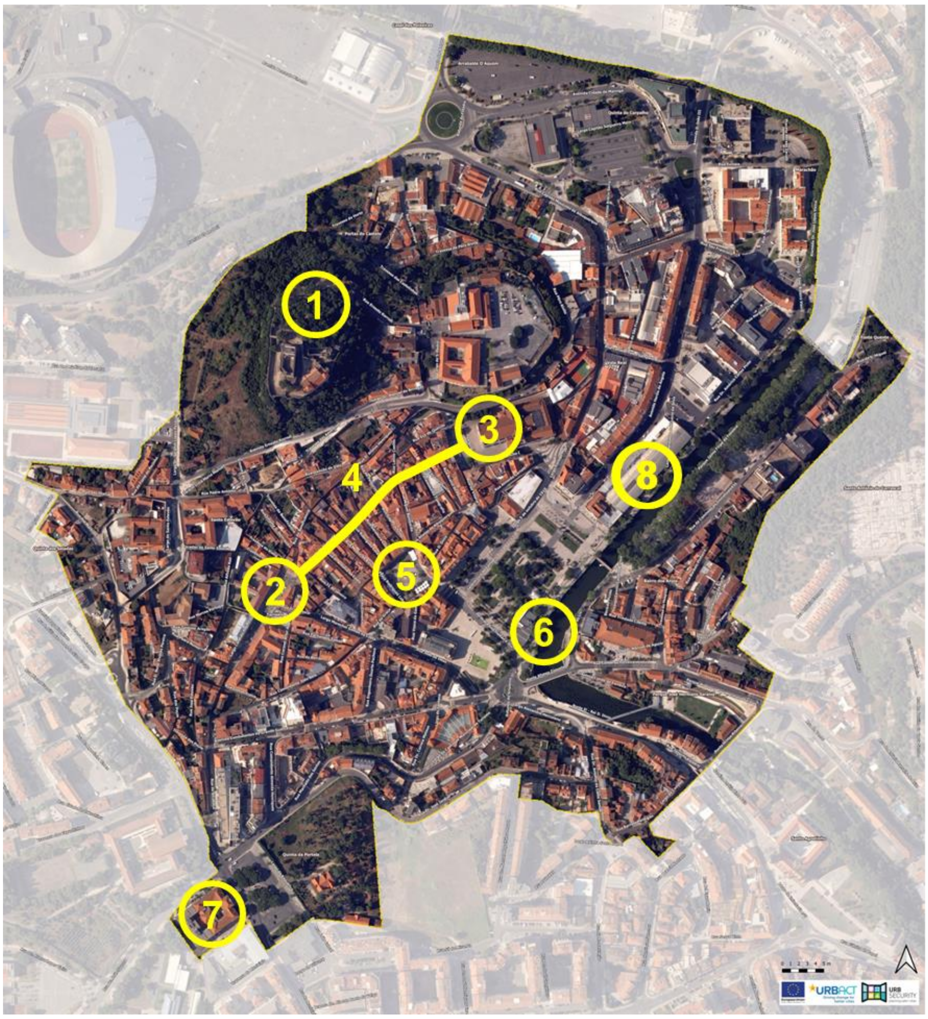

Figure 9.1 – Case study urban zone. Landmarks and places: 1 – Castle; 2 – Terreiro; 3- Cathedral; 4 – Rua Direita; 5 – Praça Rodrigues Logo; 6 – River Lis; 7 – City Hall; 8 – Central bus station. (Source: UrbSecurity / Municipality of Leiria).

HCCL is an Urban Rehabilitation Area with approved regulations to foster urban regeneration and heritage protection. The Research Team (RT) developed a CP approach that engaged the local stakeholders to reflect and propose ideas to increase the urban security of the zone. We proposed an analogue game-based planning approach to be co-designed with the stakeholders and ML planning officials (PO). Our proposal would help PO create the final action plan.

The crimes per 1.000 habitants in Leiria (21.3) are below of (26.8%) the national average value (29.1) during 2021 (INE, 2021). Portugal scores higher (87.2) than the EU27 crimes related to robbery (40.8) but lower in homicide (Eurostat, 2022). It was expected that the perception of security would be considered in a broad way, more than from a crime perspective, by the participants because the *Urbact* principles consist in fostering participatory approaches through a variety of urban issues (Urbact, 2023).

The ML defined invited the stakeholders, controlling the bureaucratic and legal proceedings (including GDPR compliance, data authorizations the use for research purposes). The research team defined the serious game codesign process and trained the PO to be facilitators during the sessions, attended by 20 to 30 participants simultaneously. Later, the Covid-19 Pandemic lockdowns affected participation. During some sessions, we were not allowed to have more than 6 participants in the same room, requiring only a facilitator from the RT. These Covid-19 constraints affected the game usage, demanding flexible solutions (playable by a variable number of participants per game session).

Half of the stakeholders (five participants) attended all the sessions, while the others just participated in some. The ML invited organizations like the police officers, fire department, local schools, and associations (civic, habitats, commercial, and business), also the religious and political representatives. Some organizations never attended, while others chose different persons to attend each session. After all the sessions with the stakeholders, the ML asked the RT to do two more S3 sessions (using the developed serious game), one for the city councillors (CC) and another for the civil servant departments' leadership (DL) of the ML. When we use the term serious game (singular), we are describing the game played during S3. When we refer to the term participants, we mean all the persons that played the games (stakeholders, city councillors and civil servant leadership). Stakeholders are the representatives that the Municipality of Leiria invited to the UrbSecurity initiative.

9.2. Collaborative planning and codesign

Collaborative planning (CP) approaches intend to empower participation in planning (Innes & Booher, 2018), considering that stakeholders can be motivated to think, learn, and find solutions to solve collective spatial problems (McCann, 2001). CP practices aim to deliver consensus when dealing with complex spatial issues (Purbani, 2017; Törnroth et al., 2022). Stakeholders are the human representatives engaged in a CP process to discuss, negotiate, and decide according to their collective goals and claims (Fisher, 2001). In CP, planners act as facilitators, supporting decision-making, providing information, and collecting data for planning processes (Healey, 1997; Innes & Booher, 1999a). CP is described as a bottom-up approach that changes the traditional top-down decision-making processes (Ashtari & de Lange, 2019; Legacy, 2010). From an institutional perspective, CP is a way to collect external data and understand the participants' claims and interactions (West et al., 2014). Through CP, planners can collect local knowledge that would be difficult to access or predict in any other way (Caspary, 2000; Corburn, 2003) and tackle problems during the planning process that would appear later (Moote et al., 1997). Also, a way to build up trust and commitment from the participants toward the decision-making results (Brody et al., 2003). Arguing for CP, Goodspeed et al. (2020) state that poor collaboration generates inferior policies, less creative plans, longer decision times, and flawed use of scientific knowledge.

CP relates to Participatory Action Research (PAR) principles, claiming that participants knowledgeable about issues at stake will be able to participate efficiently and provide meaningful contributions in a bottom-up planning process (Kemmis et al., 2014; Olsson et al., 2004). Being part of the context is essential to the success of a CP process (Calderon & Westin, 2021), and being involved from the beginning and in all the stages of development increases the success of a CP (Bovaird, 2007). Participants can work together and produce documents about their claims and agreements (McCann, 2001). Sorensen and Sagaris (2010) argue that citizens can participate in decision-making effectively and do it even better when they have the necessary technical support. Co-production and co-design are part of the consensus building and decision-making aiming for collective affairs when considering the planning contexts (Watson, 2014). From a co-design and co-production perspective, involving participants in the decision-making from the beginning of the process generate better outcomes (Cash et al., 2003; Webb et al., 2018). Summarizing, co-creation, co-design, and co-production are collaborative processes planners can use in CP to improve the outcomes of a spatial planning process and solve complex problems (Gaete Cruz et al., 2022; Manzini & Rizzo, 2011).

Despite all the CP advantages, there are several criticisms to be considered. The CP tends to diminish the normative planning goals and the overall processes (Fainstein, 2000; Fainstein & DeFilippis, 2015). It can hide or tame the social constraints and power dominances (Neuman, 2000; Phelps & Tewdwr-Jones, 2000). CP can legitimize results for majorities or the established power (Huxley & Yiftachel, 2000; Innes & Booher, 2016). Balancing knowledge and power inequality is difficult to address in real applications (Cullen et al., 2010). It is hard to balance the groups of stakeholders because it depends on who can attend the meetings (Nienhuis et al., 2011; Westerink et al., 2017). Authors like Innes and Booher (2018) argue that CP is inadequate for all planning problems. CP is known for dealing with wicked problems, although it can fail to deliver consensus, achieving only weak agreements and about irrelevant and superficial issues (Allmendinger & Tewdwr-Jones, 2002; Ashtari & de Lange, 2019; Hillier, 2003). In practice, CP can be just a way to check participation requirements without effective results (Kahila-Tani et al., 2016). CP practices are still proving to deliver effective collaboration (Bobbio, 2019). Finding ways to evaluate CP is also an ongoing endeavour (Faehnle & Tyrväinen, 2013). Participation motivation is another important obstacle to CP (Goodspeed et al., 2020). Achieving deep participation does not mean CP would be successful and deliver effective results (Bishop, 2011; Van Empel, 2008).

Surprisingly, the apparent failures of CP can be a strength of the method when approached as design thinking (Raynor et al., 2017). Planners act as facilitators to learn from the process to improve it continuously (Watson, 2014), which may tend to be more informal (Fox-Rogers & Murphy, 2014). These dimensions are why CP tends to be more like guidelines and sets of principles for achieving collaboration in planning than rigid methods for practical implementation (Liu et al., 2022).

Besides all the dynamics and interactions, consensus-building processes can be dull and lack the necessary engagement and innovation (Goodspeed et al., 2020). Enjoyment and meaningful results are essential to keep users participating in a planning process (Innes & Booher, 1999b). Finding new ways to imagine and idealize solutions in more sand-box environments have high potential. Sketching, sharing, and discussing utopias can be a powerful way to essay playful approaches for CP (Törnroth et al., 2022). The results might not be obvious initially, and the lack of evident direct results does not mean that the process failed. Planners need guidelines to interpret these outputs (Faehnle & Tyrväinen, 2013). Even indirect participation can impact a planning solution. This phenomenon was observed when non-player participants (observers) of a planning game influenced the participants playing and making decisions, generating indirect participation (Sousa et al., 2022a). Using Design Thinking in planning allows solutions to emerge from the interactions and adaptation to the goals and the participants' perspective (Chambers, 2003), benefitting from trial and error cycles (Gaete Cruz et al., 2022). Learning from failure is one of the core elements of games (Juul, 2013) because players can fail, try again, progress, and improve the results through feedback loops (Salen & Zimmerman, 2004). Planners can explore these relationships between Design thinking, Codesign, and games for CP.

9.3. Serious games for spatial planning

Since the 1960s, Serious Games (SGs) have been explored by several fields of research and practice, including planning (Mayer, 2009). SGs are those games developed and played to achieve purposes beyond generic entertainment (Abt, 1987; Dörner et al., 2016; Michael & Chen, 2005; Ritterfeld et al., 2009), usually learning, awareness, and other results like collective decision-making (Sousa, 2020a; Sousa et al., 2022a; Tan, 2016, 2022). Games have proven to increase engagement, enjoyment, and participants' trust in planning processes (Baldwin-Philippi et al., 2014). Knowing that a planning process will have a playful dimension, like a game, influences the users to adopt a less confrontational approach, lowering the conflicts (Innes & Booher, 1999b). A game can be a way to plan and change the participants' perceptions about the issues at stake, invoking concepts of fairness and making them visual and tangible (Goodspeed et al., 2020).

Introducing visualization tools and interactive features, like those in games, where users can make decisions and see the effects as spatial representation, help engage and generate planning information for users (Fox et al., 2022; Xu et al., 2017). Building this simulation and visualization tools helps to reveal possible futures under divergent perspectives (Bohunovsky et al., 2011). Using colours and elements to support decision-making helps the user in an interactive spatial environment like a game (Elizabeth & Shalin, 2010). 3D visualization digital tools have a higher potential to express complex data. However, 2D and analogue maps and bits (pieces) are more approachable to most users (Gill et al., 2013). Digital tools can be powerful but generate inequality participation opportunities (Van Dijk, 2005). Increasing the complexity of the simulation within a game to deliver more realistic experiences can jeopardize the participation objectives because some participants might not understand how to play it within the available time (Billger et al., 2020a; Goodspeed et al., 2020), which can be frustrating and inefficient (Nakamura & Csikszentmihalyi, 2009). Analogue game solutions have proven to be easy to use and effective, exploring the advantages of face-to-face interactions (Ferri et al., 2018; Sousa et al., 2022a; Tan, 2017). The social interaction of modern board games is one of the main reasons they are growing as a worldwide trend despite the dominance of digital games (Booth, 2021; Calleja, 2022)

Despite games potential for planning, there are several limitations, like being expensive and long to develop and balancing the playability with the simulation (Sousa et al., 2022b). Games can deliver unpredictable results that reduce the confidence of policy decision-makers and planers (Tan, 2016). When creating SGs, there are no clear guides on how to build the games and no established framework to define the game elements like the mechanics, platforms, components, and narratives to achieve the serious goals (Ampatzidou et al., 2018; Ampatzidou & Gugerell, 2019a, 2019b). Attempts have been made to use the most influential game design frameworks like the Mechanics, Dynamics, and Aesthetics (MDA) framework as a guide to develop game-based planning (Sousa et al., 2022b). Ampatzidou et al. (2018) and Constantinescu (2020), argue that planners can only use games as tools when these gaps are overcome and start mastering game elements like game mechanics, which approach the MDA framework. The literature also offers compilations of game examples but without explaining the game development process (Dodig & Groat, 2019a; Tan, 2017). There is also a lack of evaluation tools for SGs in planning (Rumore et al., 2016; Wouters et al., 2013). The standard method has been using pre-tests and post-tests to track changes (Goodspeed et al., 2020; Rouwette et al., 1998), detailing in some cases the gaming and serious goals of the experiences and mixing quantitative with qualitative methods (Mayer et al., 2014; Sousa, 2021b; Sousa et al., 2022b). Even though practical information is scarce, we found relevant contributions in the literature. Van Empel (2008) recommends identifying the parties (stakeholders) and their motivations to participate, then the possible conflicts of interest, evaluating the participants' satisfaction level and relation to the objectives and the options delivered to the community. Champlin et al. (2021) propose a co-design method starting from structured dialogue and representations to foster creativity and participants' engagement to support the game development, interactions, and later debriefing after playing. We propose a method to design analogue SGs, composed of several stages, where participants define the priorities and influence the options available for serious game design.

9.4. Transforming analogue games into serious game tools for planning

Digital games dominate the gaming world (Flanagan & Nissenbaum, 2014). Despite this, the tabletop and board market is growing (Booth, 2021; Konieczny, 2019). Because building an analogue game is easier and less expensive than doing a digital one (Fullerton, 2014; Salen & Zimmerman, 2004), and the face-to-face interactions increase the participants' empathy and foster collaboration (Luiz Cláudio S Duarte et al., 2015; Rogerson et al., 2018; Zagal et al., 2006), we propose to explore Modern Board Game (MBG) design for planning, following previous approaches like those defined by Sousa and his colleagues (Sousa, 2020a; Sousa et al., 2022a).

MBGs evolved in the last 40 years, from the simulation of *Wargames* to the elegance of *Eurogames* and the interactions of *Americangames* (Woods, 2012). Today there are many design options and game mechanics that can inspire game designers to build engaging and detailed games, some with considerable complexity and the ability to simulate complex realities like cities. The innovation and potential of modern board games result from their innovative mechanisms, the quality of the components, and narrative development (Sousa & Bernardo, 2019). On the Board Game Geek (BGG) (www.boardgamegeek.com) website city building and territory building games are among the most popular family of games. BGG is the most complete website regarding information on MBGs, identifying design elements like game mechanics and mechanisms (Kritz et al., 2017; Samarasinghe et al., 2021).

Considering that SGs can result from the modification of standard entertainment (ortho[18]) games (Elias et al., 2012) or created from scratch (Dörner et al., 2016), both are valid approaches. Modifying games (Modding) is a fast way to deliver SG experiences, although the ability to generate detailed and fit-to-purpose solutions is not perfect (Abbott, 2018; Sousa, 2021b). These game usages work as engagement tools and are suited to explore soft skills that can be useful for a CP process (Ampatzidou et al., 2018; Devisch et al., 2016; Sousa, 2021b, 2022e).

Our codesign process (three steps) resulted in an analogue collaborative serious game (S3) where participants (stakeholders, city councillors, planning experts and civil servants) can play to set the priorities and solutions to increase the overall security of an urban zone. The serious game has two stages (S3.a and S3.b). In the first stage (S3.a), participants exchange white cubes (votes) with coloured cubes that represent types of problems, locating them in the map of the urban zone (divided with hexagons. In the second step (3.b), each participant receives coins (representing a part of the overall budget) at the beginning of four rounds (years). They can discuss strategies to spend the coins pieces (representing a real investment value) in several available generic solutions (technically viable). Some cost more coins than each player has available, forcing participants to get the support of other participants until they have the necessary money to pay for the solution (spending coins). Participants place the necessary coins on the support tables, replacing the game piece that represents the generic proposal (see number 1 in Figure 9.2). Then participants place the obtained piece (proposal) on a second map (similar to the one of the first step), marking the proposal location (see number 2 in Figure 9.2). The game ends after four rounds. This collaborative game resulted from a codesign methodology, described in the following section.

[18] Ortho(dox) games are considered commercial games made for entertainment, with defined win-and-lose conditions.

Figure 9.2 – Result from the S3.a with DL (1 – Support tables; 2 – Map to place the game pieces; 3 – supply of coin pieces (money) (Source: author))

9.5. Methodology

The following subsections present the methodology for developing the final serious game (S3) and collecting data. We followed a co-design and design thinking approach where the creations from the previous steps (S1 and S2) generated data for serious game development. This creative process demanded flexibility and combining quantitative and qualitative data. The codesign method required two game sessions where stakeholders interacted and identified options to explore in the final serious game (S3). This specification required us to explain this previous process in the methodology and how it affected the game (e.g., game economy).

In S1, all the stakeholders (n_{S1}=17) were together, working in three separate tables. Stakeholders were divided into two groups in S2 ($n_{s2.1}$=4, $n_{s2.2}$=6) and in S3 ($n_{s3.1}$=5, $n_{s3.2}$=4. The sessions for City Councillors (CC) (n_{cc}=11) and Department Leadership (DL) (n_{DL}=10) did not have these restrictions. Due to the low number of participants per session (less than 20), we only present median ($\tilde{x}$) values and their variations (before and after) of the participants' perceptions. Each session was set for approximately two hours.

9.5.1. Defining a codesign process to build the serious game

We defined a three-step process with three different sessions to deliver a game-based CP for UrbSecurity, fowling multi-step codesign principles combining planning where the knowledge from professionals and stakeholders/citizens helped to design the game (Champlin et al., 2021; Van Empel, 2008). In Session 1 (S1) and Session 2 (S2), we modified a set of MBGs (i.e., *Dixi*t, *Telestrations*, *Ikonikus*) to engage participants and foster collaboration and creativity (Sousa, 2020b). Before session 3 (S3), we developed a new game by combining MBG mechanisms, PO information/suggestions, and the stakeholders' preferences from S1 and S2. The schematic flowchart to implement our three-step co-deign proposal is presented in Figure 3, detailing the purpose of each session, game usage, and outcomes to be classified as an overall SG approach. After the games, there was a moment of debriefing and discussion with the participants conducted by the RT and PO facilitators. All the game sessions (S1, S2 and S3) should deliver ways for the participants to express themselves in a collaborative playable environment (yellow box in figure 9.3).

