Serious Games in Spatial Planning: Strengths, Limitations and Support Frameworks

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Abstract

Serious games are being developed in many fields of research and proving to be valuable practical tools. In the planning field, games can help approach complexity and engage more participants through first-person experimentation. This paper presents an overview of the main strengths and limitations of applying serious games in spatial planning and discusses available support frameworks. It proposes some guidelines for researchers and practitioners that want to profit from game usage. Serious Games can be powerful tools but can easily lead to failure processes, which demand previous systematic analysis of what planners may do and expect from games.

Keywords: *Spatial Planning; Serious Games; Participation; Complexity.*

1 Introduction

Why should games be used in planning practices? Departing from the concept of games as interactive processes that generate outcomes [1], and from the notion that planning generates outcomes influenced by political powers [2], promoting engaging and enjoyable planning processes can be valuable [3]. Participation in spatial planning needs new tools to avoid being long, tedious, and attended by the same reduced quantity of persons [4].

Games establish active participation and collaboration while fostering innovation by incorporating multiple perspectives from participants [5]. This may increase civic empowerment, expression, experimentation, and even cocreation [6]–[8]. Codesigning games, for serious purposes, may avoid misinterpretations and simulation failures [9], [10] and provide the opportunity to create engaging experiences that achieve predefined goals [11].

Arguably, games may be the tools capable of establishing the missing bridges between experts and citizens [12]. When participants play games, planners can gather information and bind socially with participants [13]. 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 [14], [15]. To Lundström et al. [16], spatial planning activities are like playing a wicked game. To Dodig and Groat [8] 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 uses is necessary. Departing from Taylor [17] that addressed the advantages of simulation games for planning, we aim to understand contemporary trends. We highlight Münster et al. [18] work on digital media in participative planning and Ferri et al. [19] on urban play as interactive participation processes related to experiences. Constantinescu et al. [20] and Ampatzidou et al. [21] produced relevant introductory literature reviews of SGs, while Vanolo [22] approached SGs and gamification. The game-based approach from Hartt et al. [23] suggests that gamification and SGs can improve teaching about planning. While Latifi et al. [24] identify relations between gamification and smart cities. Ashtari and de Lange [25] focused on the skills required to benefit from games for planning processes. The book *Play the City* [26] is a landmark about practical experiences of games applied to planning, and Dodig and Groat [8] 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 [12], [21], [27], 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.

1.1 Defining Serious Games

Salen and Zimmerman [1, 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 [28], related to learning and simulation. Games can create engaging and emotional social spaces [29], fuelled by conflicts, learning, overcoming of new challenges, and the tensions, uncertainty, and surprises they offer [30]. During game activities, players acquire knowledge and develop skills to deal with problem-solving contexts through first-person experimentation [7], [15]. Games allow players to learn and think by doing, and testing multiple options, accumulating knowledge without the negative consequences of real-life choices [31]. Games can produce experimental situations that would otherwise be impossible to undergo in real life, safely and at a low-cost [32].

SGs generate experimental environments where learning and comprehension occur through game experimentation [33]. Players' active roles in games provide meaningful contexts for choice and action, distinct from reality but related to it [34]. Games provide intrinsic motivation, but forcing someone to play may destroy the attraction of playability [35]. While the emulation of reality in games would create standard simulations, SGs avoid doing this by balancing simulations and playability [32], [36]. SGs must integrate the gaming dimensions with the serious intentions they aim to address [7], [9]. But the term serious can be problematic to describe games that tend to be associated with unserious issues [37], [38]. Even the boundaries between simulation and SGs are not clear [12]. 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 [39]. These games are serious because they can be engaging work tools beyond being ludic (or fun) [28], [40], [41].

