Mini is beautiful. Playing serious mini-games to facilitate collective learning on complex urban processes

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Abstract. Spatial planning projects can be conceived as processes of collective learning. Planners have been looking at games and playful approaches to support these processes. Considering that planning projects are long and complex, we propose to not reason for single, full-fledged and all-encompassing games, but instead work with strings of, so-called, serious mini-games that each addresses a specific learning goal, guided by a collective learning model. This paper conceptualizes a toolbox to support the development and contextualization of such strings of serious mini-games.

Keywords: Serious Games, Collective Learning, Mini Games, Sustainability Transitions, Urban Governance, Spatial Planning

1 Introduction

In 1981 John Friedman published *Planning as Social Learning* in which he suggests to no longer approach planning as the making of plans, but as an act of *mutual learning* based on dialogue and transactions between individuals [1]. Ever since, an increasing number of practitioners and academics approach planning as a process of collective learning. In a review of strategic planning, Albrechts [2], for instance, conceptualizes planning processes as four-tracks: *"one for the vision, a second for the short-term and long-term actions, a third for the involvement of the key actors, and finally a fourth track for a more permanent process (mainly at the local level) involving the broader public in major decisions"*. With the fourth track, Albrechts

argues that there is not only a need for civic participation (track 3), but also for inclusive and more permanent empowerment processes in which citizens *"learn about one another and about different points of view, and they come to reflect on their own points of view"*. Albrechts conceptualises these empowerment processes as *places for continuous learning* that engage (disempowered) citizens into a long-term dialogue, instead of in isolated, fragmented and project-driven discussions This dialogue should, according to Albrechts, help these citizens to learn to argue or reason, to learn to talk and think spatially, to learn to present and defend outcomes in front of formal policy settings, and, over time, build up a resource of mutual understanding, a *social and intellectual capital*. While Albrechts four tracks are intertwined processes that might reinforce, obstruct or interrelate they also follow their own trajectories, with an own objective, rationale and rhythm. This paper focusses on the trajectory of track 4, the collective learning track, and does not take any planning procedure into consideration, realizing that, within strategic planning, this focused condition can only temporary.

Some planners have, over the past 40 years, experimented with (pervasive) games and playful approaches to support this process of collective learning [3] and [4]. Salen and Zimmerman [5] define a game as "*as a system in which players engage in an artificial conflict, defined by rules, which results in a quantifiable outcome*." These features turn games into powerful tools for learning, because they provide a safe space for experimentation and experiences. Participants can play around, explore the space of possibilities, observe the consequences of decisions taken, without running any real risk or damage [6]. By interacting with one another, commenting, engaging in role-play, imitating, etc., the players develop shared values, practices, ways of knowing, acting, being, and caring [7] and, as such, create Albrechts' places for continuous learning.

Driven by the increasing popularity of (pervasive) games, games for non-entertainment purposes (like games-for-learning) recently obtained the common name of *serious games* [8] and [9]. Serious games are typically developed with one particular (sectorial) design-goal in mind, such as the conception of a public transport system, or the spatial appropriation of a neighborhood or the development of an energy plan for an urban district (see among others [10], [11], [12] and [13]). These types of serious games are mostly played only once in a given planning process. Considering that regular planning processes are rather long and complex, consisting of different project phases and team compositions, these games support and facilitate collective learning only to a limited degree. This limitation might be considered problematic, given that durable collective learning requires the long-term engagement of a collective which has to go through multiple stages of learning with different foci and necessities (a/o [14]).

Thus, we propose to no longer rely on single, full-fledged and all-encompassing serious games, but instead to depart from strings of *serious mini-games* that each addresses specific experiences and learning goals along a learning trajectory. Existing research on serious mini-games focuses on their application in educational contexts and on their instructional value (e.g. [15] and [16]). While there are defined characteristics for the design of mini-games (e.g. short games that focus on a single concept of learning, basic rules, easy to play) they do not include strong considerations on collective learning within a real-life context.

Hence, the aim of this paper is to conceptualize a toolbox that supports spatial planners (1) to develop serious mini-games framed by a *collective learning model* and (2) to contextualize a string of mini-games to *specific complex urban processes*. The conceptual toolbox is developed on the basis of a design-based and empirical research conducted within the Play!UC research project. The mini-games, presented in this paper, are developed to illustrate and back up the conceptualizations in the toolbox (see also [17], [18] and [19]).

2 A Framework For Using Games To Support Collective Learning

In this chapter, we review a selection of collective learning models and a number of game design models. On the basis of these reviews we integrate, in chapter 3, one collective learning model and one game design model into a conceptual toolbox for serious mini-games. In chapter 4, we illustrate how to use this conceptual toolbox by applying it to three collective learning processes.

2.1 Learning and Collective Learning Models

Recent years have shown an impressive rise of literature discussing the significant role of collective learning for planning, policy-making and governance (e.g. [20], [21] and [22]). This popularity has also increased the diversity of approaches to collective learning. In this section, we discuss some of the learning models that form the basis of these approaches.

In his seminal book *Mindstorms: Children, Computers, and Powerful Ideas* Seymour Papert [23] introduces the learning theory of *Constructionism*. He illustrates that we do not learn by simply transmitting knowledge, but by re-constructing knowledge based on existing literacy and in response to a concrete problem. Papert proposes to use games to support this process of, so called, *problem-based-learning*. These games (e.g. Logo, a programming language designed for use by children) were developed to invite students to discover a problem from multiple perspectives by challenging them to formulate solutions while using specific (game) artefacts or following specific (game) rules. With each completed game session, the students build up literacy and skills to re-construct the issue and improve their understanding of the problem.