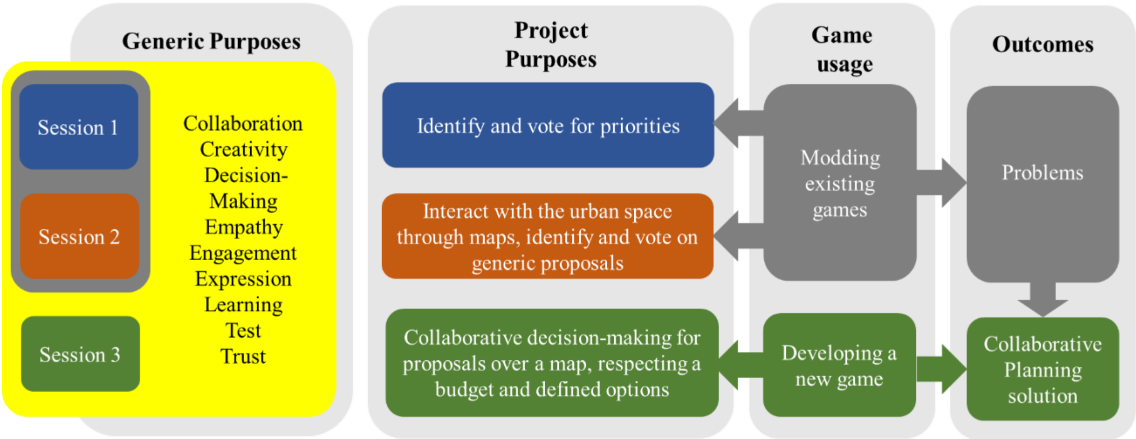

Figure 9.3 – Result from the S3.a with D (1 – Support tables; 2 – Map to place the game pieces

In S1, participants used storytelling, drawing, and communication games to share information and establish empathy. The S1 process (Figure 9.4) was set to introduce the participants to the process, do the ice-breaking, foster teamwork, and divergent and convergent thinking (creative process) to define the collective priorities to increase the urban security of the zone (Kaner, 2014; Wates, 2014). These collective experiences helped them to frame the problems collectively. Participants sited at tables with no more than six persons forming three groups (One PO facilitator per table). Detailed information about the games can be found at BGG (BGG, 2000) and footnotes (according to the publisher).

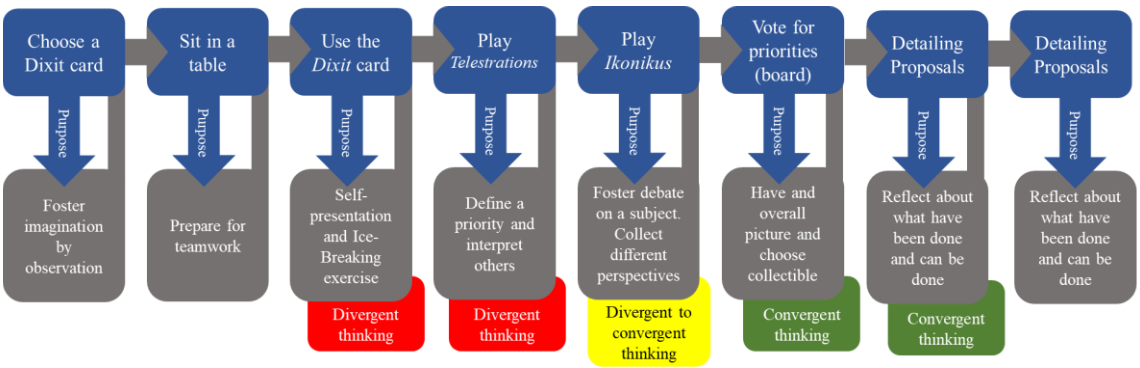

Figure 9.4 – Session 1 (S1) process detailing the game usages, purposes, and divergent/convergent thinking.

First, each participant picked a *Dixit*[19] (Roubira, 2008) card (illustrated with surrealistic pictures) from a table to do their self-presentation for the group. Then played a modified version of *Telestrations*[20] (Användbart Litet Företag, 2009), writing in their notepads a word that represented their priority to increase the safety in the HCCL. After, the participants played a modified version of *Ikonikus*[21] (Palau, 2013) to explore their identified priorities as a group. Each participant would play once as a narrator and expose a security concern. Each other participant played cards to deliver feedback. Then the session general facilitator (RT) asked each table to propose priorities to add to a board. Giving six votes per participant, the participants distributed the votes per priority. After this, each group of stakeholders filled out Form 1 (F1) (Appendix E), where they detailed the most voted priorities (e.g., writing how to solve it, who should solve it, when, and with what resources). Participants voted in a second voting round (six votes per person) in the forms (F1) detailing the priorities.

Figure 9.5 – Voting and Proposal presentation during S1 (Source: author).

In S2, participants worked to add more detail on their priorities as groups. Again, MBGs were used to generate interactions, collaboration, and expression. In S2, the purpose was to complement the results from S1, allowing the participants to deal with maps and graphical representations of the urban area subject to analysis. We adapted *Fake Artist Goes to New York*[22]

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[19] "Each turn in Dixit, one player is the storyteller, chooses one of the six cards in their hand, then makes up a sentence based on that card's image and says it out loud without showing the card to the other players. Each other player then selects the card in their hand that best matches the sentence and gives the selected card to the storyteller, without showing it to anyone else" (BGG, 2000).

[20] "Each player begins by sketching a […] word. The […] sand timer may limit the amount of time they get to execute their sketch, but it certainly doesn't limit creativity! Time's up! All players, all at the same time, pass their sketch to the next player, who must guess what's been drawn. Players then simultaneously pass their guess -- which hopefully matches the original word (or does it??) -- to the next player who must try to draw the word they see -- and so on" (BGG, 2000).

[21] "[…] In the game, a player raises an issue and the others must choose which of their cards best represents that emotion. Each card represents an emotion with multiple readings." (BGG, 2000).

[22] "[…] is a party game for 5-10 players. Players take turns being the Question Master, whose role is to set a category, write a word within that category on dry erase cards, and hand those out to other players as artists. At the same time, one player will have only an "X" written on his card:

(Sasaki, 2012). In this game, a narrator expressed a problem, passing written information about it to all participants except one. Then the narrator sketched the same problem on the urban zone map, and all the other participants completed the drawing without ever telling what the problem was. The result was a graphical representation of the problem, using the map layout of the urban zone (mixing the game mechanisms with the map). Next, the narrator explained the problem at stake. After this, all the participants defended their drawings/sketches, discussed, and voted to find which participant ignored the information. After all participants played as narrators, they discussed generic proposals expressed in the collective drawings and voted on the generated proposals (Figure 9.6) as in S1 to define the most important ones (same voting system).

Figure 9.6 – S2 sessions: Playing *Fake Artist Goes to New York* modified version (1), a drawing result regarding accessibility (2) and the voting system with several post-its per participant (3) (source: author).

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they are the fake artist! Players will then go around the table twice, drawing one contiguous stroke each on a paper to draw the word established by the Question Master, then guess who the fake artist is. If the fake artist is not caught, both the fake artist and the Question Master earn points; if the fake artist is caught and cannot guess what the word is, the artists earn points" (BGG, 2000).

S3 demanded a longer development process and working together with the PO. The available options/choices for participants in the S3 game resulted from the identified priorities and problems during S1 and S2. S3 was divided into two stages (S3.a / S3.b) (Figure 9.7). In S3.a, participants vote on problems by replacing the coloured cubes with their white cubes (votes) and placing the coloured ones on the map of the urban zone (divided into hexagons). This process resulted in a graphic of priorities (replaced white cubes on a table) and the spatial location of the problems (coloured cubes over the map). S3.b occurred in another table near the first one (S3.a) so the participants could track the identified problems. In the second table, participants played four rounds (one round per year, representing a municipal government term) where they could spend their part of the budget represented by the game coins (each player got limited coins per cycle) to choose from the available options. The available options were codesigned by the RT and PO, using information from S1, S2, and internal data from the municipality. Each session was supported by a facilitator from the RT and several from the PO.

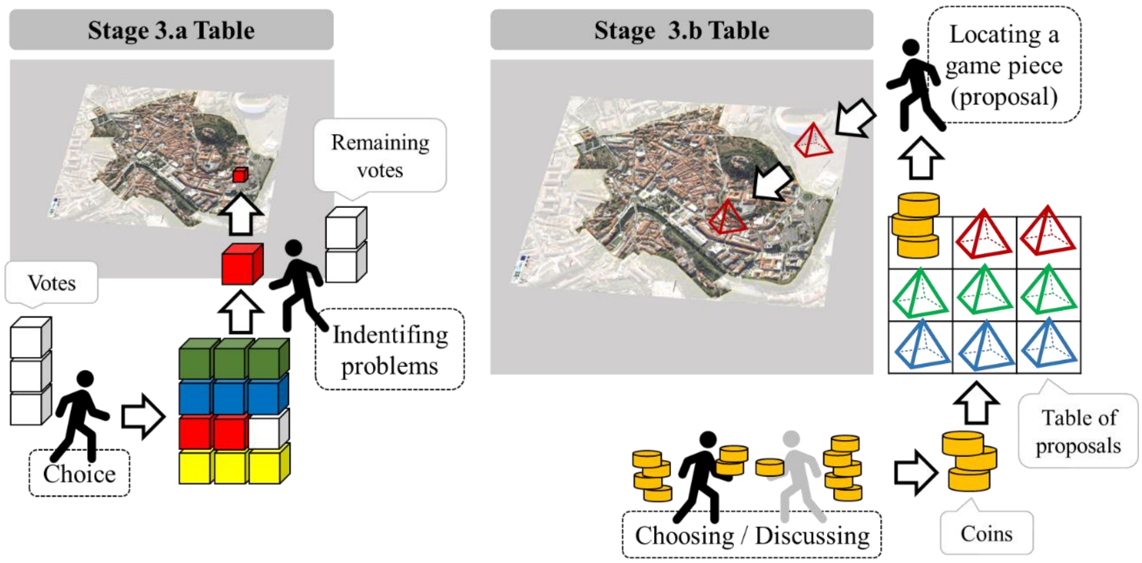


Figure 9.7 – S3 play scheme. S3.a: voting with cubes. S3.b: spending coins (combining) to choose and place solutions (game pieces represented by a pyramid) on the map.

Each coin represents an average of 30K€ (according to the ML internal costs). The game was tested with 10K€ per coin, but it increased the game duration by over an hour, and the stacks of coins were prone to falling during handling in the proposals with a higher cost. After spending the four year budget, participants filled in Form 2 (F2) (Appendix E), describing how the overall solution increased safety in the urban zone. F1 and F2 forms were introduced to help participants summarise, reflect, and justify their collective decisions during the games and provided the PO with data to build the UrbSecurity report. These forms were developed with the help of the PO as ways to collect data for the *UrbSecurity* report.

Figure 9.7 illustrates S3.a and S3.b stages, showing the voting (S3.a) and budgeting of proposals (S3.b). Figure 9.8 presents the gameplay of the final serious game (S3), the rooms and game components display.

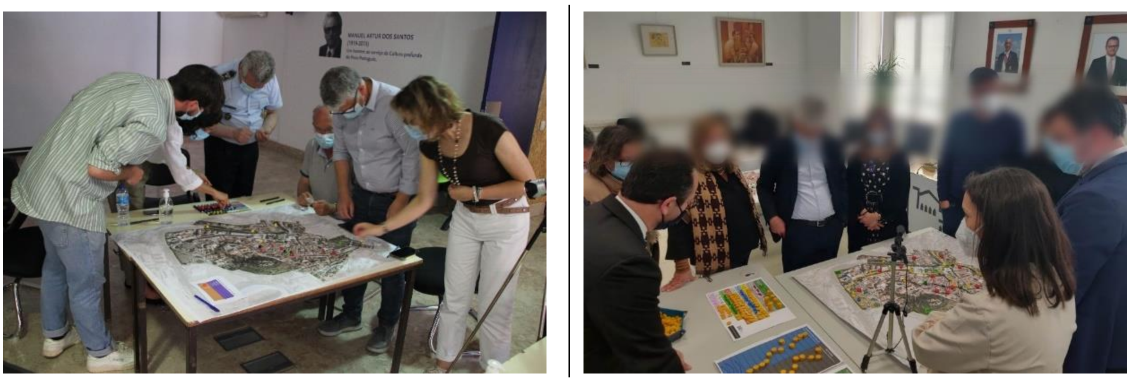


Figure 9.8 – Stakeholders and Elected Officials (EO) playing S3.a and S3.b stages. *(Source: author)*

9.5.2. Collecting data

In each session (S1, S2, and S3), we used pre-workshop and post-workshop surveys to collect information about the game-based process, participants' experiences with the games, the perception of the effectiveness of the process, suggestions, and general comments (Goodspeed et al., 2020; Rouwette et al., 1998; Sousa et al., 2022a), detailing the gaming dimensions (playability and enjoyment) and serious goals of the experiences (generating collaborative planning proposals) (Mayer et al., 2014; Sousa, 2021b). The surveys collected information about the perception of the importance of collaborative planning and using new strategies to engage participants (e.g., game-based collaborative planning) (Appendix E).

S3 surveys add new questions regarding the experience with the serious game, evaluating its playable dimensions and ability to deliver a collaborative planning tool. Only during S3 was the serious game ready to be evaluated according to the purposes set for *UrSecurity* because S1 and S2 were necessary to develop S3. For S3, we asked additional questions to participants if the collective proposals improved their individual ones, if the overall set of proposals was coherent, and if they should be implemented.

Although the purpose of the paper is to explore the effectiveness of the serious game delivered to participants during S3, we included the participants' perceptions from S1 and S2 in the quantitative results tables. This inclusion allowed us to compare two types of game usage, modding in S1 and S2 and creating a new game in S3.

In S1 and S3, participants filled in forms (F1 and F2) to detail their priorities (S1) and proposals (S3). This data supported the action plan PO should deliver for the *UrbSecurity* initiative (*Urbact* projects demanded data collection from a participatory process). During S2, there was no form because it was done to complement the identification of proposals from S1).

During S3, maps were video recorded to track the game's progress (for research purposes). All the other outputs were photographed, including the voting results and the forms (F1 and F2) done with post-its, paper, and pens. The inquiries and the graphical information generated summary tables and graphics (With less than 20 participants per session, statistical analyses lacked statistical validity).

9.6. Exploring the S3 game design and game economy

The proposals appearing in S3 serious game resulted from the problem and proposal identification by the stakeholders during S1 and S2. After analysing this information, the RT and the PO build the game economy (available resources and options for the players). For the S3.a stage, participants could choose to replace their votes (white cubes, see Figure 9.7) to choose from ten types of problems (represented by coloured cubes):

- Lack of cleaning and hygiene (Brown).
- Lack of public lighting (Yellow).
- Inefficient public infrastructures (water, power, etc.) (Blue).
- Inadequate accessibility and mobility (Grey).
- Low surveillance (formal and informal) (Black).
- Lack of social welfare programs (Pink).
- Building degradation (red).
- Lack of empathy and civilian attitude (Orange).
- Lack of green spaces and parks (green).

The available pieces representing the proposals (S3.b) followed a similar colour code as the problem cubes (S3.a) (e.g., red for buildings, yellow for illumination, etc.). These available choices with the respective quantity and costs (S3.b) are presented in Table 9.1. The costs (coins) per piece (proposals) resulted from costs identified by the PO and the ML. The number of pieces (proposals) available for participants to choose from during S3.b resulted from the identified problems and proposals during S1 and S2 (Figure 9.8). Table 9.1 presents these results from the voting system S1 and S2 in percentage, expressing the concerns and preferences of the stakeholders (participants in S1 and S2). Each problem was codified with an ID to ensure it was considered when setting the proposals for S3.a.

Table 9.1 – Stakeholders votes in S1 and S2 to identify problems and priorities (%)

Identified problems	Problem ID	% Of Votes per session		
		S1 Problems	S1 Proposals	S2 Priorities
Lack of cleaning and hygiene	1	0.00	0.00	14.71
Lack of public lighting	2	27.66	27.50	0.00
Inefficient public infrastructures (water, power, etc.)	3	6.38	2.50	0.00
Inadequate accessibility and mobility	4	27.66	25.00	59.24
Low surveillance (formal and informal)	5	0.00	0.00	11.76
Lack of social welfare programs	6	4.26	0.00	0.00
Building degradation	8	12.77	17.50	39.29
Lack of empathy and civilian attitude	7	12.77	22.50	0.00
Lack of green spaces and parks	9	8.51	5.00	38.24

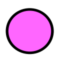
Options for participants to choose	Game piece	Price per piece	Available quantity
Cleaning and hygiene		1	12
Public illumination		2	12
General public infrastructures		3	20
Parking		10	6
Sidewalks and bicycle lanes		2	20
Public Transportation		2	20
Pedestrianization		1	10
Roadways		3	20
Policing		2	12
Civilian and social welfare programs		1	8
Marketing, signals, and information		1	8
Urban renewal programs		2	12
Green and leisure parks		5	6

Figure 9.9 – Game pieces, quantity, and price for S3.b proposals

The quantities and costs of Figure 9.9 were redefined through playtesting (playing and correcting the game) and discussing with PO to deliver enough choices/options to participants while avoiding undesirable repetition. A defined budget of 10 million euros necessary to build all the proposals was represented by a limit of 350 coins. During the playtesting, we tested 10K€ per coin (requiring 1.000 coins). So many coins were difficult to handle during the game, making it long and fiddley. During the game (four turns), the facilitator only provided the participants between 220/240 monetary units (depending on the number of participants), limiting the participants' choices. They could do 60% and 70% of the combinations of available proposals. This constraint forced them to make decisions and prioritize investments per year (turn). The unpredictability of how many participants would attend (between 4 and 12) forced us to adapt the game each time, changing the number of coins each player received per turn while avoiding them spending more than 70% of all available game pieces (proposals). From a game design perspective (using the board game design terminology), we used the following game mechanisms (Engelstein & Shalev, 2019; Sousa et al., 2021b) to deliver game experiences for S3.b (scheme in figure 10):

- Tile placement: to change and add proposals (game pieces per option) to the map.
- Tableau building: track the cost and budget spent because players should replace the game piece (Table 1) with the necessary monetary units and add it to the map; when players remove a piece from a board the cost is revealed.
- Cooperative play and negotiation: players discuss and negotiate to form networks/connections of pieces; some options cost more than the money each player received for the turn (can go beyond zero-sum).
- Income /Renewal cycles and resource limits: players received a fixed quantity of coins per turn, representing their power to influence the collective budget spending.