SGs seriousness is dependent on the way they are designed and used, regardless of the game platform [42]. Games must have rulesets to define the goals and procedures, including metaphors and narratives to generate meaning [29], game mechanics, interfaces, platforms, and objects to be manipulated [43]. Mechanics are a core element because they are how

players activate and interact with the game system [44]. Game mechanics are key design elements in SGs for planning [9]. 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 [6], [45]. 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 [46]. Games mechanics and dynamics must be interconnected to build the game experience towards SGs purposes [47]. By doing so, games can reveal participants' initial assumptions, decisions, and feedback that construct experiences that simulate multiple scenarios [48]. Games can provide awareness to participants about the implications of their decision, individual and collective [7], which results from combinations of different elements, knowledge, and experiences players bring to play [49].

Framing games as tools for complex decision-making in uncertain environments requires having facilitators [50]. 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 [51], [52].

1.2 Serious Games in Spatial Planning

By the 1960s, academics and experts developed game models to build scenarios to explore spatial interactions [20]. The first games were strongly mathematical in their attempt to simulate reality [12], [53]. Taylor [17] 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 [12], [54].

Game approaches decreased over the years, mostly after the 1980s [4], when post-modern views started to influence planning [55]. But since the 2000s, games were recovered for planning uses [56]. Many new game approaches try to capture the variety of human behaviour and the emergence of unpredictability, both expressing the complexity of contemporary societies [12], [26]. These games focused mainly on motivation and improving civic participation [34]. Planners realized that many of the deliberative decision-making processes and system analyses are like games, with their rules, objectives, and multiple scenario exploration [57], generating unexpected interactive results [7], [58]. The SG approach remerged, fusing simulation and learning with engagement and fun [21], [59].

Storytelling has been used in participative planning, at least since the 1980s, to engage participants, provide context, and persuade their action [60], [61]. Narratives provide meaning to mechanical systems [29]. These contents help planers to understand power relations, engage participants' attention and support the expression of their personal views [62]. In the 1990s, Healey [63] highlighted the need for more communication tools for planning, while Innes and Booher [60] endorsed using role-playing games (RPG). Through role-play, players can swap and experiment with multiple visions of the same problem, promoting rational communication [64]. Personal claims, experiences, and even irrationalities and inconsistent assumptions can be addressed in a controlled way to generate common knowledge [40]. Introducing this storytelling dimension can improve the engagement and results of game-based planning exercises [23]. 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 [65], [66].

Portugali [14] 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*" [67, p. 11]. Games can address these wicked dimensions when

multiples players generate different solutions with changing rulesets and constant feedback [16], [57], [68]. Designing these collaborative planning game systems reinforces the need for planners' involvement [53].

Portugali et al. [69] 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 [26]. 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 [70], [71]. Valuing the gameplay is necessary to generate the desired outcomes of SGs for planning [4], as this is essential to develop civic skills like knowledge, communication, group thinking, and decision making [25]. But allowing the game system to reveal emergent results, dependent from the participants inputs and interactions, is also important [70].

1.2.1 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 [37], [38]. On the other hand, many games fail in consensus building due to a lack of adaptation to reality [20]. 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 [72]–[74].

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 [21], [31], [52]. Including several of these sporadic games is not the same as transforming the entire planning process into SGs and does not increase participation automatically [75], [76]. 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 [9], [77]. Trust improves if game approaches start simple and build up with complexity while addressing reality in a comprehensive way [39], benefiting from sequences and pauses to discuss and analyse game results [78]. Designing and adapting games during play, following co-creation approaches, can enhance game advantages even more [11], [49]. Low-tech games, like board games, can be better for citizens than for experts that can deal with complex digital simulation approaches [79]–[81]. But approachability in games that is useful to engage the broader public may produce heuristics that lead to inefficient solutions, far from precise simulation [32], [82], [83]. 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 [11], [20].

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 [7]. Independently of the approach, face-to-face dynamics should not be neglected [18]. Even in digital games, face-to-face meetings are significant to enforce confidence, empathy, and collective learning among participants [49], [77], [81]. The relationships between participants and planners can be improved through the analogue dimension of tabletop games [81], [84]. Allowing participants to manipulate scenarios and see the impacts of that interaction can reduce the complexity of the reality being simulated [19]. 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 [11].