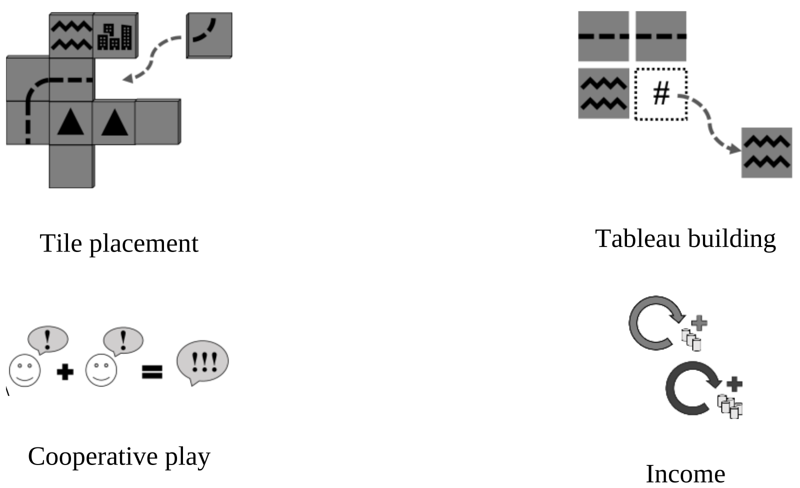


Figure 9.10 – Schematic representation of the board game mechanisms used in S3.

9.7. Serious game results

Table 9.2 presents the percentage of the votes' allocation in S3.a for each session with different participants (stakeholders, CC and DL), identifying the relation to the ID problems. Table 9.3 shows the budget percentage allocation to each game option in each game session (S3.b).

Table 9.2 – Percentage of participants' votes per problems (%) during S3.a

ID Problems	S3.1	S3.2	S_{CC}	S_{DL}	Average ($\bar{x}$)
1	9.84	16.39	18.52	9.26	13.50
2	16.39	9.84	18.52	14.81	14.89
3	8.20	6.56	1.85	16.67	8.32
4	16.39	11.48	3.70	16.67	12.06
5	9.84	4.92	12.96	11.11	9.71
6	4.92	9.84	3.70	5.56	6.00
8	16.39	16.39	18.52	18.52	17.46
7	8.20	8.20	16.67	5.56	9.65
9	9.84	16.39	5.56	12.96	11.19

Table 9.3 – Percentage of the budget allocation per proposal type for S3.b sessions

Proposals/ Game options	ID	S3.1	S3.2	S_{CC}	S_{DL}	Average ($\bar{x}$)
Cleaning and hygiene	1	4.78	4.98	5.43	2.50	4.42
Public illumination	2	9.57	9.96	10.86	5.83	9.05
General public infrastructures	3	10.43	4.98	16.29	18.75	12.61
Parking	4	17.39	12.45	9.05	8.33	11.81
Sidewalks and bicycle lanes	4	8.70	9.13	2.71	5.83	6.59
Public Transportation	4	4.35	9.13	11.76	12.50	9.44
Pedestrianization	4	3.48	4.15	0.90	2.50	2.76
Roadways	4	6.52	17.43	16.29	16.25	14.12
Policing	5	4.35	4.98	1.81	3.33	3.62
Civilian and social welfare programs	6	3.48	3.32	2.71	2.92	3.11
Marketing, signals, and information	7	3.48	3.32	2.26	2.92	2.99
Urban renewal programs	8	10.43	9.96	10.86	10.00	10.31
Green and leisure parks	9	13.04	6.22	9.05	8.33	9.16

9.7.1. Mapping the proposal results from S3

For each S3 session, the results were different, even among similar participants like the stakeholders' groups (S3.1 and S3.2).

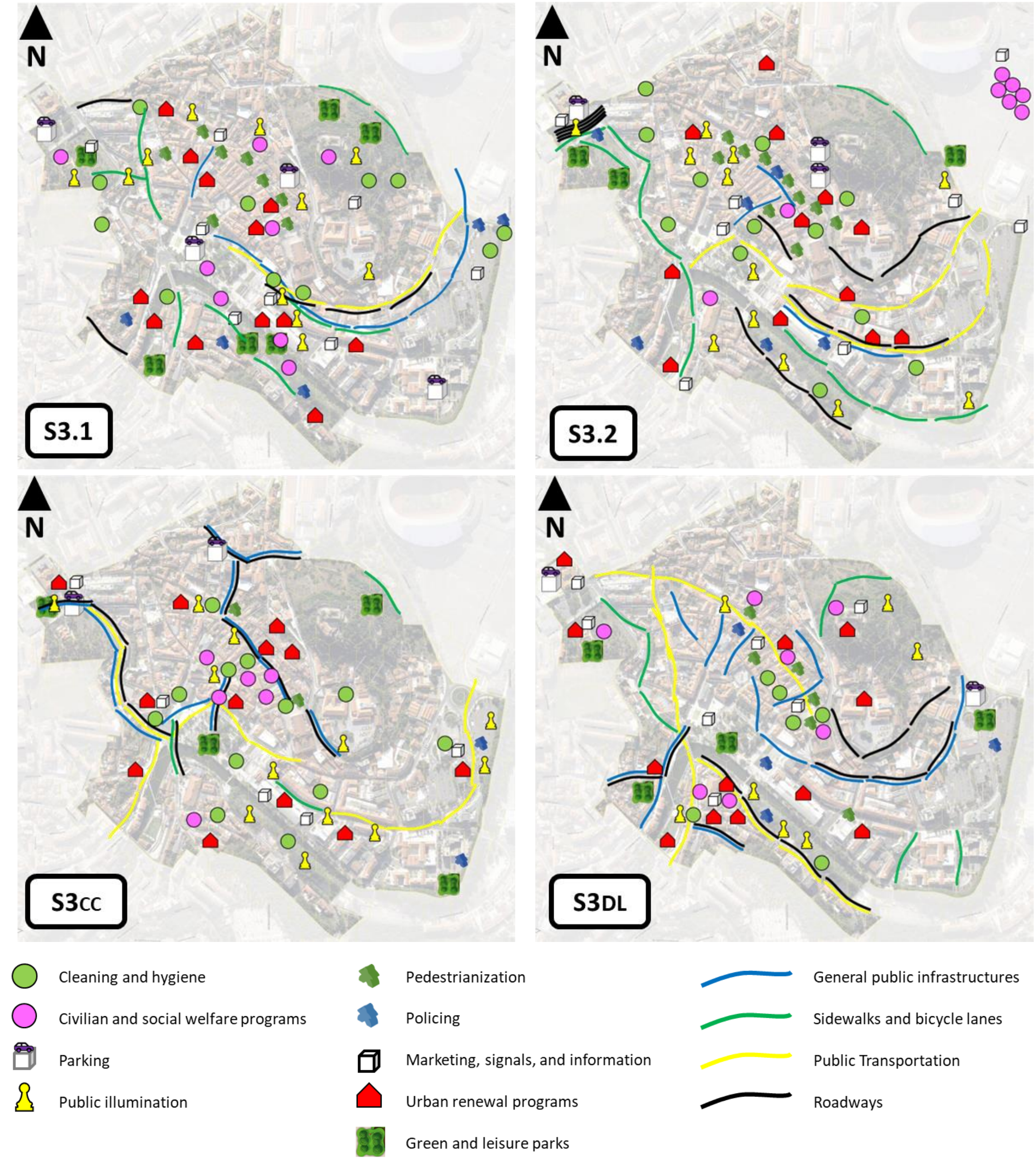


Figure 9.11 – Game results from S3 sessions.

In Figure 9.11, we grouped the choices of all participants during S3 for four types of proposals, two regarding proposals participants identified as affecting the sense of security directly (1 - Policing, 2 - Public Illumination) and two others that indirectly affected the sense of security, regarding the urban image (3 - Urban renewal programs, 4 - Green parks and leisure). These maps (Figure 9.12) exemplify the location of the proposals; higher concentrations mean that the participants located more proposal pieces in similar places.

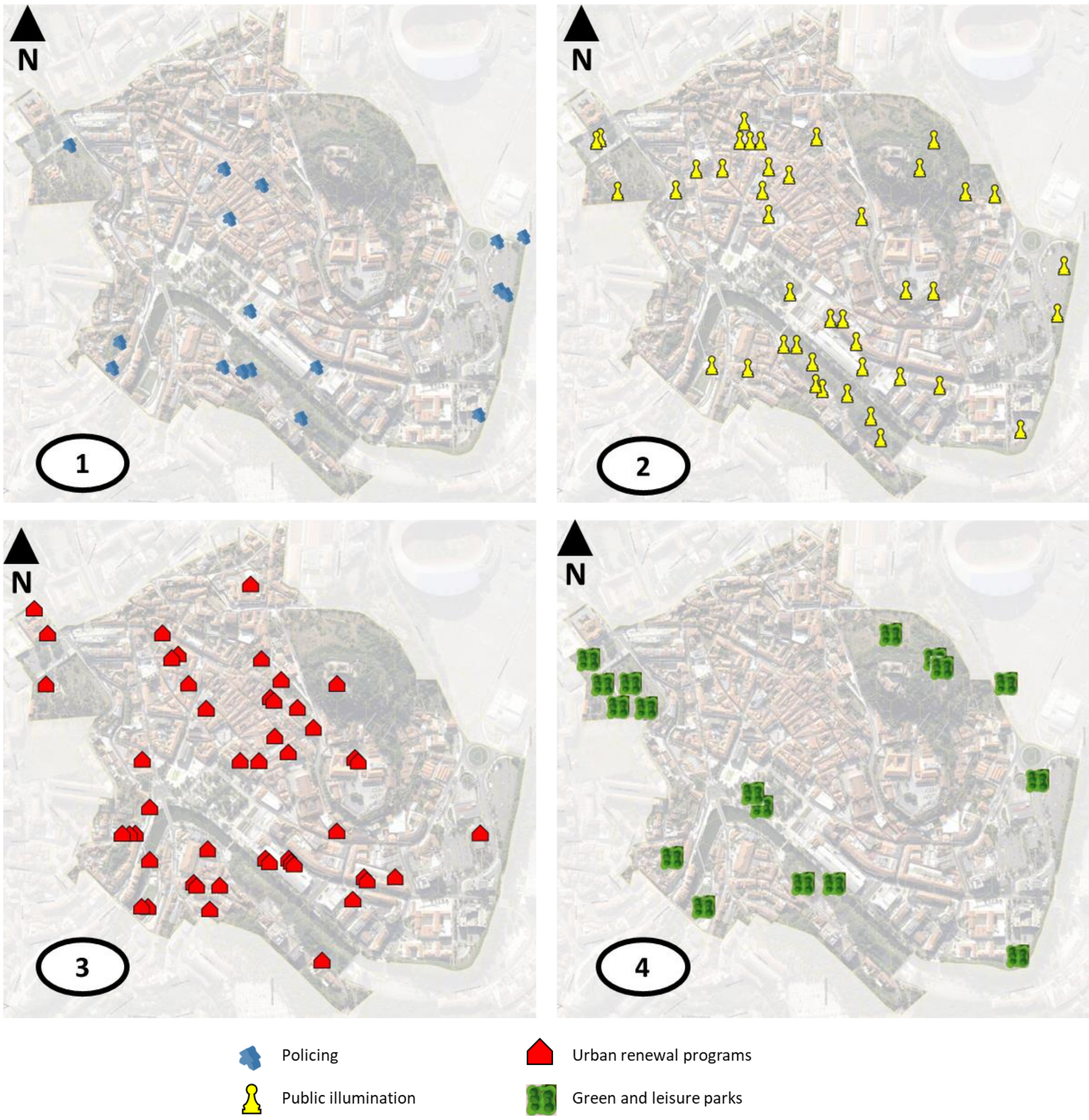


Figure 9.12 – The sum of the results from S3 sessions proposals for Policing (1), Public Illumination (2), Urban renewal programs (3), Green and leisure parks (4).

9.7.2. Survey results

The quantitative results from the preworkshop assessment test and the postworkshop test (Likert scale 1 to 7) are represented in Table 9.4 and 9.5 results. As explained before, S3 survey included new questions to address the effects of playing the serious game. S3 was the tool to identify and propose proposals to increase the urban safety. This was the serious game that we wished to evaluate. S1 and S2 were also important but as a process to develop S3.

Table 9.4 – Results regarding participants' perceptions for the sessions (S1, S2 and S3) ($\tilde{x}$ values).

Session	Empathy with facilitators	Feeling of Competence	Difficulty level	Collaboration	Sharing ideas	Generated Learning	Addressed urban security	Collective improved individual	Coherent solution	Different priorities	Should be implemented	Should be Repeated	Participate again
S1	7.0	6.0	2.0	6.0	7	7.0	6.0	-	-	2.0	-	7.0	7.0
S2	6.0	6.0	2.0	6.0	6.5	6.0	6.5	-	-	5.5	-	7.0	7.0
$S3_{1+2}$	6.0	5.0	3.0	6.0	6.0	6.0	6.0	7.0	6.0	2.0	6.0	6.0	6.0
$S3_{CC}$	6.0	6.0	2.0	6.0	6.0	6.0	6.0	6.0	6.0	3.0	6.0	6.0	6.0
$S3_{DL}$	6.0	6.0	2. 0	6.0	6.0	6.0	5.0	6.0	6.0	3.0	5.5	6.5	7.0

Table 9.5 – Participants' perception changes before and after the sessions (S1, S2 and S3) ($\tilde{x}$ values).

Session	Motivation / Excitement			Empathy with the group			Importance of collaborative planning			Importance of engaging participants (B) and using ludic approaches (A) in planning		
	Before	After	Variation	Before	After	Variation	Before	After	Variation	Before	After	Variation
S1	6.0	6.0	0	6.0	7.0	+1.0	6.5	7.0	+0.5	7.0	6.0	-1.0
S2	6.0	6.0	0	6.0	6.0	0	6.5	6.5	0	6.0	6.0	0
$S3_{1+2}$	6.0	6.0	0	6.0	6.0	0	6.0	7.0	+1.0	6.0	6.0	0
S3cc	5.0	6.0	+1.0	5.0	6.0	+1.0	6.0	6.0	0	6.0	6.0	0
$S3_{DL}$	4.5	6.0	+1.5	5.5	6.0	+0.5	5.0	7.0	+2.0	6.0	6.5	+0.5

In the post-test questionnaires, the participants could write comments regarding their experience. Table 9.6 shows the overview of commentaries, organized per statement type, according to the grounded theory principles (Charmaz, 2014). The 46 participants in all sessions produced 24 comments: 55 referred to positive issues, while 4 to negative ones. We considered positive the comments that highlighted the purposes of the serious game (e.g., debating, collaborative decision-making, enjoyment, etc.). As negative, we considered the comments that revealed failures to deliver a collaborative decision-making process, including the game dimensions like duration and the required number of players to play the game.

Table 9.6 – Type of statements referred by the participants in the comments.

Classification	Type of comment per issue/cluster	Number of comments
Positive	Collaborative	7
	Meaningful debate	5
	Generic positive	14
	Idea sharing/generation	7
	Interactive/Involving	11
	Useful results	11
Negative	Manage/enough time	2
	Need more participants	1
	Some options were individualistic	1

9.8. Discussion

Participatory Action Research and co-creation principles helped establish the proposed SG approach. The unpredictable number of attendants demanded adapting the games each session. Despite following a predefined protocol (Figure 9.2), we learned and collected new information from each session. Playtesting with the PO defined the SGs, but each session with the users (stakeholders, CC, and DL) revealed improvements for the game. This show that developing serious is an ongoing iterative improvement that follows the design thinking process and co-design applied to collaborative planning (Champlin et al., 2021): define ideas, test, and adapt to purpose. To maintain the same game (e.g., game economy), we only improved the quality of the game components. Introducing yellow pawns that looked like public lamps helped the participants to differentiate from other generic game components like coloured discs (St3.b). Using white cubes instead of white discs for the voting in the S3cc and S3dl. Although this was just a change in the game materials (bits and components), it helped visualize the information (e.g., the table to place the votes for S3a generated a graphic of priorities with similar objects (Figure 9.13).

Figure 9.13 – Table to place the votes for the stage s3.a. Done with discs and other components to mark problems (Left) and done only with cubes (right). *Source: author*.

It was notorious that each group of participants proposed different solutions, even when they are all stakeholders (S3.1 and S3.2) (Figures 9.11). Stakeholders should be representative of the urban zone at stake, people, claims, activities, etc. (Calderon & Westin, 2021). Defining who will participate in the game is important because it affects results (in this case it was set by the ML). Table 9.3 shows the percentages of budget allocation per session, highlighting the highest values per type of proposal. Stakeholders were the ones more concerned with the need for more parking solutions. CC focused on the renewal of the public buildings, whereas the stakeholders focused on the private ones that affected the city's image the most, like the central bus station. DL were concerned with the infrastructure, the flooding, and the efficiency of the transport system. Nevertheless, all agreed that some spaces needed more public illumination, and some parks should become more agreeable and less frightening due to abandonment and excessive vegetation (Figure 9.12). The Pedestrianization of *Rua Direita (Figure 9.1)* was unanimous since it is the primary street of the historic city centre, and the conflict between automobiles and pedestrians happens due to its narrow section. The S3 proposals seem to reinforce the claims of the local residents and shop owners (Silva, 2023). New parking was something stakeholders and CC agreed on, locating them near the City Hall and the Castle (Figure 1 and Figure 9).

Regarding the participants' (stakeholder, CC and DL) perception, Tables 5 and 6 reveal that the participants found the experience valuable and reached the purposes of collecting their contributions and providing collective proposals (scores above 5.0). Participants (all sessions) considered that the sessions generated empathy (min. of 6.0 after play), were not complex (max. of 3.0), helped to generate ideas (min. 6.0), and fostered learning (min 6.0), which are traits of collaborative planning (Table 5). The perception of collaboration was high during all the sessions. In $S3_{CC}$, the facilitator noticed that the freedom to play without a turn order and that all players had the same votes and money helped to level the power relation (there were institutional hierarchical differences between the participants).

Table 5 reveals that all participants would like to repeat the session (min. 6.0), but S1, S2 and $S3_{CC}$ classified it higher (7.0). These were the session where the desire to implement the proposals was higher. Free comments can shed some light on this. Participant 31 (P31) said that "*You should repeat the game with the people that live there*", while Participant 34 (P34) wrote that "*I hope that these proposals are done for real*". It seems that stakeholders are willing to participate (7.0), and we interpret that they demand more participation and that the results of their participation are consequent (desire to see the proposals implemented $\tilde{x} = 7.0$).

None of the participants stated that the available choices were incorrect or that other ones were missing, neither during the game nor in the commentaries. We argue that this can be interpreted as an apparent success of the codesign process, at least for problem identification (S3.a) and the proposals to spend the budget (S3.b). The only negative feedback was the downtime in S2, related to the time some participants took to make their moves which made others wait. Also, during the $S3_{DL}$, P51 asked for more time to discuss the choices. In $S3_{CC}$, P39 argued that the game was prone to individual moves. A single participant could place a game piece without other players' contributions (coins) because the coins they received per turn were enough to pay for some proposals (e.g., policing, public illumination) but not for others (e.g., Parking). This easiness to pay coins for some pieces is a design fragility considering the players' perspective. But it was an intentional design choice. We offered individual and collective choices because the individual actions would reduce the available money for expensive collective plans. These situations lead to discussions in every S3 session. It was a way to enforce negotiation among participants. We were also aware that the unpredictability regarding the number of participants in each session demanded redefining the available coins per player (Sousa et al., 2022a). Reducing the coins per player/cycle would increase the game duration above two hours. Increasing the value (number of coins) for choices like “Policing” and “Cleaning and hygiene” would distort the prices when compared to costly options like “Parking”. These design choices are clear examples of the balance between playability and simulation of serious game processes (Dörner et al., 2016).

The overall low perception of complexity (maximum of 3.0) and desire to participate again (minimum 6.0) are indicators of adequate playability. The motivation/excitement measured before and after the sessions reinforce this perception (Table 6). After all the sessions, the motivation/excitement and empathy with the group (of participants) stayed unaltered or increased. Because half of the participants (stakeholders) played all the games during S1, S2 and S3, the novelty effect of using games and already knowing the other participants might have reduced the empathy with the group for S2 and S3. However, when comparing the values about “if planning processes should be more engaging” (before the sessions) and “if ludic approaches should be used more often” (after playing the games), the variation was not always neutral or positive. In S1, this variation was negative (-1.0), and the only positive change occurred in $S3_{DL}$. The $S3_{DL}$ recorded a higher increase in motivation/excitement (+1.5) and even higher regarding the advantages of using collaborative planning approaches (+2.0). We interpret that public servants and their leaders considered the SG methods as solutions to improve participation and collaboration. DL comments corroborate this interpretation: “*Very interesting session. I liked the methodology. To repeat*.” (P48); “*This methodology should be used for the local participatory budget*” (P53); “*Very dynamic. Allowed us to reflect about the problems and solutions with pairs. Something we cannot do regularly*.” (P54). We can say that participants recognized the "need for more engagement in planning" (min 6.0 and max 7.0). But they did not consider the "use of ludic approaches in planning" with the same importance (min 6.0 and max 6.5). We interpret this as a failure to establish undoubting awareness of the ludic approaches as direct ways to increase engagement in planning. Apparently, only the DL participants established this possible relationship (+0.5). The collected commentaries reinforce the absence of ludic references. Only P25 referred to the ludic dimensions, saying that “*The ludic dimensions were very interesting*”. Having this unique statement might result from unawareness or prejudices about game usage for serious purposes (Ampatzidou et al., 2018). Arguably, the ludic dimension is assumed to be less relevant, and the proposed serious game was not enough to highlight it for all participants. It appears that the developed serious game (S3) was more effective to generate awareness of the use of games as ludic approaches to planning (6.5) (Table 9.5). S1 and S2 games were more generic and can be adapted to other group dynamics (Sousa, 2021b, 2020b).

Because $S3_{DL}$ were the last participants to play the game, another effect might explain the higher scores. The facilitator was more trained to conduct the game, explain the rules, and help the players to deal with the game.

9.9. Conclusions, limitations, and future research

Designing SGs for CP is challenging when we need to keep the participants' engaged during long and continuous sessions. A game can be a tool to explore complex problems, deal with chaotic interactions, foster collaboration, and reinforce collective decision-making. In our case, we adopted a step-by-step codesign method that allowed us to use simple rule sets of game mechanisms, maps, tables, and analogue game components. This serious game development process helped the PO build the *UrbSecurity* action plan (Urbact, 2022). As expected, the proposals approached security as the result of the improvement of generic urban dimensions.

However, the serious game that resulted from the development process (S3) was prone to some problems. Establishing the game economy forced us to adopt 30K€ per coin, which confused some participants. Another direct effect was that the participants could do some of the proposals without discussing them with other participants (their individual income was sufficient to play the coins of the proposal). This economic dimension is a serious game design typical problem due to the need to balance playability and simulation (Dörner et al., 2016). The game demanded considerable logistics (rooms for two tables 2.0x2.0m) and a permanent facilitator to enforce the rules, provide income (coins), control time and clarify doubts. The facilitators' independence might be biased if they know the participants. The way they explain the rules can make suggestions that affect the participants' decisions. The facilitators' experience conducting the game can also affect the participants' experiences of enjoyment and mastering the game. However, the participants' perceptions seem to indicate that the developed game (S3) was perceived with higher potential as a tool for planning purposes (positive perception variations after playing the S3 game; see Table 9.5).

Games can be useful tools for planners, although the game design and the facilitators' performance may affect the outcomes. Our experiment revealed that the results might be perceived as less coherent than desired because this dimension did not get the higher classification in any session (always 6.0). Stakeholders seem eager to have new effective ways to participate and influence decisions, but they demand results. The ability to generate proposals appears to surpass the value of the ludic dimension. Adopting cocreation approaches helps develop tools for expressing the stakeholders' claims and delivering data for planners. Though serious games resulting from codesign process can be useful as planning support systems (PSS). We argue that our game was a tool to engage participants and provide them with means to discuss, decide, and generate data, not a solution to replace the standard planning process. We believe that the proposed serious games emerged from a method that other fields dealing with human complexity can also explore.

Despite the absence of negative comments and critics regarding the game design process, we have not done extensive interviews with the participants to evaluate this. The novelty of using a game for planning purposes, the face-to-face interactions and the formality of the survey might have restrained the participants' negative comments or critiques. Doing a focus group and structured interviews with the participants, conducted by a different facilitator, might clear these doubts.

Another limitation was the number of participants. The Covid-19 lockdowns and restrictions stalled the process and forbidden sessions with no more than six persons per room. The participants could not see the proposals from other participants. Having sessions where several groups playing the games (simultaneously) would deliver new interactions that could enrich the testing of the serious games. The ML invited the stakeholder directly. Some never appeared in the session because it was voluntary participation. Other stakeholders' representatives changed from session to session. This instability is a methodological difficulty because of the data variability, and we cannot know why people miss the sessions. We cannot say if this was due to the failure of the overall process and the serious games or any other reason.

Analogue game design techniques are compliant with the codesign and participatory approaches for collaborative decision-making, delivering flexible game-based tools that demand low resources. However, they require game design and facilitation expertise (e.g., like a game master in narrative games that keep the game evolving and progressing according to the designed rules), like the ability to treat the collected information and transform it into useful data for planning. The major difficulty was defining a method to analyse and collect the data from the game sessions. We combined quantitative and qualitative methods and faced the same challenges as referred to in the literature (Mayer et al., 2014; Rumore et al., 2016; Wouters et al., 2013).

Acknowledging the limitation and potentials of analogue game-based approaches is utterly important. We recommend future research on these boundaries, evaluating the costs and effects of detailing the simulation and the participants' reactions. For example, testing longer processes and combining digital technologies with analogue games, like computer vision, dealing with the placement of game pieces on the boards, and generating information in real-time for users.

10. GAME-BASED VERSUS OPTIMIZATION-BASED PUBLIC FACILITY PLANNING: THE CASE OF MARINHA GRANDE (PORTUGAL) ELEMENTARY SCHOOLS

10.1. Introduction

There have been an increasing number of attempts to foster the participation of stakeholders in planning processes, making them more adapted to community needs and development strategies (Bond & Thompson-Fawcett, 2007; Brody et al., 2003; Sorensen & Sagaris, 2010). Some of these attempts aim to make participation more effective and rewarding, increasing the number of participants and gathering new insights and perspectives able to affect the planning decisions (Bobbio, 2019; Bovaird, 2007; Legacy, 2017; Van Empel, 2008). Participants must feel that their time and efforts are useful. Otherwise, they might not want to participate again.

Games have been rediscovered and used for serious purposes during the last twenty years, sometimes in a successful manner (Mayer, 2009; Poplin, 2011). Humans are fascinated by games. Since the dawn of time, games have been always around human communities (Huizinga, 2014). Recently, new game design approaches, aiming for user-centred experiences and collaboration, have been applied to planning practices (Dodig & Groat, 2019b; Tan, 2017).

Although games can be very engaging and attract participants to a planning process, applying them to achieve purposes beyond entertainment is prone to some challenges. One of them is the consistency and quality of planning decisions and overall outcomes of a game-based planning approach. The literature regarding the use of games for planning refers this questionable quality (Sousa et al., 2022b). Another problem of game-based planning is the cost and technical expertise necessary to develop a planning game. Considering the suspicions regarding the outcomes, the costs and the lack of preparation from planners to use game-based approaches (Ampatzidou et al., 2018), these undoubtedly are challenges to consider.

Arguably, games are a way to deal with the crisis of participation (Legacy, 2017) because they invite participants to a planning process that can be effective and pleasant (Constantinescu et al., 2020b; Constantinescu et al., 2015). We know that game prejudice exists and drives away some potential participants (Koens et al., 2020). Saying that a user enjoys gaming is too generic. Users tend to like games according to personal preferences, typified and simplified for game design analysis as player profiles (Zagalo, 2020). When using games for planning, finding ways for the participation of non-player participants is a way to benefit from game usage without forcing people to play them (Sousa et al., 2022a).

In this paper, we want to analyse whether games provide outcomes that planners can use for their planning practices. Can serious games be used as tools to engage participants in finding solutions to real planning problems? And how can these solutions be compared to those of other planning-support approaches like optimization? More, can a low-tech board game deliver all this?

We compared the solutions of an optimizer (*Fico Xpress IVE*) to the outcomes of a board game, replicating the same facility location problem (FLP). Participants played a board game to decide which elementary schools (facilities) would be necessary in the municipality of Marinha Grande (Portugal) to fully cover education demand and minimize the facility costs plus the transport costs of students between their houses and the schools. The game was developed using design mechanisms from modern board games (Engelstein & Shalev, 2019). The playtest and multiple iterative experimentations generated a game that reduced the problem's complexity and helped users reach solutions. Through the game, participants solved the problem effectively in one hour. Besides solving the problem, participants with better local knowledge played the game considering relevant social and cultural factors. From a game design perspective, finding ways to represent the optimization problem in a board game format playable in about one hour and easy to grasp was a creative challenge.

We tested the game in seven sessions with different participants (knowledge, experience, expertise) and contexts (institutions and places). The game was played separately by transport planning and spatial planning PhD students, education and planning city council officials, municipal councillors, local gamers, and professors from the local university (Polytechnic of Leiria). The several game sessions revealed that the participants could reach proposals in general near the optimization solutions. Some participants went beyond the optimization problem as represented in the game, addressing morphological, environmental, social, and cultural issues. This phenomenon occurred more when participants were familiar with the territory at stake.

The paper is organized according to the following structure. The next section presents our planning problem and the following one presents the corresponding optimization model. The serious game we have designed, and the game test sessions and development process, are described afterwards in separate sections. Then we analyse the test sessions and, in particular, compare the solutions obtained through the game with the solution provided through the optimization model. Before concluding, we discuss the whole game experience.

10.1.1. Presenting the Marinha Grande case study

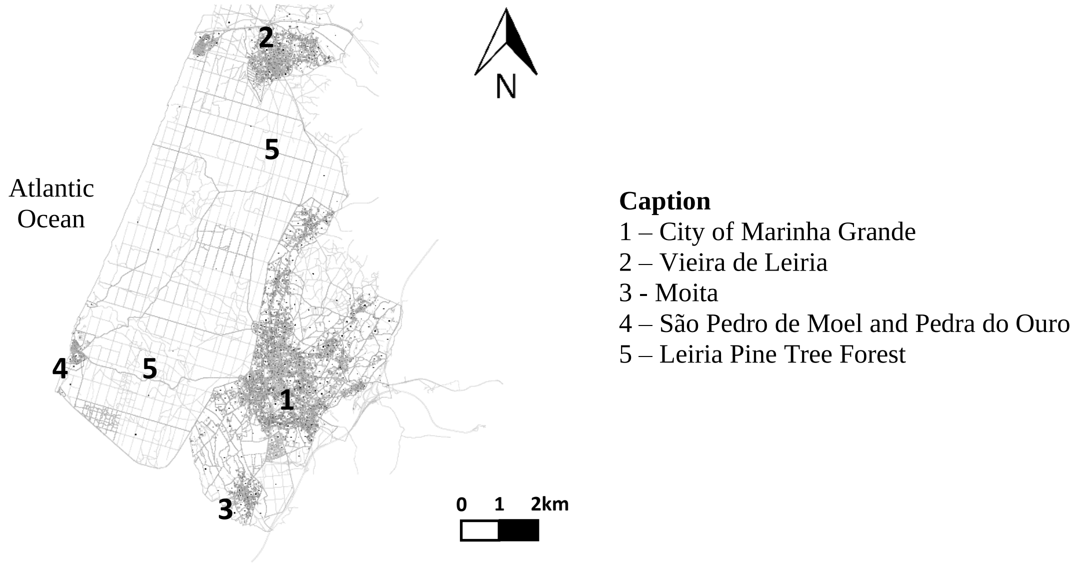


Figure 10.1 – Municipality of Marinha Grande (Portugal).

The municipality of Marinha Grande (Figure 10.1) currently integrates 18 elementary schools, with a total of 66 schoolrooms (an average of 3.66 classrooms per school), located all over the municipality. Many of the existing schools are small and old, and their capacity is not enough for all the resident population from 6 to 9 years old (2002 children, according to the Portuguese census). The Marinha Grande city council desires to renovate the network of elementary schools and that the smallest schools have at least four classrooms. This requirement is mandatory for the Portuguese government to fund the construction of new schools and the renovation of existing ones. There have been local discussions to define the plan for this improved network.

In line with the objectives being considered in the discussions, we have defined a planning problem consisting in minimizing the building and renovation school costs (considering modules of four classrooms) plus the students' transport costs for serving all demand. We assumed that each classroom has a capacity of 25 students, thus one complete school (with four classrooms) can serve up to 100 students. At least 50% of this capacity (50 students) should be used. We identified the existing schools with four classrooms and the incomplete ones (two or three classrooms). The costs to renovate the incomplete schools, increasing their capacity to four classrooms, were estimated at 200K€ per classroom. New schools cost 250 K€ per classroom (i.e., a 4-classroom school costs 1.000 K€). The transport cost per student was assumed to be 0.125€/Km, replicating those currently incurred by the city council.

10.2. Formulating the Optimization Model

The planning problem described in the previous section consists in determining the best location (and capacity) of facilities to respond to the demand of the services they provide. Such problems, known as facility location problems (FLP), can be represented by integer optimization (or programming) models that have been thoroughly studied in the literature (Daskin, 2013). Over time, there have been many successful applications of FLP models to different types of facilities (Drezner & Hamacher, 2004; Eiselt & Marianov, 2015), notably schools (Araya et al., 2012; Bruno et al., 2014; Castillo-López & López-Ospina, 2015; Delmelle et al., 2014; Mandujano et al., 2012; Pizzolato et al., 2004; Teixeira & Antunes, 2008).

The particular model that represents the specific planning problem at stake is the capacitated fixed-charge model with single-allocation constraints. This model assumes demand to be concentrated in a given set of centres, and facilities (i.e., the existing schools and possible new ones) to be located in a given set of sites. Schools have a maximum capacity and a minimum occupation. Students residing in the same centre must be allocated to the same school.

For formulating the model, we will use the following notation:

Sets

$\boldsymbol{J}$: set of centres

$\boldsymbol{K}$: set of sites

Parameters (data)

Cf_k: fixed costs of a school located at site k

Cv_k: variable costs (per student) of a school located at site k

Ct: transport costs per student and unit of distance

d_{jk}: distance between centre j and site k

z_k^{max}: maximum capacity of a school located at site k

z_k^{min}: minimum occupation of a school located at site k

u_j: number of students residing in centre j

Decision variables

$Y_k = 1$ if a school is located at site k; otherwise $Y_k = 0$

$X_{jk} = 1$ if students residing in centre j are allocated to a school located at site k; otherwise $X_{jk} = 0$

Given this notation, the model can be formulated has follows:

$$\sum_{k\in\boldsymbol{K}} Cf_k \times Y_k + \sum_{k\in\boldsymbol{K}} Cv_k \times Z_k + \sum_{j\in\boldsymbol{J}} \sum_{k\in\boldsymbol{K}} Ct \times d_{jk} \times u_j \times X_{jk} \qquad (1)$$

subject to

$$\sum_{k\in\boldsymbol{K}} X_{jk} = 1, \quad \forall\, j \in \boldsymbol{J} \qquad (2)$$

$$X_{jk} \leq Y_k \,, \quad \forall\, j \in \boldsymbol{J}, k \in \boldsymbol{K} \tag{3}$$

$$\sum_{k \in \boldsymbol{K}} u_j \times X_{jk} \leq z_k^{max} \times Y_k \,, \quad \forall\, k \in \boldsymbol{K} \tag{4}$$

$$\sum_{k \in \boldsymbol{K}} u_j \times X_{jk} \geq z_k^{min} \times Y_k \,, \quad \forall\, k \in \boldsymbol{K} \tag{5}$$

$$X_{jj} \geq Y_j \,, \quad \forall\, j \in \boldsymbol{J} \tag{6}$$

$$Y_k \in \{0,1\} \,, \quad \forall\, k \in \boldsymbol{K} \tag{7}$$

$$X_{jk} \in \{0,1\} \,, \quad \forall\, j \in \boldsymbol{J}, k \in \boldsymbol{K} \tag{8}$$

The objective function of the model expresses the minimization of the sum of facility costs with transport costs. For each site, the facility costs comprise a fixed component and a variable component dependent on the capacity of the facility. The transport costs are calculated by applying a unit transport cost to the distance travelled by students between the centres where they reside and the schools to which they are allocated.

Constraints (2) and (3) together ensure that all students from each centre will be allocated to a site where a school is placed ($Y_k = 1$). Indeed, according to (3), if $Y_k = 0$ then $X_{jk} = 0$, i.e., students will not be allocated to sites without schools. Constraints (4) guarantee that the number of students allocated to each school will not exceed the school capacity, and constraints (5) guarantee a minimum occupation for each school. Constraints (6) ensure that students of a centre where a school is located will be allocated to that school. Finally, expressions (7) and (8) state that both the location variables (Y_k) and the allocation variables (X_{jk}) are binary. By defining X_{jk} as a binary variable, it is guaranteed that all students residing in the same centre will be allocated to the same school.

10.3. Describing the serious game

For the experiment described in this paper, we developed a serious game (SG) to deliver a planning solution. The only motivation to participate in the game was to solve the problem through collaborative play. We did not introduce game mechanics to modify an existing planning process. These characteristics are why the game is a serious game (SG) and not a gamification approach (Becker, 2021; Walz & Deterding, 2014). By playing our SG, participants generate a planning solution: the purpose and serious goals of the game. The enjoyment emerged from overcoming the challenge, interacting with the other players, and moving and activating the game mechanisms as players explored the game. All the different options and interactions may deliver an enjoyable experience to participants who like problem-solving, exploration and socialization (Zagalo, 2020).

The SG provided the players with a challenge to overcome by spending as little money as possible while delivering a collaborative experience in dealing with complexity (Hunicke et al., 2004; Zagal et al., 2006). Because it is an analogue game, interacting face-to-face with the other players and moving the game components should be an enjoyable experience (Rogerson et al., 2016; Xu et al., 2011). Combining the serious purposes of the game (planning solutions) with the playable elements for board games (enjoyment) should balance the two dimensions of serious game as recommended in the literature (Dörner et al., 2016; Michael & Chen, 2005). Despite our efforts, the game proposal is unlikely to engage all possible player profiles. And there is no extrinsic motivation like in gamification approaches, where some game elements are combined with non-game activities to engage users and incentivize them to do something specific (Becker, 2021; Deterding et al., 2011). We only relied on the intrinsic motivation of playing a game that can deliver planning solutions.