When researching planning games, the literature refers to several works about digital city builders. Games like *SimCity* are useful for teaching planning [59], 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 [53], [85], [86].

Despite their advantages, inexperienced players can have difficulties addressing defined objectives through city builder games [87]. The inevitability of 'black boxes' and hidden coding hinders system understanding, relations, and cause-effects [59], [88]. *City: Skylines* 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 [68]. Despite all these limitations, digital city builder games are useful when combined with other planning approaches [85], adapted through scenario building, and supported by proper teaching and facilitation [89]. Recently, *Minecraft* is being used in participatory planning [90].

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 [91]. Adapting existing board games is frequent, although some authors say they are childish and unable to simulate reality in meaningful ways [88], [92]. But modern board games like *Carcassonne*, *Agricola*, and *Lords of Waterdeep* can be combined with RPG elements, providing meaningful decision making to address spatial planning [31], [93].

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 1 presents the combinations of keywords that supported the systematic literature review.

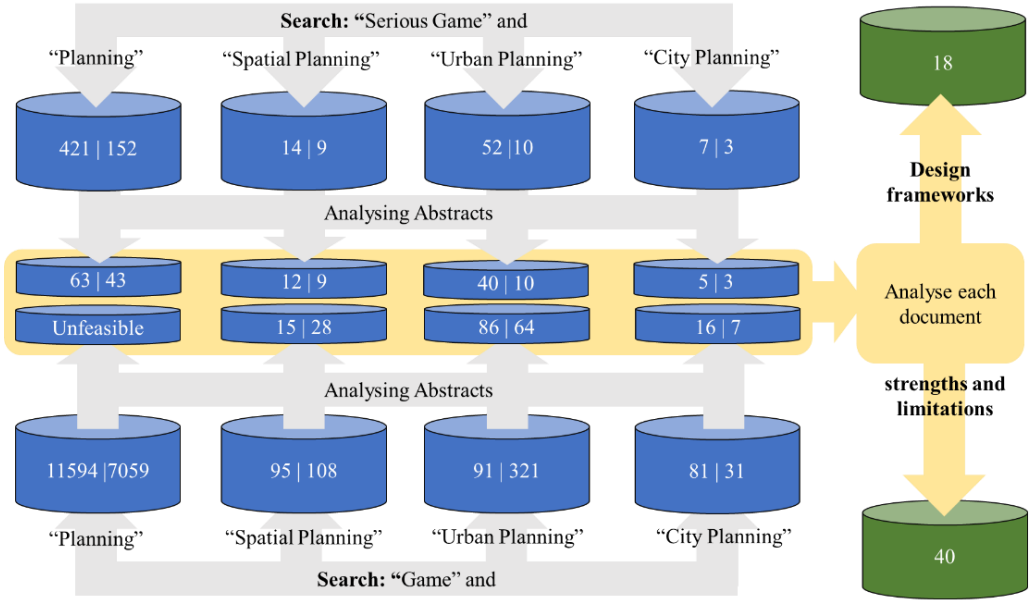

Figure 1. *Flowchart of keyword search and filters; numerical results indicate number of articles obtained from Scopus (left values) and from Web of Science (right values)*

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. [19], Taylor [17], and Winn [94]. These references might not be indexed but are relevant for game design and framework development. One paradigmatic case is the MDA framework [95] influence.

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 [8], [21]. 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 [13], [76].

3.1 From limitations to opportunities with SGs

Setting clear frameworks and usage guides will allow transferring gameplay experiences to real planning processes [4], [20], [40]. Benefits from the use of SGs increase when they build consciousness for planning complexities and increase participants’ knowledge and skills just by playing [6, p. 50], [75]. But this can only be observed if the game results are adequate and fit demands and expectations [13], [96]. Through games, participants can understand the different scale effects, broader visions, and complex interactions about urban systems [31], [32]. Understanding urban systems is difficult by non-experts [86]. SGs can engage players by levering decision power while providing new ways to access knowledge [91]. Despite the many success cases, it is still unclear what conceptual considerations guide SG design for planning [31]. Which game mechanics determine more participative involvement and what level of co-creation should be adopted in a process to reinforce participation [9], [27].

Using games is not an automatic way to bring more participation and do better plans [76]. Game design may deliver superficial or obscure experiences [37], [97], and choosing which participants to play may jeopardize the whole process [98]. Game legitimacy for planning is not unquestionably established, due to the lack of measurable and accountable bases [76]. The problem might be the way games have been used in planning practices [6]. 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 [13], [37], [54]. In practice, these design options led to many simulation simplifications to provide playable experiences [7], [22], [39], [52], [83]. Competition is one of these effects, which can engage some participants but distort the SGs goals [21].

Because games are social activities of personal expression, players can be exposed to uncomfortable situations that demand anticipated design control and gameplay facilitation

[7]. 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 [67], [99]. Game facilitators can manage unpredicted behaviours, different player profiles, and interpretations while incentivizing balanced participation [21], [100]. Having experts participating in the game also influences higher coherent solutions [54], although negotiations become tenser and game models more questioned [101]. It is also improbable that inexperienced players participating in SGs would provide perfect solutions [102]. 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 [103].

The openness of some games is suited to deal with wicked planning problems, although difficult for systematization and evaluation [39], [104], which is challenging to support academically [102]. Devisch et al. [52] 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 [5], relating the game mechanics to the SG objectives [9], [50], [105].

Younger citizens usually are very open to game-based participation processes [18], [77], although older adults can also be engaged [37]. 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 [21]. The rejection of games for planning processes might be related to the process and not the games themselves [7]. When the first prejudice barriers fall, even sceptics tend to enjoy and recognize the value of SGs [102]. Politicians and planners can be averse to games when they feel their power undermined due to game unpredictability [54]. Nevertheless, most people are available to try planning games if the goals are clear [7]. Highlighting the intended effects of SG usage at the start of the planning process might help avoid initial rejection [11], [27]. 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 [75].

Despite the many game-like approaches for planning, Ampatzidou et al. [21] 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 [19]. Acknowledging all these uncertainties, limitations, and challenges is essential to develop successful SG approaches.

3.2 Finding existent SG frameworks for planning

Taylor [17] 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 [100] 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 [106], possibly organized in a sequence of introduction, self-reflection, analyses, and generalisations [96]. Like in participatory and collaborative planning approaches, facilitation and debriefings are mandatory in SGs to achieve planning goals [40], [51].

Mayer et al. [13] 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. [42] 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. [32] propose another framework to successfully design an SG, based on Harteveld's [107] 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. [32] 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 [95] dominates the game design literature, despite the many alternatives, variations and critiques [108]. Constantinescu et al. [11] 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. [19] found that codesigning games engage participants, delivering better participative experiences. Later Constantinescu et al. [27] 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 [25] 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. [19] propose a method that combines PLEX [109] 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. [19] 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 [94]. The DPE added more layers to the MDA, introducing the specific flows for the learning dimension and narrative dimensions. Ampatzidou and Gugerell [49] adopted the DPE framework, an approach that inspired Sousa et al. [81], [110] 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. [13]. Ampatzidou and Gugerell [9] also related the learning mechanics with the game mechanics through the 8 Learning Events Model (8LLE) [111]. 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 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 [70].

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. [11], [105] and Ampatzidou and Gurell [9] 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 [112] 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. [32] design interactions also relate to the codesigning approach that Champlin et al. [84] 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 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.