Our analogue game follows the findings from Tan (2016), according to which physical components and a meaningful game economy help the participants to deal with complexity and make conscious decisions. Having an economic dimension, i.e., accounting for costs, made the playable process meaningful. The playability and the users' interaction/experience (UI/UX) during the SG development is a way to generate engaging games that deliver serious results (Ampatzidou & Gugerell, 2019b; Engelstein, 2020b; Fullerton, 2014). If users, the participants in a planning process, can deal with complexity and find planning solutions through a collaborative process (McCann, 2001; Purbani, 2017; Törnroth et al., 2022), the game can be a planning tool and a way planners can collect information that would be difficult to gather by other planning tools (Caspary, 2000; Corburn, 2003; Moote et al., 1997). The game development process and the first steps of creating the game happened simultaneously with the development of the optimization model for the software. It demanded continuous adaptations, assuring the game and the software would deliver comparable solutions.

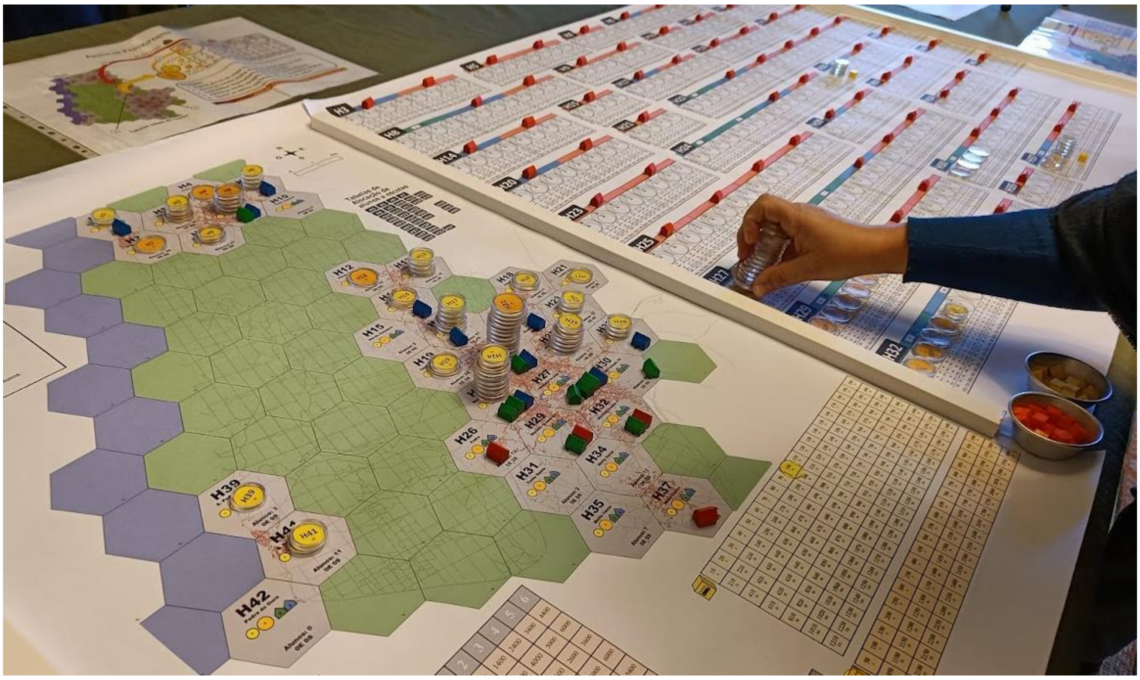


Figure 10.2 – Detail of the game pieces and game boards. MP (left) and SB (right)).
Source: author.

Figure 10.2 presents an image of the SG being played by the participants. It is a board game with two boards: the Map Board (MB) and the Side Board (SB). Participants collaborate to allocate the students in MB to schools in the SB. Students are represented by round tiles (yellow and orange) piled up over the hexagon associated with their residence location. The SB has tables representing the schools that can be built in each hexagon (identified by H and the respective number) and their capacity to receive students. When students are allocated to the tables, players must confirm if they need to renovate or build schools, placing them in the MB (coloured wood pieces). The game set up includes the existing schools (green and blue house pieces) and provide the existing capacities to allocate schools, but demand that the remaining schools have four classrooms (green house pieces for existing schools, red ones for new or renovated schools). MB has two tables to track the construction and transport cost. Whenever students are allocated to a different hexagon from where they live players must track the travel costs. The ends when there are no more students to allocate in the MB.

10.4. Testing the serious game

A thorough test process was carried out during the development of the serious game. Initially, the game was tested solo by the research team and consulting professional game designers that provided technical feedback. The SG had to provide comparable solutions to the optimization model and be played in a meeting table (1.5 x 2.5 m) in one hour at most. We considered this stage to be the Session 0 (S0). After having a playable version of the SG, we organized several sessions to test the game with different participants, as follows:

- S1: Session with PhD Students.

    - S1.1 Spatial planning program.
    - S1.2 Transport systems program.
- S2: Session with MMG education civil servants.
- S3: Session with MMG planning civil servants.
- S4: Session with MMG elected officials (politicians).
- S5: Session with local board gamers.
- S6: Session with local planning professors.

After explaining the game, the game facilitator continued to help the participants, enforcing the rules, and providing any necessary clarifications. The game ended when all students were allocated to a school, and participants considered they achieved the best possible solutions. After this, the facilitator conducted the session debriefing, considering a number of predefined issues to explore:

- Playability.
- Interactions and engagement.
- Collaboration and decision-making.
- Potentials, limitations, and future applications.

Participants were invited to reflect and describe their experiences playing the game after seeing the solutions generated by the optimization software in a map showing the same game elements they have used.

All participants filled out pre-test and post-test questionnaires with Likert scales of 1 to 7 to express their perceptions in a quantified way, where free commentaries could be added to detail more information, following the recommendations for practical implementations of SG (Mayer et al., 2014; Sousa, 2021b) (Appendix F). The sessions were filmed, photographed and audio recorded also for content analysis through grounded theory (Charmaz, 2014; Sousa, et al., 2022a). The facilitator had a form (F3) to take notes and highlighting what to focus on during the game explanation and the issues to address during the session debriefing (Appendix F). We collected the necessary written consent to use the collected data.

10.5. Developing the serious game

For developing the serious game, we started by defining a hexagonal grid to cover all the MMG area (Figure 10.3). Hexagons are a standard manner to model territories for games (Adams, 2014). Hexagon centres are located at 2 km from each other, representing the limit a person can walk comfortably by foot. We used the statistical sub-sections boundaries to set centroids and sum the number of students associated with the centroids inside the hexagons to consider the location of students. This method generated the number of students per hexagon (centre j). For the existing schools, we have done the same process. The shortest distances between the centre of the hexagons generated a matrix that supported the calculation of transport costs. Each hexagon was identified by the letter H and a unique number (#), represented in MB, SB, and students game tiles. The terrain map consisted of 34 urban hexagons where it was possible to place schools and the surrounding hexagons as forests and the ocean, where building schools was not allowed.

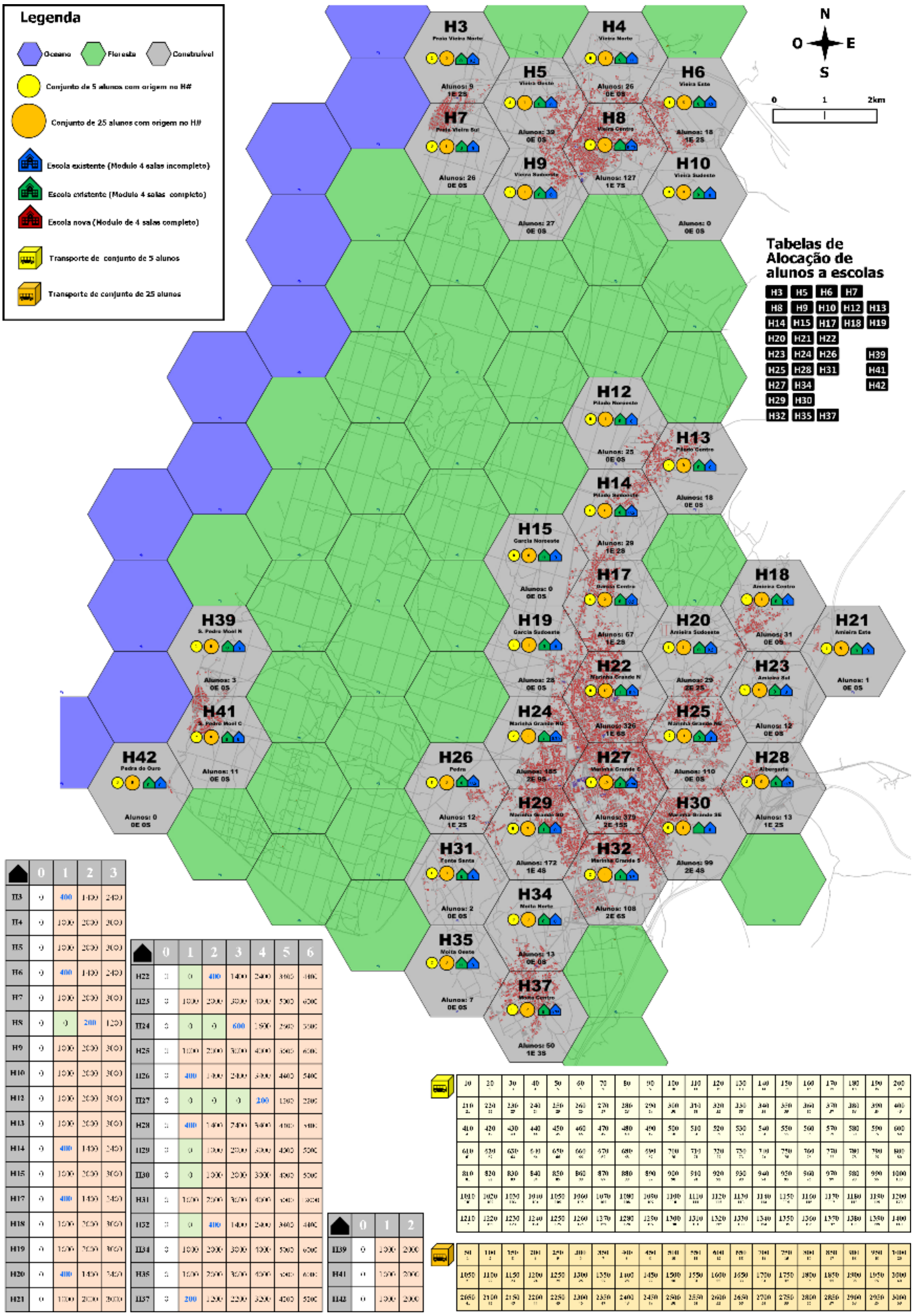


Figure 10.3 – Map Board (MB), including the set-up information (student pieces and schools per hexagon) and tables to record the sum of accumulated construction and travel costs.

The SG decision process is simple. Existing schools in any hexagon (H#) can be used or eliminated. Only complete schools can remain in use (modules of four classrooms). An incomplete school demands investment to get the four classrooms. Whenever the capacity of an existing school is full, a new school can be built. This process is repeated as many times as necessary to respond to all demands. Hexagons where schools do not exist, can accommodate a new school. Players were required to allocate all the students from the same hexagon to the same or another hexagon. This rule constrained the decisions and increased the challenge for players but simplified the available options. Whenever a student needs to travel outside his/her hexagon (centre j) to reach a different hexagon (site k) a travel cost is incurred.

The serious game development process took two years of non-continuous work (S0). It started by selecting a small part of the municipality to experiment with the core game mechanisms and playtest results. We chose Vieira de Leiria community, to create the first version of the game prototype. This territory includes eight hexagons (H3, H4, H6, H7, H8, H9, H10) with urban occupation, four schools and 272 students (Figure 10.3). The test revealed that dealing with variable costs per student would increase the game complexity to a level that participants could not manage within one hour of play. Even professional game designers (S0) had difficulties handling the game. Vieira de Leiria territory is approximately 15% of the municipal territory. We removed the variable costs, dealing instead with costs per module.

We selected "Pickup and delivery" and "Tile placement" as the core game mechanisms. The first mechanism is used to represent the travels and the second to change the game board, removing/adding schools (Engelstein & Shalev, 2019). The first challenge was how to represent the students. Using a cube per student would be unfeasible, requiring more than two thousand cubes. Then we modelled students per groups of 5 and 25. This grouping reduces the number of pieces to handle and the table space necessary for the game. The rounding exercise to fit the tiles of 5 and 25 was done hexagon by hexagon, rounding up but not reducing to zero in the cases where the hexagons had less than five students (this assured all the hexagons with students were considered). The total number of students after rounding and adjustments, became 2010 (8 more than the census).

To allow undo moves (decisions), each piece representing students needed a reference to the original hexagon (H#). We created tiles of different sizes and colours to differentiate the number of students (yellow circle of 2 cm diameter for groups of 5 and orange circle of 2.5 cm diameter for groups of 25). We printed these tiles and soaked them inside plastic coin capsules to make them easier to handle and more playable. During the game setup, the facilitator staked the students' tiles and placed the existing schools (house pieces from the *Catan* (Teuber, 1995) board game: green for complete modules and blue for incomplete) in the respective hexagons. The "staking" game mechanism helped players to identify the locations with more students.

During S0, the student tiles were staked below school pieces to represent the allocation, but testers considered it confusing. Students not allocated to schools stayed near the allocation pile (school on top). Hexagons could not be bigger than 8 cm (largest dimension) because this would generate an enormous terrain map that would not fit a regular meeting table. Introducing a Side Board (SB) for student allocations simplified the allocation process. The side map represents school capacity per hexagon. Each school is represented by a table in the SB with space to allocate the student pieces and includes a build piece (red house) that covers a printed cost (Figure 10.5). Whenever the allocation of students demands to expand or build a new school, players move the red house (game piece) from the respective table to their location (hexagon) in the map (Figure 10.4).

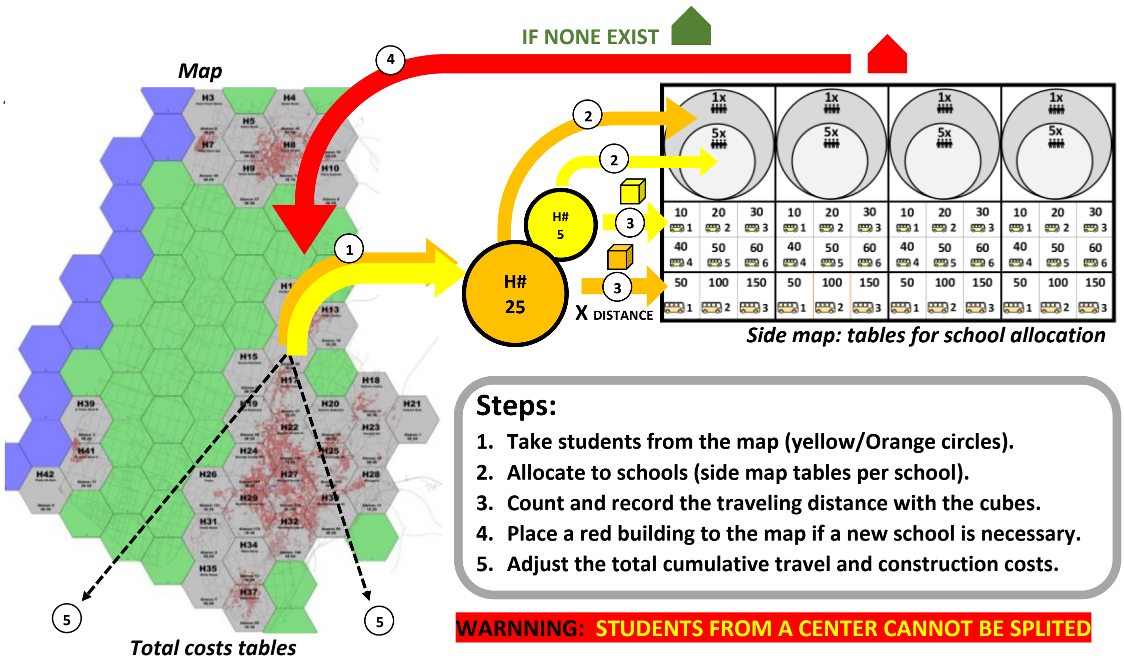


Figure 10.4 – Player aid for clarify the actions and effects during gameplay.

To differentiate incomplete schools from complete ones on the map, we used green houses for complete modules (four classrooms) and blue for incomplete modules (less than four classrooms). By the end of the game, only the schools with allocated students should stay on the map, and they should all be complete schools. The game ends when all the students are allocated to the side map, to the tables of schools per hexagon (Figure 10.5). Red houses represent new or renovated schools, while green houses schools represent existing schools not needing to be upgraded. Whenever the players move school pieces from the side map to the terrain map (board map), this action reveals new costs. They are the investment necessary to complete/build that school. This solution is an example of a “Tableau Building” game mechanisms. In reality, there are 18 schools of various sizes, totalizing 66 classrooms. The representation of existing schools demanded to place during the game set-up: 12 complete schools (green houses) with four classrooms and ten incompletes (blue houses) with less than four classrooms, totalizing the same 66 classrooms.
Besides the construction costs, it is necessary to record the transport costs. Below the space to place student tiles in the side map, we created tracks per classroom to quantify the distance those students travelled, one track for yellow cubes (groups of 5 students) and another for orange cubes (groups of 25 students). From a game design perspective, these track and piling mechanisms allow players to keep track of game state, also visually.

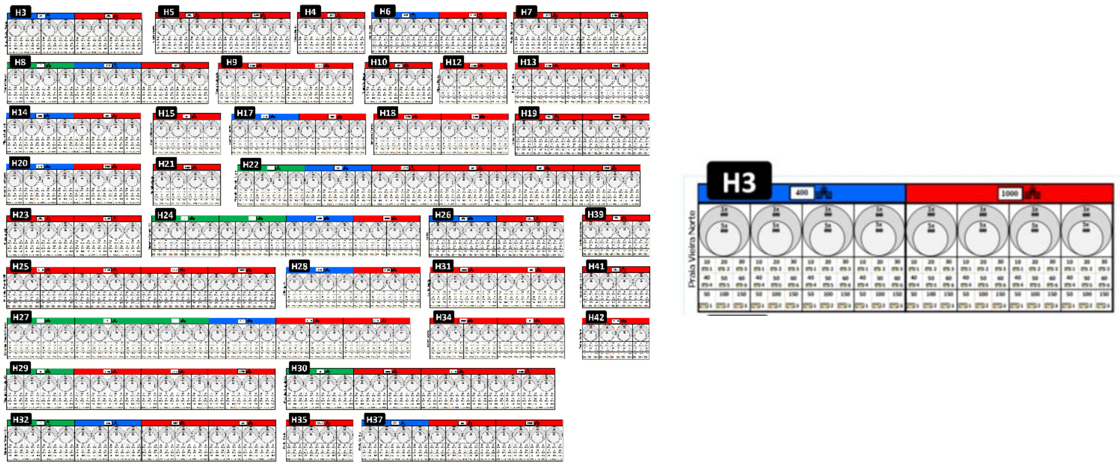


Figure 10.5 – Side board (SB) with the available schools per hexagon where player could allocate student tiles and track individual travels and detail of H3 schools (the blue label represent that one school of two classrooms exist in this location)

The first solo playtests revealed that printing numbers in the students' tiles helps to undo and change decisions, trying new possibilities to find better solutions. However, it was easy to make mistakes, to miss or skip a cost or leave a piece behind. To solve this, we introduced two new tracks in the MB for the costs of schools per hexagon and the total transport costs per yellow and orange cubes. This way, players can double-check the information in the MB and the tables of the SB (Figure 10.5).