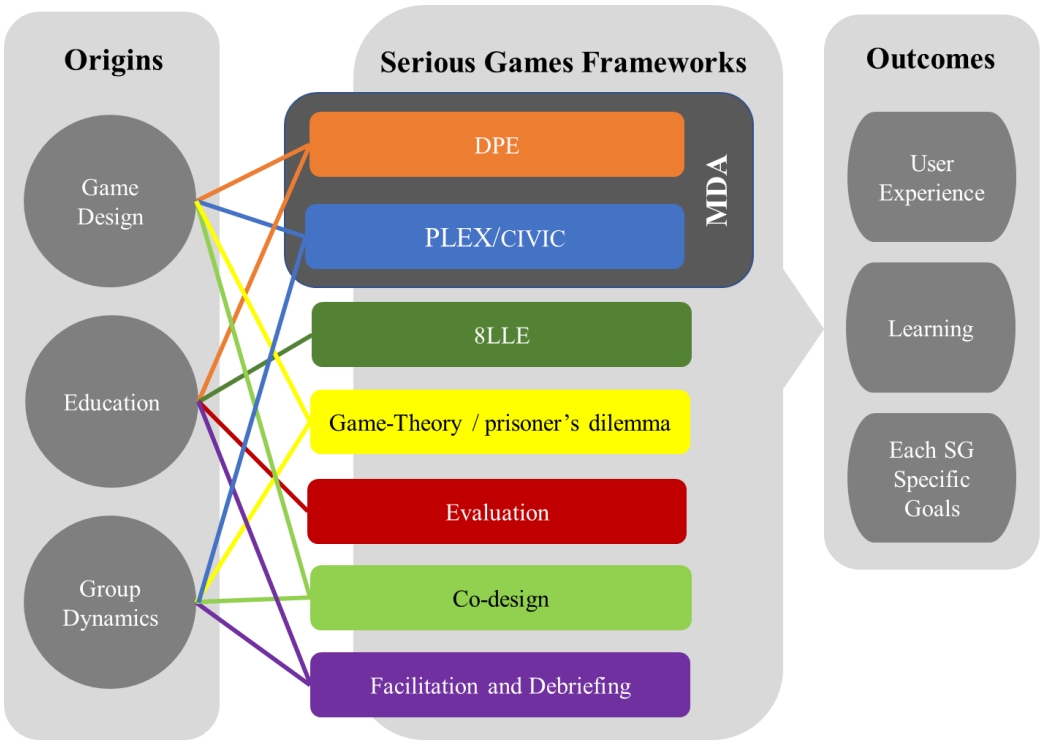

Figure 2. *Origins and outcomes identified in the literature about SGs for planning. Authors' proposal.*

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 [12], [21], [56], [105]. Table 1 presents the authors and the identified groups of strengths and limitations that planners need to consider when using or developing SGs. Figure 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 Table 1 and Figure 3 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.

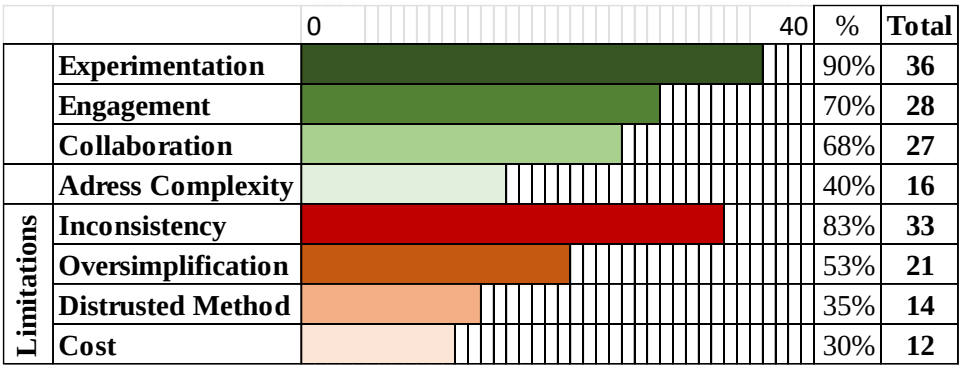

Figure 3. *Number of references about strengths and limitations of using SGs in planning according to Table 1*