The SG combined modern board game mechanisms to help the players solve the problem step by step like they were testing the possibilities. Players could come back and do it again until they considered that the solution responded to all demands at the lowest cost possible. We tried to make the game look and feel similar to a standard modern board game (Figure 10.2).

10.6. Learning from the test sessions

As stated before, sessions had an approximate duration of one hour. The number of participants varied according to the volunteers to play the game (2 to 5 players per session, see Table 10.5). In the MMG sessions it was impossible to control the number of participants. A total of 21 (n =21) participants played the game during the seven game sessions. Figure 10.6 shows the S5.

The variation and the small sum of participants make complex statistical analysis unfeasible. We present the median ($\tilde{x}$) values for the pre-test (Table 10.1), post-test (Table 10.2) and the variation for questions repeated before and after the play sessions (Table 10.3). This way, we quantified the participants' perceptions about the game and the use of serious games for Planning (Pln) and Decision Making (DM) applications.

Table 10.1 shows high values for every dimension (maximum of 7), meaning that a positive variation after playing the games could not be very large. Twelve participants had a previous experience playing or observing serious games, and nine had never tried them before (57.14%). None was an expert and used these techniques by themselves as a tool.

Figure 10.6 – Session with municipal councillors at the Marinha Grande city council.

Table 10.1 – Participants median ($\tilde{x}$) pre-test values for: using games for Planning (Pln) and Decision Making (DM) (Source: author).

Asked Dimensions	S1.1	S1.2	S2	S3	S4	S5	S6	All sessions
Ludic environments to support Pln and DM	5.0	7.0	4.0	5.5	6.0	5.0	6.0	5.0
Collaborative method to support Pln and DM	7.0	7.0	4.0	7.0	6.5	6.0	7.0	7.0
Visualization/simulation to support Pln and DM	7.0	7.0	5.0	7.0	6.5	6.0	7.0	7.0
Games as tools for P and DM	5.0	7.0	5.0	6.0	6.5	6.0	6.0	6.0

Table 10.2 – Participants median ($\tilde{x}$) post-test values about the game experience.

Participants perceptions	S1.1	S1.2	S2	S3	S4	S5	S6	All sessions
Communication between participants	7.0	7.0	6.0	7.0	6.5	6.0	7.0	7.0
Fostering communication	7.0	7.0	6.0	7.0	7.0	6.0	7.0	7.0
Enjoyment and engagement	7.0	7.0	6.0	6.5	6.0	6.0	7.0	7.0
Support problem analysis (minimizing costs)	7.0	7.0	6.0	6.0	6.5	6.0	7.0	7.0
Support solution analysis (number of school and travel distances)	7.0	7.0	6.0	6.0	6.5	6.0	7.0	6.0
Quality of the final solution (results) for the purpose (planning the network of schools)	7.0	7.0	6.0	6.0	5.5	6.0	7.0	6.0

Table 10.3 – Participants median ($\tilde{x}$) post-test values

Questions	S1.1	S1.2	S2	S3	S4	S5	S6	All sessions
Ludic environments to support Pln and DM	6.0	7.0	6.0	6.0	6.0	6.0	6.5	6.0
Collaborative method to support Pln and DM	7.0	7.0	6.0	6.5	6.5	7.0	6.5	7.0
Visualization/simulation to support Pln and DM	7.0	7.0	6.0	6.0	6.5	5.5	5.5	6.0
Games as tools for P and DM	7.0	7.0	6.0	6.5	7.0	5.5	5	7.0

The game evaluation was highly positive, as shown in Table 10.2. All the ratings were above $\tilde{x}$=6, except for the quality of the solution in the S4 session ($\tilde{x}$=5.5). PhD students and local professors were those that enjoyed the game the most. Local gamers never evaluated the game with more than $\tilde{x}$=6. Elected officials were those classifying the quality of the solution with the lowest grade ($\tilde{x}$ =5.5). However, they attributed high classification to other dimensions like communication and supporting decision-making.

Comparing Table 10.1 to Table 10.3, it is clear that variations were inexistent or positive. The perception that ludic environments and games as tools can support planning and decision-making increased one point. The collaborative methods and visualization/simulation stayed unaltered.

To complement the quantitative analyses, we analysed the commentaries through grounded theory (Charmaz, 2014), obtaining two main clusters: playable dimensions and serious purposes. These clusters are organized into different sub-clusters. Of the 21 participants, 13 wrote commentaries about the sessions. Table 10.4 shows the number of times the commentaries mentioned the sub-clusters. The most stated was that the game supported decision-making and was a way to generate solutions (10 statements), followed by the ability to frame and understand the planning problem at stake (7 statements). The playable dimensions obtained fewer commentaries each (6 statements), referring to fun, dynamic, engagement, surprising and challenge.

Table 10.4 – Cluster analysis of the participants commentaries

Playable dimensions		Serious purpose dimensions		
Fun, dynamic, and engaging	Interesting, challenging, and surprising	Foster interaction and collaboration	Help understand/framing the problem	Help decision making and generate solutions
6	6	3	7	10

Filming the sessions allowed us to analyse the sessions' gameplay and create Table 10.5 with clusters of events. The facilitator's notes helped to confirm the interpretation. Except for session S3, the division of tasks and chores was high. In S3, one of the players assumed a leadership role (this person was the former department chief). S4 also had two participants, but leadership was not noticed (participants were city councillors with the same institutional power).

Participants in session S2 were those with more difficulty understanding the game rules, arguably because they did not have specific training or knowledge about planning. But the number of participants and the confusion of cross-talking might have been the main reason for this difficulty.

The facilitator was able to explain the game better to the groups with fewer participants. The printed player aids (Figure 10.2) were not used by the participants directly. They preferred to ask for help directly from the facilitator. Local gamers (S6) were not planning experts, but their previous game experiences helped them to understand the game more easily.

Table 10.5 – Observations of the gameplay videos and notes from the facilitator

Dimensions	Sub-dimensions	S1.1	S1.2	S2	S3	S4	S5	S6
Interactions	Debating and discussing decisions	●●	●●	●●●	●●	●●●	●●	●●●
	One player assuming the leadership	●●	●●●	●	●●●	●	●●	●●
Playability	Confusion and difficulty understanding the rules	●	●	●●●	●	●●	●	●●
	Dividing the tasks and chores of the game	●●●	●●●	●●●	●●	●●●	●●●	●●●
Simulation	Considering other dimensions beyond the rules of the game (social, cultural, environmental, topography, existing road system, etc.)	●●	●	●●●	●●●	●●●	●	●●●
	Number of participants per session	3	3	5	2	2	3	3

● – Low; ●● – Medium; ●●● - High

From a simulation perspective, considering other dimensions of the territory that were not captured by the optimization model, PhD students and local gamers were the participants that ignored them the most. All the other groups, with solid knowledge related to the school management of the territory in general, took these dimensions into account. Considering the population's social, cultural, and affective relationships between communities and places has impacted the decisions in S4 and S6, where the option was for solutions more costly but addressing what participants thought were the population preferences. In S2, participants tried to mimic the ongoing decisions for the future organization of the network of schools. Although S1.1 ignored the local reality of Marinha Grande, they asked the facilitator for some additional information to support their decisions.

To verify which participants got closer to the optimal solution, we retrieved the solution of the optimizer and printed a version on a smaller scale of the game map (Figure 10.7). The participants could compare the solution obtained in their respective session with the one provided by the optimizer. Table 10.6 shows the solution for each session and compares it with the optimization solutions. The locations similar to the those obtained through the optimizer are highlighted in that table.

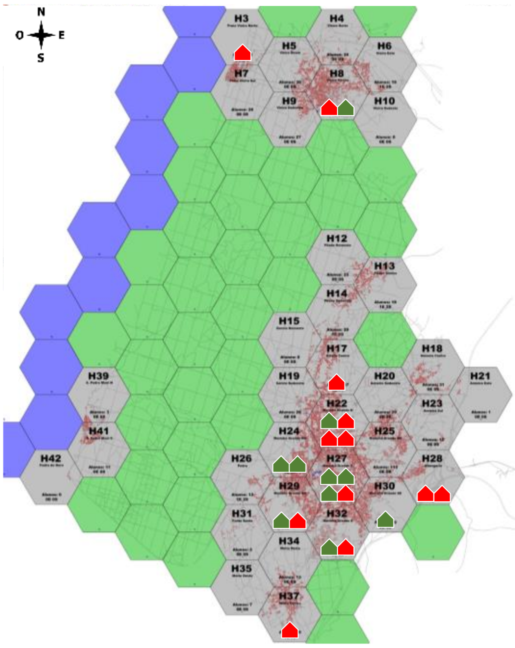


Figure 10.7 – Solution from the optimizer (*Xpress*) in a game format.

Table 10.6 – Results from the sessions with participants

Sites (K) with a School	*Xpress*	S1.1	S1.2	S2	S3	S4	S5	S6
H3	1	1	1	1	0	1	1	1
H8	2	2	2	2	3	2	2	2
H14	0	1	1	0	0	0	0	2
H17	1	1	0	1	0	1	2	0
H20	0	0	0	0	0	0	0	1
H22	4	4	4	4	4	4	4	4
H24	2	3	2	4	4	2	2	2
H25	2	2	0	0	2	2	0	2
H27	4	4	4	4	4	4	4	4
H28	0	0	2	0	0	0	0	0
H29	2	1	2	2	2	2	2	2
H30	1	1	1	1	1	1	3	1
H32	2	2	2	2	2	2	2	0
H37	1	1	1	1	0	1	1	1
Total number of schools	22	23	22	22	22	22	23	22
Construction costs (K€)	6 600	7 200	6 600	6 800	8 800	7 200	8 200	8 600
Transport costs (K€)	1 410	1 140	1 550	1 590	1 590	1 350	1 200	920
Total costs (K€)	8 010	8 340	8 150	8 390	10 390	8 550	9 400	9 520
Deviation from optimal (%)	0.0	4.12	1.75	4.74	29.71	6.74	17.35	18.85

Table 10.6 shows that S1.2 found a solution with a total cost close to the optimizer (+1.75%), choosing a different location for one school (H17 instead of H14) and other transport solutions. Sessions S.1.1 (+4.12%). S3 (+4.74%) and S5 (+6.74%) also found solutions close to

optimization solution optimum, achieving this while considering their knowledge of managing the school's local network (S3) and the social and cultural preferences of the populations (S4).

10.7. Learning from the test sessions

This game experiment proved that a real public facility planning problem can be properly replicated by a board game. This is not easy to accomplish, requiring creativity and game design expertise. The process demands prototyping, playtesting and continuous correction before delivering the game (Sousa et al., 2022b). The final game resulted from a long development process: testing multiple solutions, reducing complexity, and evaluating the player feedback during gameplay. The S0 session of solo and playtest with professional game designers helped the development process and avoided an overcomplicated game (with high complexity). Besides testing the game economy, there was the need to test the game mechanisms with different physical components. Coin capsules transformed simple thin paper tiles into engaging pieces. It was necessary to test the text fonts, colours, size of the game boards to fit tables, and the quantity of pieces players could handle in the available time.

Developing a game is always a creative process but having the solution to the real-world problem from an optimizer (*Xpress*) helped us to frame the game. It helped to understand the limit of complexity and detail the game should include. Soon after doing the first game prototype, it was evident that it would be difficult for users to deal with costs besides those of building and renovating schools and transporting students.

Considering the results of the six sessions, we claim that the game classifies as a serious game. Participants solved the problem and planned the municipal network of elementary schools. Four sessions achieved a solution up to 6% more expensive than the optimal solution (Table 10.6), solving the problem in a dynamic collaborative in less than one hour and with high levels of engagement (Table 10.2). PhD students were the participants that obtained a solution closer to the optimization solution and those enjoying the experiment the most (together with the younger groups). S1.2 was the one that was closer (+1.75%), though we observed that it was dominated by a participant with a sharp mathematical mind. In S1.2 and S3, results were similar (4.12% and 4.74%), but the participants collaborated more and tried to incorporate the social and cultural dimensions of spatial planning (Portugali, 2016). Players who got results near the optimal solution (from Xpress) proved the game can be a tool to reach the minimum costs, as defined by the objective function. However, this does not mean this specific solution was the better option according to other criteria. The participants who were aware of other territorial dimensions made different choices. The game allowed them to address cultural, social and environmental issues, although they were not considered in the game directly. The sandbox dimension of the game allows these play approaches.

The game was an optimization challenge rewarding participants that calculated and tested the minimal cost options. This challenge engages player profiles that are problem solvers but might disengage other more narrative and exploratory player profiles (Zagalo, 2020). However, the game relied on a graphical representation of the territory. Participants more aware of the territory characteristics used their knowledge and imagination to interpret and consider the cultural, social, topographical, and existing infrastructures in their decisions. The relatively low score (5.5, see Table 2) given by the participants in session S4 to the quality of the solution reveals this need to include more factors affecting decisions. The gameplay videos show that some participants were disturbed because the social and cultural characteristics were not considered (S4 and S6). In the game, students were represented by numbered tiles inside a coin capsule. Nothing besides the facilitator description suggested they were students, people with needs and feelings. Participants assumed they were dealing with real students and tried their best to find the best solution. The participants more aware of the local social and cultural features, considered more information beyond what was represented by hexagons. This extra knowledge influenced their decisions. They argued that a purely mathematical solution would not make sense and that other dimensions should be considered when making decisions. This attitude was notorious in S2, S3, S4 and S6. One participant stated this directly: "*It was quite interesting to interact/collaborate to reach a decision, but I recognize the interference of other known factors of the territory and its population, which prevents decision-making to result simply from a cost minimization exercise*." (P12). Besides the focus on the type of solutions, participants highlighted the advantages of using games to learn together interactively and collaboratively: "*It was a great pleasure to participate in this session today. I confess, it was a pleasant surprise. I ignored the advantages of using games as an approach to planning, especially for making the team think about a whole system through an involving and collaborative spirit. We gain a lot by participating*" (P11).

A higher number of participants playing at the same time increased their difficulty to understand the game, generating confusion and cross-talking. The facilitator was less efficient in explaining the game and clearing doubts in larger groups like S3. During session S6, one of the participants argued that it was difficult to start because the game required a lot of calculations. The facilitator suggested that they started to move the game pieces from the MB to the SM tables because they could undo the moves at any time. After the suggestion, S6 participants advanced in the game without problems. Something similar happened in all the sessions. First, the participants stated anxiety and preoccupation because it seemed complicated. As soon as they started to move the pieces, the complexity decreased. However, the game stalled due to the discussion and testing of several options. The game mechanisms of tile placing, tableau building, staking, and tracking helped users to solve the problem in a tangible way without hiding information about the decision steps.

Table 3 shows that participants enjoyed the experience, giving it a high classification. Arguably, because there was no selection of participants per player profile and type of preferred gaming experiences, the game can engage different player profiles and distinct play experiences at the same time. Despite the high classification in communication and collaboration between participants (Table 10.2), the facilitator observed that the power relations outside the game and the easiness to solve the mathematical problem by some participants can generate dominant leadership. The game was prone to this since it had no game mechanism to control alpha and dominating players. These power relationships can affect a collaborative planning process. According to the facilitator's observations (Table 10.5), there are behavioural differences in each group session, meaning that character dimensions, backgrounds and roles outside the game space can impact the play experience and results. Some groups discussed and collaborated more to solve the problem than others. Some approached the game as a mathematical problem (S1.1), while others imagined the social challenges the proposal would deliver to the populations (S2, S3, S4 and S6). The remaining groups were somewhere in between (S1.2 and S5).

The experiment proved that participants in a SG can reach solutions similar to those obtained through an optimization model if the game complexity is controlled, proving that a game can produce reliable solutions according to optimization principles. The game engagement can be compatible with the ability to generate good solutions. Modern board game mechanisms can help the simulation and reduce complexity for users, increasing the UI/UX of the game. Although this clears some doubts about the efficiency of SG for planning purposes, a planner without game design experience and knowledge would probably fail. The game development was long (more than one year) because it was a SG done for research purposes. The material costs are low. One person that masters game design and the project purposes can do it alone (not considering discussing with other experts and the playtest with users). Figure 10.8 summarizes the development process, replicable for similar game-based approaches.

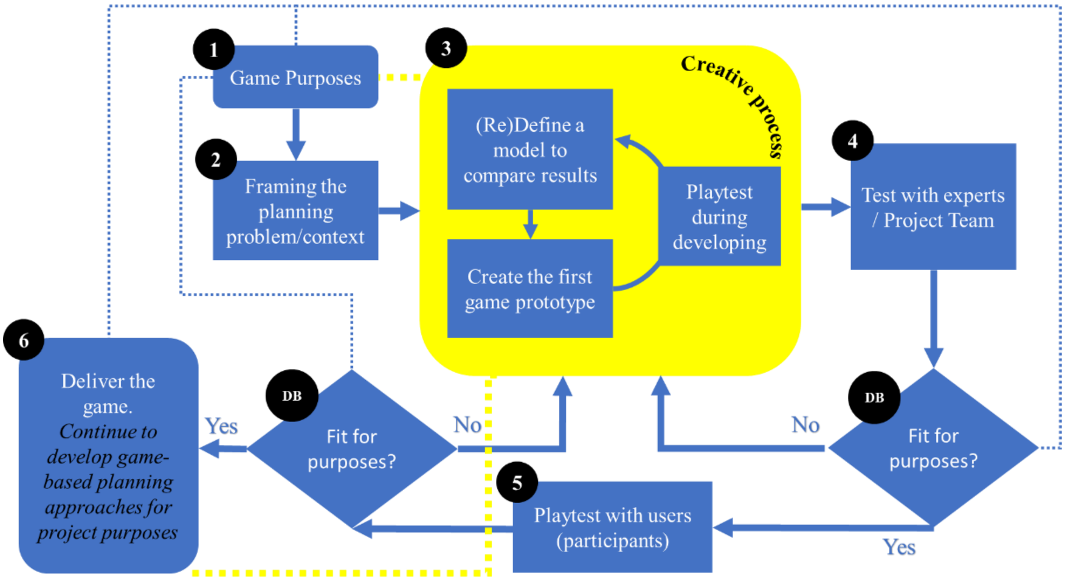


Figure 10.8 – Process to develop a game-based approach for planning that is comparable to other planning tools and models.

Like in a standard SG, the start of the process is defining a purpose for the game (1), which is connected to the planning problem or context (2). Then we suggest that the creative process of developing the game is like a cycle of defining a model to compare results to the results of the game prototype (3). After this, the SG must be tested with experts, the development team, or the client (4). If it does not fit the purpose, the creative process should restart (DB). If it fits, participants should test it directly (5). A new evaluation (DB) could restart the development process or advance to the delivery (6). After the delivery, the SG can continue to be improved because the continuous play experiences will reveal new data and player experiences. In our game, some small adaptations were done, like having containers to separate the pieces to move and tags to organize the pieces to decrease the set-up time. Participants asked whether they could see the results with different transport costs. We printed more solutions in a game format showing the solutions for different transport costs per km. We found that providing a printed player aid (instructional scheme) to each player during the game explanations helped participants to understand the game, only if they were incentivized to read it before the game. No substantial game changes were necessary during the sessions, meaning that the previous playtest and development accounted for most possible issues. Doing as many playtest sessions as possible during stages 3 and 4 is recommended.