Table 1. *Literature about Strengths and limitations of using SGs in spatial planning after year 2000*

References	Strengths				Limitations			
	Experimentation	Engagement	Collaboration	Complexity	Inconsistency	Oversimplification	Distrust	Cost
[4]	■	■			■		■	
[5]	■		■		■			■
[9]	■		■	■	■	■	■	
[11]	■	■	■		■	■	■	
[16]	■			■	■	■	■	
[18]	■	■	■				■	■
[19]		■	■		■		■	
[20][71]	■		■	■	■	■		
[22]		■	■		■	■		■
[24]	■	■	■	■				■
[25]	■	■	■					■
[31]	■	■		■	■		■	
[32][93]	■	■			■	■		
[37]	■	■			■	■		■
[39]	■			■	■	■		
[40][83]	■	■	■		■	■		■
[48]	■				■			■
[49]	■	■	■		■		■	
[50]	■	■	■		■			■
[52]	■	■	■		■	■		
[54]	■	■	■	■		■	■	
[57]	■			■	■			
[68]	■							■
[70]	■	■	■	■	■			
[75]		■		■	■		■	
[76]	■	■	■		■			
[77]	■		■		■	■		■
[78]	■		■		■			
[79]	■	■	■			■	■	
[81][84][85]	■	■	■	■	■	■		
[82]	■		■					
[27]	■	■	■	■	■		■	
[102]	■	■		■	■	■	■	
[103]	■	■			■	■	■	
[104]		■	■		■			

The literature highlights the importance of codesigning and testing prototypes to ensure the balance between the topic and the level of playability [49]. Codesign brought ways to deliver a meaningful and fun experience. It is usually done by exploring and adapting various prototypes to engage the participants [19], [27], [84]. 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 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 [19] that focus on the player experiences and the evaluation frameworks like the one proposed by Mayer et al. [13]. 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 4 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 3 and using the knowledge listed in Table 1). 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 4 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 4 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 4) is compatible with interactive codesign processes [8], [49], [84], [113], following the recommendations of playtesting and continuous adjustments [114], [115].

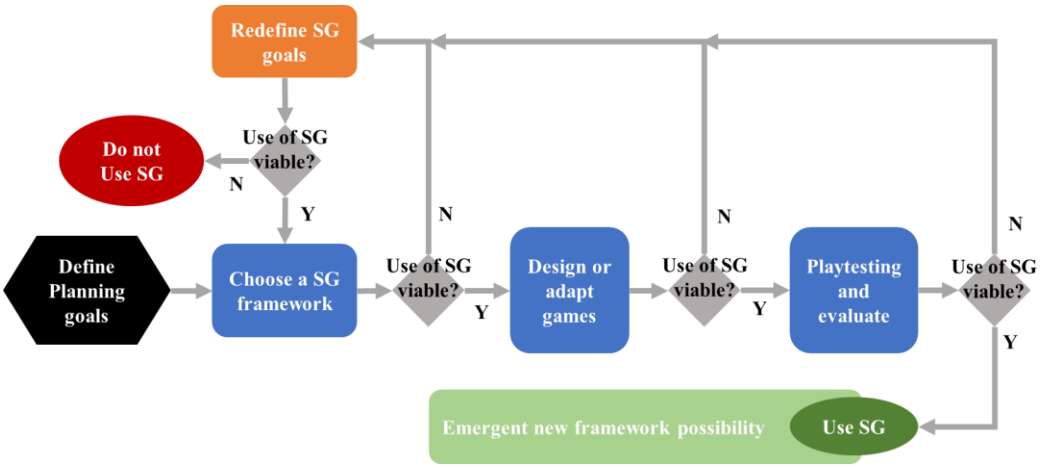

Figure 4. *Scheme to introduce SGs in planning.*

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 4), 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.

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 4. 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 4).

Table 1 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).

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