10.8. Conclusions

The design of modern board games is far from being explored in serious game usage, even less in planning. They can be applied to planning games and be used in parallel with other decision-support approaches, notably optimization. Using analogue games for planning purposes can foster participation, support learning, and deliver efficient solutions for different criteria. This way, we can deliver games that engage users, increasing participation in planning. The experiment proved that some users could solve problems quickly and efficiently while having an enjoyable experience, while others used the same game as a tool to express their knowledge about a territory and discuss complex issues regarding the best solutions, by considering several dimensions (cultural, social, etc.) not modelled by the game directly.

However, planning practice and education are not used to deal with game-based planning, which can reduce the impact of our proposal. There is a need to develop games with experienced and knowledgeable developers. Regardless of this limitation, the standard development process requires creating, playtesting and reformulating the games is a learning process and a continuous adaptation to purposes. We argue that planners can benefit from game-based planning approaches if they have the necessary time to learn and improve by practice. Board games have the advantage of being simple and not so expensive to develop. Testing the same approach with other planning problems is recommended to reinforce our findings. Adapting these games to hybrid and digital platforms that keep human interactions present is a possibility to explore in the future for larger and more complex planning problems.

11. CONCLUSION

11.1. Summary

Games are a promising tool for planning but hard to master, apply and use effectively. They can be just curiosities, providing useless data, if not addressed systematically. Though, these drawbacks might diminish apparent positive perceptions of participants using game-based methods for the first time. Games are not a panacea to all planning processes. The literature highlights the variety of case studies while revealing the lack of support frameworks and guides to explore games systemically. Games can deliver some outcomes to support a planning process, though they will unlikely replace standard planning methods in a significant way. Besides this, planners are not trained to use and develop games, which increases the difficulty of using games as tools to support a planning process. Game development (analogue, digital, hybrid) requires game design knowledge. And, even if the appropriate knowledge is mobilized to the project, the game product might not serve the desired purposes. Any game development process is composed of many iterations, requiring testing with users, adaptation, repetition, and multidimensional evaluation (game system, user interface and experience, player behaviour, and outcome data). Despite following available recommendations and similar processes to successful cases, like any game, serious game approaches might fail in achieving some purposes due to the behaviours of users, their characteristics, and expectations. The role of facilitators is a key factor in a serious game. Facilitators' ability to be empathic with the participants, conduct the games, clear doubts, and control the timing and the rules of play are utterly important. The way data is collected also affects the outcomes. There is the need to establish previously how the game will generate data and how it will be collected, the method to treat it and how all will serve the serious game goals. Otherwise, there is no way to evaluate the game rigorously.

Modern board games provide transparent visual examples of game systems, especially the mechanisms and how they are combined to simulate urban dimensions, that planners can use to create simple and low-tech serious games. These game design elements can easily be combined with printed maps and other group dynamics that are more familiar to planners (e.g., participatory meetings, focus groups, etc.). When compared to digital games, analogue games deliver tangible and face-to-face interactive experiences. Besides the ability to be produced fast and cheaply, analogue games main strength for participatory and collaborative planning is the potential to foster empathy and a collective learning environment. With the correct facilitation, the analogue games can be adapted to users and explored in planning processes as co-design approaches.

Although the potential exists, developing engaging games that deliver the intended serious goals is not easy. It demands game design and facilitation knowledge, experience, and expertise. These requirements can be a barrier some planning practitioners might need to overcome before exploring the potential of games. Though a set-by-step process of learning, testing, redoing, and re-testing through continuous cycles (design thinking approach), focused on the users (participants), and aiming at serious purposes (serious games), it is possible to find tools to support participatory and collaborative planning. The material costs are low, and the playtesting of the games can be a continuous improvement process. It can be long and difficult to test with real users, which is problematic in planning practices. Without proper training to use game-based approaches, including the analogue ones, these methods would be difficult to implement in planning practice.

The thesis explored a process of learning about the state of the art of serious games for planning (focusing on participatory and collaborative planning), choosing a type of game (analogue modern board games) to study (learning about its design features). Then it explored several case studies where each game experiment identified difficulties and some possible solutions to use them as support planning tools. Though the thesis does not define a method to design serious games, it provides guidelines to start using serious games while proposing future research and developments. As a work of art, it is not absurd to say that a game is never finished or perfect.

11.2. Main contributions

The thesis main contributions are organized by eleven chapters. Although they represent individual articles, they follow a common logic (process). After the introduction (chapter 1), chapters 2 to 5 explore serious games for planning and the design elements of city and territory games, going deep into the game mechanisms (how they are combined to build new games). These first chapters deliver guides to those that wish to use game-based approaches for planning. Chapters 6 to 10 explore the development process of games applied to real case studies and the findings regarding the challenges of developing games and evaluating the outcomes. The games explained in these chapters implement the findings of the first chapters (design guidelines), showing that serious game development is a process of continuous designing, testing and improvement that generate new outcomes each time the games are played. This way, games might never replace a planning process but are ways to collect information and give participants new ways to express themselves. Developing a serious game that is a planning process from start to finish would require a considerable amount of resources beyond the materiality of the game (e.g., time and people). The game-based approach tends to be a planning support system, tools that planners can develop or apply to support a traditional planning process like a master plan, a transport system plan, etc.

Chapter 2 shows that using games as tools is a growing trend in spatial and urban planning. Several case studies argue that games fostered participation and collect data useful for professional planning practices (1). Although it is not recent, because there were pioneer works since the 1960s, it is still not as well-spread as we might think. The literature about game-based planning regards experimental case studies, most of them for research purposes and in academic backgrounds. After analysing these cases, the strengths, and limitations of using games as planning tools (planning support systems) were evident (1). Games can engage participants in a participatory or collaborative planning approach, foster collaboration (empathy and social resilience), and allow experimentation in interactive environments that simulate urban and spatial dimensions. Games deliver virtual environments (digital or analogue) to explore the effects of complexity in urban backgrounds. However, when using games, planners must be aware of pitfalls like inconsistent results and oversimplification that lead to distrust (by the professionals and the participants), and the development costs are considerable. Learning from game design, gamification, and serious games, in general, is necessary and a way to define a way to start using game-based planning. The thesis focused on the methodology of serious games, demanding to adapt or develop games for specific purposes (planning goals) to engage participants in intrinsic ways (no other rewards besides playing the game and generating outcomes). This choice means that the game experience and results are what motivate players. The game outcomes must fit the planning purposes, like collecting data and generating debate and compromises. Besides knowing how to develop an effective serious game that engages participants and delivers the planning goals, it is necessary to master de production of the game (analogue or digital), the facilitation of the process, the way to collect data and evaluate the effectiveness of the project. Frameworks like MDA, DPE, 8LLE, and PLEX/CIVIC were used successfully, also considering other generic serious game approaches where the games are evaluated during the development, implementation and after playing considering the participants' perspectives. The methodological game design approach followed user-centred game design methods. The chapter proposes a simple process to help planners overcome the challenges of developing serious games for planning: defining the planning goals for a specific case → designing/adapting →playtesting/evaluating → redefining goals.

After exploring games for planning in general terms, chapter 3 focuses on a specific phenomenon: modern board games. A significant number of successful modern board games, according to BGG, use the names of cities. These games simulate urban dimensions, approaching the depicted city from historical, economic, political, and cultural perspectives. Some represent the urban morphology with some details, while others do not. Planners cannot use these games directly as a planning supporting tool. However, exploring these modern board games help planners to learn how to represent some elements to replicate in serious games. Modern board games keep engaging new users, year by year (annual growth rates of approximately 20%), since the 2000s. This phenomenon happens because of the face-to-face material and human interaction experience fuelled by innovative game design features. Replicating the same approaches for planning is a potential to explore. In the case of modern board games, the players highlighted that these games delivered them pleasant experiences regarding the urban build-up processes and cultural and historical representations, allowing them to explore places that fascinate them or are emotionally attached (2). Exploring this human fascination and the game design techniques that support them can be a way to increase participation, empathy, and social resilience. Indirectly, a way to collect data for planners to use. However, this approach demands playing the games and entering a game development process. The survey used to identify the games with names of cities revealed that a small percentage are persons related to planning (7.84%). Considering the characteristics of participants that answered the survey, it is unlikely that all persons will enjoy these board games as they exist because the demographics of board gamers are not the same as the overall population distribution (age, gender, education, available resources).

After analysing several games with names of cities, chapter 4 is about exploring one specific game mechanism. Modern board games combine many different game mechanisms. Drawing is one of them, existing in many different game types. Drawing is a typical way of expressing and recording information during a participatory or collaborative planning process, combined with maps and other ways to signal information like post-its. After analysing the top drawing games, according to BGG, it was evident that drawing, as a core game mechanism, must be complemented by other mechanisms to deliver decision-making processes (3). Voting is one of these mechanisms. Chapter 3 reinforces the proposals in the previous chapters. Even considering simple drawing games and combining them with printed maps as game components (game boards) require game design knowledge. If planners wish to explore games as a planning support tool, they should play to learn more about games experiences and search for the types of games related to planning or the skills planners typically master. After this, testing their game approaches step by step. To help planners use drawing games, the chapter proposes the Modding drawing games for planning processes (MDGPP) framework.

Chapter 5 complements the findings from chapter 4. It analysed board games related to city and territory building. BGG classifies games by family and type. City and territory building are popular typologies of games at BGG. After analysing 50 games (highest rank) and crossing the information with analogue game design literature to identify the most common game mechanisms, how they relate to the simulation, depicted game theme and the physical components used to build the game. A planning game should combine several game mechanisms, defining the game system, the economy, and the progression, representing the spatial relationships and elements, and delivering interactive ways for the players to change the game state (4). Game mechanisms are abstractions (the building blocks for game design). However, it was clear that some mechanisms, like tile placement, are common in city and territory building games to represent spatial changes. The set collection mechanism represents the complexity of the interconnected effects of the urban system. Another example are tech trees and tracks to record relationships and indicators in a quantifiable way. The chapter proposes tables where the game mechanism of the most popular modern board game related to planning is presented with graphical schemes and examples of the simulations they can help generate.

Chapter 6 reveals the first original game created for the thesis, exploring if the same design principles and game mechanisms of modern board games were suited to use in an online game environment. A game about a hypothetically simplified urban zone was played by two different groups (planning experts during a conference and game design students during a class). The game

defined seral teams of stakeholders that could decide about the transport system and land uses, having different and clashing objectives (converted into a scoring system). Participants played the game through *Zoom* and *Google Slides* software. There were popular tools during the Covid-19 pandemic remote work because there were very easy to master. Between sessions, the game evolved, which was part of the development process, as expressed in the previous chapters. The participants in each session identified different positive and negative experiences after playing the game. Planners focused on the potential of the practical implementations but were concerned with the simulation failures and the necessary simplifications these types of games require. Game experts highlighted the ability to engage participants but were concerned with some playability issues due to the chosen platforms (*Google Slides*). The experiment highlighted the duality of serious games: the balance between playability and simulation. This first practical case study shows that modern board game mechanisms can support online simple planning games, but the games can fail when trying to achieve high requirements of simulation and playability (5).
Chapter 7 was the first case study of the thesis where modern board game mechanisms defined a game tested with real users in a face-to-face experiment. The game was played during an urban and regional planning class for undergraduate students (civil engineering course). The game was considered complex according to BGG standards, having an economic and feedback system where players needed to master the available resources and the positive and negative effects of their choices while redefining the urban land uses and infrastructures. The game generated a collaborative experience where a group of 4 to 8 players would try to increase the sustainability of the Leiria city centre. Students played with board game pieces (bits) over a printed satellite map of the city. The students enjoyed the game and discussed urban-related issues like the effectiveness of the transport system and the sustainability of polyfunctional urban zone. However, these results were only possible because the facilitator mastered modern board game mechanisms and facilitated the session, constantly answering questions and explaining the effects of the choices to players. Using games of this complexity is possible but demands previous game design knowledge and a trained facilitator per game table, which increases the logistics and resources for a face-to-face planning process for more participants (6). DPE framework helped to set the game experience. However, without a grid dividing the map into terrain units to define the influence of the game pieces (choices) laid over the map, impacts are difficult to perceive. Without a tracking system for income and negative effects, the game demanded more facilitation. Using other mechanisms to solve these problems is recommended.
Chapter 8 results from an experiment with a fast and simple game made of coloured strings to place over a printed map, done during a local conference about mobility and transport systems. The facilitator invited the participants in the theatre to enter the stage to play the game. Some attendants voluntarily decided to play, while others observed and tried to help or influence the decisions of those playing the game. This way, because of the layout and the easiness of the game with simple visual representations (coloured string over a map), the collaborative game delivered different levels of participation, even for those not playing the game directly. The analogue

dimension allowed the facilitator to adapt the game in real time. Without this flexibility, the game would fail because it was defined for a higher quantity of participants. The game economy was adapted to fit the number of participants, which is difficult to set in a digital game. This experiment shows that some games allow indirect ways of playing and participating, engaging participants in different ways and being a solution when there is some inertia or discomfort about participating. The game layout, how it is displayed, and the facilitators' performance incentivise the participants and foster interactions.

Chapter 9 explores the codesign process of an analogue collaborative serious planning game. The final serious game (S3), a product of the codesign process, delivered results that the planning officials from the Municipality of Leiria (Portugal) used to make their report for the UrbSecurity initiative (*Urbact*). Previously, the other games used in the codesign process (S1 and S2) engaged stakeholders, incentivizing them to identify their claims and preferences to increase the urban safety of the historical city centre of Leiria. After these first steps, the planning officials, and the research team codesigned S3. The proposals (choices) available in S3 resulted from the stakeholders' preferences and the cost to implement them (based on the Municipality of Leiria's internal data). Stakeholder participants played S3 first, and other participants like the city councillors and the civil servant department leaders of the municipality after it proved to work. Civil servant participants were the users that perceived the higher use for the game, considering it as a process to debate and explore multiple options from different viewpoints. Stakeholders also classified S3 to be useful, but they demanded that their participation influence real projects and interventions. Because stakeholders participated in the previous steps of the codesign process (S1 and S2), the tiredness of being involved in a long process might affected their perceptions. And the city councillors were more concerned about the type of proposals that they could implement according to their real power and legal limitations. The perception of empathy, learning and collaboration was high in all play sessions. All participants considered that collaborative planning was relevant to approach urban planning, but the perception that inducing ludic elements to support collaborative planning was less evident (8). The absence of negative comments and reactions might result from the novelty of the approach (game usage) and the direct contact with the facilitator. These particularities might generate bias, and the evaluation process should consider it. Although the games delivered collaborative experiences, the sessions required human facilitation and previous game design knowledge to build a playable experience aiming for the goals at stake.

Chapter 10 explores the final case study where another original game simulated a planning process. In this case, the analogue serious game addressed a facility location planning problem, the location of elementary schools for the municipality of Marinha Grande (Portugal). The game was developed to be comparable with an optimization modelling for the software (*Xpress*) that generated optimization solutions, revealing what was the minimum cost to the location of schools (considering building costs) and travelling (students from home to school) to respond to the demand (all the students living in the municipality). The collaborative serious game used modern board game mechanisms to simplify the decision process, making it a playable tool for humans. Several participants played the game, solving it in one hour (average). Some participants reached solutions close to those obtained by the optimization software. Other groups were more distant when they considered dimensions not included in the optimization model. The participants that knew the territory accounted for the cultural, social, environmental, topography, and existing infrastructures not represented in the game and optimization model. These additional considerations revealed that games can deliver similar results to optimization but can also be used to consider other dimensions and express their economic implications (9). The combination of board game mechanisms and the facilitator's presence helped to reduce the game's complexity.

11.3. Possibilities for future research

The overall objective of the thesis was to test simple and inexpensive ways planners could explore game-based planning applicable to participatory and collaborative planning processes. Despite the apparent simplicity of the tested games (analogue), developing these serious games was more complex than expected, demanding knowledge and playtesting time to reach acceptable results (playable and fit for the serious purposes/goals). Considering that most planners are not prepared to explore serious games, there is a need to define guides and programs for those wishing to use these tools. Proposing guidelines for these courses and testing which ones work better is a reach topic to undertake in the future. One option is the introduction of game-based methods into courses addressing participatory and collaborative planning. The learning potential of games is clear for all fields, including planning. This potential means that we could combine game-based learning to introduce games for planning curriculums, helping planning students address planning topics in an introductory and interactive way. The challenge of balancing the simulation and playability game dimensions could be explored in a learning context because it would be a testing and mediated process by experienced teachers and experts. Through this gradual introduction of games framed by specific topics and contexts, future planners would naturally get familiar with game-based approaches, easing the barrier for entry and the learning curve to use game-based planning approaches.

The development of the case studies (Chapters 6 to 10) proved that several skills are necessary to implement game-based planning approaches. Planners should be aware of these requirements. Skills like game design, game production, human facilitation processes, and data collection and processing are key factors for success. It would be unlikely that a single person masters all these skills, demanding teams of experts to implement serious games for spatial planning.

From a serious game perspective, there is a need to continue the research and improvement of existing frameworks about how to develop the games in a way that provides data suited to evaluate game effectiveness. One of the challenges of the thesis was: how to collect data and evaluate the developed serious games, addressing the human behavioural dimensions and the planning proposals each game generated. Having solid results is a way to define to what extent serious games are applicable in practice. These are requirements for planners who use games to collect data that they cannot access by other means. However, one of the main problems (and potentials) is still not solved. Ongoing research is still trying to understand how to deal with human behaviour and the unpredictability of game interactions and results. The human potential is the biggest challenge. Planners who explore participatory and collaborative approaches should be aware of these human dimensions.

Finding ways to train facilitators for collaborative game-based processes is also mandatory. All serious games, even the digital ones, demand a certain level of facilitation. Human facilitators can be biased, interfere, and affect the game results. Independently of the game, their skills and experience impact the results. Facilitators can contribute to engage some participants that are shyer or demand more support. Unequal levels of participation might be a way to legitimize established powers. Failing to include all the inputs and interactions from participants leads to poorer processes, less democratic and creative. Ideally, in collaborative planning, participants should have equal opportunities to influence decisions. Including minorities, marginalized groups, and participants with special needs or backgrounds in a collaborative planning process is another dimension to consider when training the facilitators.

Examining some planning instruments, the Municipal Master Plans could be explored through games since it is the spatial planning instrument citizens would deal with frequently in Portugal, but because they are common in other countries. A game-based approach would allow planners to deliver an interactive visual experience where proposing land-use changes shows the impacts on the overall municipal system to reveal the relationships between personal and collective impacts (Chapters 6 and 7 approaches). Mobility and Transport Plans could be approached by games, showing the flows, paths, and centralities of demand (following the Chapter 8 and 10 examples). Other consulting and decision-making initiatives like idea contests or public budgeting could be supported by collaborative "sandbox" games with limited resources, where participants used game elements to represent proposals (the co-design process of Chapter 9).

From a technical perspective, introducing hybrid game approaches was not explored. Although the analogue dimension of the set-up and the game maintenance are chores some users enjoy, it makes analogue games complex, fiddly, and long. Analogue games are flexible, but data and methods can be compromised due to human errors. Digital technologies, combined with the analogue game experience (hybrid games), can lower the game complexity, and reduce the duration of the gameplay, which is relevant when using games with citizens or other stakeholders. Showing the results of complex relationships, like the impacts of choices within a complex urban system, can be processed by digital technologies combined with the materiality and face-to-face dimension of a board game. Computer vision technology can be combined with analogue games to provide instantaneous data processing and display the game state and changes to players, representing detailed urban indicators. Another possibility is using Augmented Reality (AR) or Virtual Reality (VR) to complement the analogue game as the core media for interactions with additional immersive and detailed information. Despite these advantages, over-digitalization might reduce the benefits of analogue face-to-face play. The game might lose its transparent systems (adding layers and additional interfaces) that simplify the problem for participants. The digital technology would make the game harder for real-time adaptations to users' needs and the project's purposes. Nonetheless, these boundaries are yet to be clearly defined. Ongoing game studies and serious game research are trying to address these design topics.

Although games as a cultural activity and planning territories as collective approaches are not new in human history, merging these two concepts is a novelty that researchers and planners are trying to explore. Game-based planning for spatial planning is a growing trend. There are many potentials to explore. However, problems and limitations still affect the widespread use of these methods. With this thesis, the author hopes to produce guidelines and examples of how to develop analogue game-based (serious games) processes for spatial planning. As for digital and hybrid game development, analogue games can also be the ignition and prototypes of other game-based approaches for spatial planning and many other fields.

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APPENDIX A

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Section A: Section 1

HOST INSTITUTION:

Doctoral Program in Spatial Planning, University of Coimbra (Portugal)

RESEARCH TEAM:

Micael da Silva e Sousa, PhD student in Spatial Planning, under the supervision of Professor António Pais Antunes, Nuno Pinto, Nelson Zagalo

STUDY PRESENTATION:

This questionnaire aims to find what drives board game players over 18 years of age to play board games with the name of urban settlements (mainly cities), addressing game design elements, urban simulation, and other general characteristics of games at stake.

No personal identifiable data will be collected. Individual generic data like age cohort, gender and education are optional. Only general game habits and the perception of players about the 21 top-rated board games at Board Game Geek that have been named after real urban settlements is mandatory. There will also be an optional open field at the end of the survey for suggestions.

This survey has 15 questions in total. with multiple choice answers, except for two open-ended questions (one about what drive player to play games with names of cities, towns, and human settlements, and the last one for optional comments), with an estimated duration of less than 10 minutes.

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CONDITIONS AND Funding:

Participation as a respondent is voluntary.

This work is funded by the Portuguese research council Fundação para a Ciência e a Tecnologia (FCT), under grant PD/BD/146491/2019..

CONFIDENTIALITY AND ANONYMITY:

The survey uses an anonymous questionnaire. The data and results from this survey may be used both for the internal development of the research (and other sequential studies in the scope of the theme by the research team) and as results for possible publication in academic and professional journals and in conferences.

The following is the Electronic Authorization to confirm it for processing the collected data. If any question is deemed as inconvenient, you can interrupt your answering the survey at any time, leaving the form. If you have any questions or would like to request further information, please contact us by e-mail

We thank you for your interest and time.

TARGET AUDIENCE

This research has as its target audience of players of the selected games: Orléans, Le Havre, Lisboa, Caylus, Troyes, Maracaibo, Mombasa, Yokohama, Istanbul, Jaipur, Praga Caput Regni, Coimbra, Carcassonne, Goa, Tikal, Bruges, Nusfjord, Saint Petersburg, Bruxelles 1893, The Great Zimbabwe, London 2ed

A1. ELECTRONIC AUTHORIZATION

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Section B: Section 2

Individual generic information

B1. Age group

- 18-25 ☐
- 26-35 ☐
- 36-45 ☐
- 46-55 ☐
- 56-65 ☐
- 66-75 ☐
- More than 75 ☐
- I do not wish to respond ☐

B2. Gender

- Female ☐
- Male ☐
- Other ☐
- I do not wish to respond ☐

B3. Education (The International Standard Classification of Education - ISCED)

- Primary education ☐
- Lower secondary education ☐
- Upper secondary education ☐
- Bachelor ☐
- Master ☐
- Doctoral ☐
- I do not wish to respond ☐

B4. Do you have any specific education or professional experience regarding urban planning or spatial planning? (optional)

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Section C: Section 3

Board game habits

C1. How often do you play board games?

- Daily ☐
- Weekly ☐
- Montly ☐
- Annually ☐
- Never ☐
- I do not wish to respond ☐

C2. On average, what complexity level do you prefer in games?

- Low ☐
- Medium ☐
- High ☐
- I do not wish to respond ☐

C3. Classify your preference in the following game types and themes (1-low to 10-high):

	1	2	3	4	5	6	7	8	9	10
Abstract	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Adventure	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
City builder	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Deduction/Mystery	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Economic	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Humour/Party	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Narrative/Storytelling	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Sports	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wargame/Combat	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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Section D: Section 4

City builders and boardgames about cities

D1. Classify the importance of simulating the following dimensions in a city-building game (1 - low to 10 - high):

	1	2	3	4	5	6	7	8	9	10
Built fabric and infrastructure	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Economy	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Historical context	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Nature and Environment	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Social and culture	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Transport system	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

D2. Classify the importance of the following traits in a city-building game (from 1-low to 10-high):

	1	2	3	4	5	6	7	8	9	10
Cultural information (names of the places, events, etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Maps (space representation 2D/3D, multiple scales, relationships, etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Miniatures and dioramas (buildings, nature, vehicles, heritage, etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Quantitative information and indicators (population, wealth, pollution, etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

D3. In your opinion, what is the best city-building board game? Can you justify why?

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Section E: Section 5

About the board game at stake

E1. Select the game at stake, the game you played and wish to analyze:

- Bruges ☐
- Bruxelles 1893 ☐
- Carcassonne ☐
- Caylus ☐
- Coimbra ☐
- Goa ☐
- Istanbul ☐
- Jaipur ☐
- Le Havre ☐
- Lisboa ☐
- London 2ed ☐
- Maracaibo ☐
- Mombasa ☐
- Nusfjord ☐
- Orléans ☐
- Praga Caput Regni ☐
- Saint Petersburg ☐
- The Great Zimbabwe ☐
- Tikal ☐
- Troyes ☐
- Yokohama ☐

E2. Approximately, how many times did you play the game at stake?

- Never played the game ☐
- Less than 5 ☐
- Between 5 and 10 ☐
- More than 10 ☐

E3. How would you rate the game at stake (from 1-low to 10-high)?

- 1 ☐
- 2 ☐
- 3 ☐
- 4 ☐
- 5 ☐
- 6 ☐
- 7 ☐
- 8 ☐
- 9 ☐
- 10 ☐

E4. How would you rate the ability of the game at stake to simulate? (from 1-low to 10-high)

	1	2	3	4	5	6	7	8	9	10
Economic context and dynamics	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Environment and natural context and dynamics	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Flows and spatial relationships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Land uses and densities	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Social and cultural context and dynamics	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
The historic period portrayed	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Transport system	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Urban amenities and public facilities	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Urban Morphology (the shape and form of the city)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Urban infrastructures (water, energy, waste, etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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E5. **Why do you think there are games with the name of cities and gamers play them?**

Section F: Section 6

About the questionary

F1. **Comments and suggestions about the questionary (optional)**

Section G: Section 7

G1.

Thanks for participating in this survey. If you have any questions regarding this research please contact: micaelssousa@gmail.com

ELECTRONIC AUTHORIZATION *

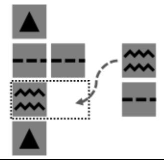
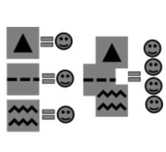
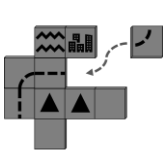
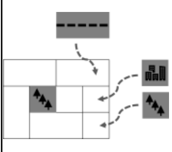
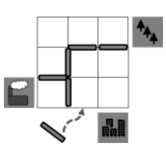
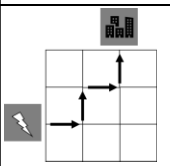
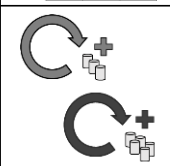
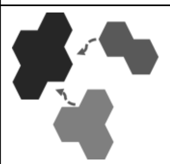
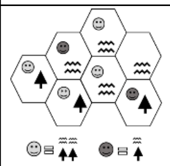
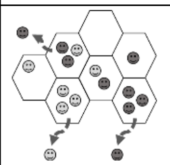
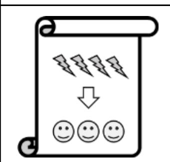
I, again after filling the survey, confirm that the authors of the research, mentioned in the introductory text, made clear the objectives, as well as the form of my participation. I read it carefully, I am aware of the answers given during the survey and understood the Consent Form.

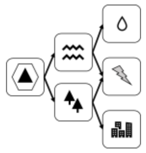
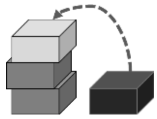
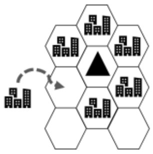
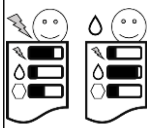
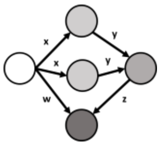
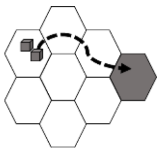
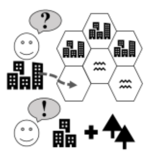
Check the option indicating or not consent/agreement to participate in the investigation after doing the questionnaire:

I AGREE to voluntarily participate in the investigation (this gives you access to answer the questionnaire). ☐

I DO NOT AGREE to voluntarily participate in the investigation (ends participation without access to answer the questionnaire). ☐

APPENDIX B

Mechanism	Scheme	Description	Spatial planning simulation examples
Pattern Building		Joining graphical elements to build complex entities.	Road networks, Land uses, Flows
Set collection		Combining elements in a way to increase their value and effect.	Mixed land uses, economic, social and environmental dimensions of development
Tile placement		Adding tiles to build patterns and form graphic representations.	Urban growth, landscape development, environmental impacts.
Grid coverage		Filling and covering predefined grids with different forms to change two-dimensional spaces.	Changing landscape, Adapting building areas to available space, limiting environmental land impacts.
Network Route building		Adding elements to build a network over a map or grid.	A Transport network, branches, distribution, and routes. Network, site connections, and land coverage.
Connections		Connecting sites in the board map	Vehicles, water, energy and, waste infrastructures. Any kind of flow.
Income		Gaining resources resulting from predefined cycles.	Tax revenues, production cycles, and natural resources renovation cycles.
Modular board		Map sizes can vary from adding or removing modules.	Urban growth or Shrinking. Landscape changes over time.
Ownership		Represent player ownership of an entity to get their effects.	Urban inequality. Urban property and stakeholders claims.
Area Majority / Influence		Multiple players/entities can coexist in the same space (percentages and influences).	Populations, offer and demand effects, distribution of votes over the territory.
Contracts		Combinations of resources, achievements or thresholds to unlock rewards (checklist).	Infrastructures, population to attract investment, new developments or policies.

Mechanism	Scheme	Descrition	Spatial planning simulation examples
Tech Trees / Tech Tracks		Connections of developments and powerups unlocked in sequences.	Technological development or Scale effects. Achieving sustainable thresholds and combinations.
Layering		Placing game components over other components.	Economic and resource accumulation, or waste and pollution. Urban densities effect and buildings height.
Enclosure		Defining new areas in maps and board by adding game pieces.	Urban growth enclosures of buildings and natural spaces. Dominating land uses shifts and monopolies.
Variable player powers		Each player has different abilities and actions they can do in the game.	Stakeholders roles and their political power and influence. Asymmetry of the demands and ability to claim them.
Events		Events that can be programmed or a random outcome that triggers changes in the game.	Political elections, weather, unpredictable and random natural cycles of catastrophes.
Point to Point movement		Movement in defined routes with associated lengths and costs.	Public transport routes, logistics and cargo distribution. Travel costs and distances.
Pick-up and Deliver		Game components are transported from one place to another.	Transport network cargo capacities. Delivery costs are affected by nearby and distant areas.
Voting		Players use their votes to decide something occur or not.	Elections. Political decisions. Public referendums. Citizens perceptions and evaluation.
Line drawing		Players draw lines to change maps, connecting, enclosing and filling spaces.	Connect infrastructures and define land uses.
Negotiation		Making agreements that can be broken or not.	Political agreements. Collaborative compromises.
Hidden roles		Players have different roles (public/hidden), including objectives and victory conditions.	Politicians and stakeholders hidden agendas.

APPENDIX C

Survey

Pre-test

Classify the following games according to your reference (1 – Do not like; 2 – Avoid play; 3 – May play; 4 - Like to Play; 5 - Like to play a lot):

- Analog games
- Sports
- Digital games
- Traditional games

Classify the learning and simulation potential of games (1 – Nothing; 2 – A bit; 3 – Moderately; 4 – A lot; 5 – Totally/always).

Post-test

Share your perceptions during gameplay (1 – Nothing; 2 – A bit; 3 – Moderately; 4 – A lot; 5 - Totally) according to the following dimensions:

- Fun
- Difficulty
- Immersion
- Challenge
- Anxiety
- Adaptation ability
- Surprise
- Empathy among players
- Frustration
- Motivation

Share your opinion about (1 – Nothing; 2 – A bit; 3 – Moderately; 4 – A lot; 5 – Totally/always):

- It was possible to test skill and knowledge in the game?
- Games could be applied to other contexts and cases?
- Games fulfilled the serious objectives?
- Would you play these games just for fun?
- Were you surprised with the game approach?
- Analog games can provide better experiences and simulations solutions than digital games?

Classify the learning and simulation potential of games (1 – Nothing; 2 – A bit; 3 – Moderately; 4 – A lot; 5 – Totally/always).

Comments to the session (free text).

APPENDIX D

Questionnaire

Q1: Do citizens have good tools, platforms, spaces, and opportunities to participate in planning processes related to the territories where they live?

Q2: Do you have any suggestions on how to improve citizen participation in planning processes?

Q3: Did you ever participated in a serious game session?

Q4: What has surprised you the most during the game session?

Q5: How complex would you consider the game to be?

Q6: How would you characterize the level of players' engagement?

Q7: How would you characterize the players' performance?

Q8: Do you consider that the game teaches something to players and the audience?

Q9: Do you think the game helped players to express ideas?

Q10: Do you think the game fostered collaboration among players?

Q11: Do you think the game was of some use to plan the Marinha Grande transport system?

Q12: What could we do to improve the game experience and achieve the goals?

Q13: Do you think we should improve and develop these games to foster public participation in planning?

Q14: Would you like to do some additional commentaries?

APPENDIX E

Survey

Pre-test

Classify from 1 (low) to 7 (high) according to your perception:

- Motivation.
- Empathy with the group of participants.

Classify from 1 (low) to 7 (high) the importance of:

- Collaborative planning.
- Importance of engaging participants for planning.

Post-test

Classify from 1 (low) to 7 (high) the following dimensions of the game experience according to your perception:

- Empathy with facilitators.
- Motivation
- Empathy with the group of participants
- Feeling of Competence.
- Difficulty level.
- Collaboration.
- Sharing ideas.
- Generated Learning.
- Addressed urban security.
- Collective improved individual.
- Coherent solution.
- Different priorities.
- Should be implemented.
- Should be Repeated.
- Participate again.

Classify from 1 (low) to 7 (high) the importance of:

- Collaborative planning.
- Using ludic approaches in Planning.

Free comments (text).

Form 1 (F1) – Priority identification form (S1)

Name of the priority
Description of the Priority
The spatial location of the priority
Related to the following problems
What has been done to deal with the problems?
What could be done to deal with the priority?
Who could implement the priority?

FORM 1 (F2) – Collective reflection form about the proposals (S3)

Session: Date: Place:
To what extent the solution improves the overall security of the urban area in general?
To what extent it improves the quality of life of citizens?
To what extent does surveillance improve?
How does the transport system improve?
To what extent does public space improve?
To what extent it deals with social problems?
To what extent it improves the image and attractiveness of the territory?

APPENDIX F

Questionnaire

Serious Games for Urban Planning

BEFORE

Generic non-identifiable personal information *(one cross per line):*

ID anonymous: ____

What is your experience with applied Games (e.g., serious games, gamification, game-based learning, etc.):

Prefer not to answer	Do not know	I have tried	I use regularly	I develop these game approaches
◻	◻	◻	◻	◻

Perceptions *(one cross per line):*

According to your opinion, classify the importance of (1= No/Nothing and 7=Yes/Totally):	1	2	3	4	5	6	7
Recreational/recreational environments for planning and decision-making	◻	◻	◻	◻	◻	◻	◻
Collaborative/interactive methods for planning and decision-making	◻	◻	◻	◻	◻	◻	◻
Visualization/simulation methods for planning and decision making	◻	◻	◻	◻	◻	◻	◻
Games as tools to support planning and decision making	◻	◻	◻	◻	◻	◻	◻

AFTER

Characterization of game dynamics *(one cross per line):*

Classify the experience of playing MMG game (1= No/Nothing and 7=Yes/Totally):	1	2	3	4	5	6	7
Communication between participants	◻	◻	◻	◻	◻	◻	◻
Foster collaboration	◻	◻	◻	◻	◻	◻	◻
Fun and involvement in the game	◻	◻	◻	◻	◻	◻	◻
Support for problem analysis (minimise costs)	◻	◻	◻	◻	◻	◻	◻
Support for the analysis of solutions (distances travelled and number of schools)	◻	◻	◻	◻	◻	◻	◻
Quality of the final solution (results) for the objective (school network planning)	◻	◻	◻	◻	◻	◻	◻

Planning and decision-making through games *(one cross per line):*

Classify according to your general perception the importance of (1= No/Nothing and 7=Yes/Totally):	1	2	3	4	5	6	7
Recreational environments for planning and decision-making	◻	◻	◻	◻	◻	◻	◻
Collaborative/interactive methods for planning and decision-making	◻	◻	◻	◻	◻	◻	◻
Visualization/simulation methods for planning and decision-making	◻	◻	◻	◻	◻	◻	◻
Games as tools to support planning and decision-making	◻	◻	◻	◻	◻	◻	◻

The potential of game-based methods for (1= No/Nothing and 7=Yes/Totally):	1	2	3	4	5	6	7
Apply in different territorial planning processes and obtain useful solutions (e.g., urbanism, transport, etc.).	◻	◻	◻	◻	◻	◻	◻
Engage participants for planning processes	◻	◻	◻	◻	◻	◻	◻
Generate innovative planning solutions	◻	◻	◻	◻	◻	◻	◻
Generate collaborative planning solutions	◻	◻	◻	◻	◻	◻	◻

General comments to the session: ____

Facilitator guidelines and notes (F3)

Session: _________________________ Place: ________________ Date: _______ N. ºP:___

Before the game (10-15 min.)	After the game (10-15 min.)

• Address problem: Allocation of all students minimizing costs.
• Address reason for the game experiment: collaborative process debate and decision-making.
• Display map: urban area, administrative boundaries, Leiria pine forest, ocean.
• Present the game elements: types of schools, hexagons, student tiles, etc.
• Mechanics and game rules: actions and restrictions
• Explain how the optimization software solved the problem.
• Game expected duration: 45 min.
	• Present the optimization solutions: solution to the cost in question, then remaining costs x2 and x5.
	• Encourage participants to share their experiences and generate debate:
	  • Playability and handling of the pieces.
	  • Interactions, engagement, and fun.
	  • How collaboration emerged.
	  • Decision-making support by the game.
	  • Question the quality of the solutions.
	• Potential, limitations, and future applications.

Students' allocations

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Facilitator's Notes

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