Rodrigo Lozano [24] takes problem-based-learning out of the classroom setting and into the realm of organizations (or organized collectives as is the case in participatory planning processes). His point of departure is that organizational learning (such as collective learning within formal planning processes) is considered a key strategy to increase the potential for innovation within (institutional) organizations, to transition towards more sustainable societies. Lozano develops a framework to support organizational learning based on two learning typologies: the first one, developed by Argyris [25], refers to the *degree of experimentation* in a learning process and distinguishes between schooling (single loop), the questioning of underlying concepts and models (double loop) and the re-framing of these concepts

and models (triple loop). Though Papert and Argyris do not refer to each other's work, they both approach learning as a re-construction or re-framing process that is triggered through action. The second learning typology, proposed by Doppelt [26], advocates different *learning strategies*: adaptive, anticipatory and action based learning. Lozano amalgamates both typologies into an integrated framework and advocates that the consolidation of new ideas requires a learning process that covers multiple learning formats ranging from adaptive single loop learning to action based triple loop learning.

Brown and Lambert [14] propose a similar, yet more operational, learning model in their book *Collective Learning for Transformational Change. A Guide to collaborative action*. They base their work on Kolb's [27] *Experiential Learning Theory* (a variant of Papert's constructionism), in which he argues that learning processes ideally follow a cycle of four stages, namely: experiencing, reflecting, thinking and acting. Brown and Lambert extend this model from individual to collective learning. Like Kolb, they argue that a collective has to pass four different stages to truly learn, namely ideals, facts, ideas and actions. Stage 1, ideals, asks '*What should be?*' and is based on the argument that "*translating different ideals into shared principles for action asks for mutual acceptance of difference*". Stage 2, facts, asks '*What is?*' and is based on the argument that "*identifying the supporting and impeding factors for collective learning means acceptance of different points of view*". Stage 3, ideas, asks '*What could be?*' and is based on the argument that "*bringing together different creative ideas calls for the groups involved to celebrate their difference"*. Finally, stage 4, actions, asks '*What can be?*' and is based on the argument that "*combining different contributions to collaborative action creates a whole more effective than any one part*" [14]. Their book is written as a guide that helps collectives to integrate these four stages into one continuous learning process.

2.2 Serious Games, Mini-Games And Game Models

Next to conveying ideas and values and persuading players [28], facilitating learning without the players even noticing it or perceiving it as tangible learning, is an important characteristic of serious games. Hence, players play for fun – while learning is packed and hidden within the gaming experience [17]. More recently mini-games are moving into the spotlight: their increasing popularity is owed to their flexibility and lower development costs, compared to full-fledged serious games [29] and [30]. Mini-games are advocated for their rather basic game mechanics, quick-to-learn game rules and limited learning objectives [16]. Though also mini-games can become progressively complex in higher game levels, the core principles for mini-games remain the same: they are rather short, simple and memorable [16] and [31]. Mini-games work in two ways: either as stand alone, or linked with other learning actions into bigger (planning) processes [32] and [33].

There is no standardized 'one-fits-all' approach in serious game design. However, game design research has illustrated that design principles and aspects used for the design of entertainment games also work for serious games [34] and [35]. One of those frameworks is the *MDA framework* (Mechanics-Dynamics-Aesthetics). The formal MDA model looks at games through three lenses: 1) rules, 2) system and 3)

fun, and subsequently relates them to their design counterparts of 1) rules-mechanics, 2) system-dynamics and 3) fun-aesthetics. The mechanics (e.g. collecting, searching, competing) define the game, generate the player dynamics (how players (inter)act), and subsequently the players' aesthetic experiences (how players experience the game). The design of a game begins with specifying the aspired player aesthetics (e.g. a feeling of increased trust among the players). The designer then has to describe the observable player dynamics that may suggest such an aesthetic experience (e.g. collaboration among the players) and begins to iteratively tweak parts of the mechanics and observes the changes in dynamics, until the game generates the desired player aesthetics [36].

Also, other game models facilitate such a structured approach to game design, like the *HABS model* (Hierarchical Activity Based Scenario) [37] and [38], the *GOP model* [39], [40] and [41] or the *Machinations model* [42]. All these approaches, including the MDA model, remain modest regarding their learning and pedagogical background and implications.

A model that does link game design with learning and pedagogy is, for instance, the *DPE model* (Design-Play-Experience) [43]. It basically extends the MDA model by integrating learning as a separate *lens* into the model. Hence, the DPE model provides a model of four layers to deconstruct serious games: learning = content/pedagogy; storytelling = character/setting/narrative; gameplay = mechanics; and user experience = game interface. Each layer has a design, play and experience aspect [43]. Like the MDA model the DPE game design process starts with the envisioned player experiences and the fundamental 'design goal', to then work in iterations towards the design aspect of the serious game [5] by (co-)designing, (co-) prototyping and playtesting.

Other game design models that explicitly focus on learning are the *Four Dimensional Framework* [44], the *GOM* (Game-Objective-Model) [45] and [46], the *Game-based Learning Framework* [47], the *Serious-Game-Design-Assessment model* (SGDA) [28] and the *Activity Theory-based Model of Serious Games* (ATMSG) [48].

3 A Conceptual Toolbox for Serious Mini-Games

On the basis of the (selective) review of theories of collective learning and the assessment of game design models we propose a conceptual toolbox to support the development and contextualization of serious mini-games to facilitate collective learning over complex urban processes. As Figure 1 suggests, we structure this toolbox around the collective learning model of Brown and Lambert [14] and the MDA game design model [36].

We select the collective learning model of Brown and Lambert [14] because it is rooted in Kolb's Experiential Learning Theory: a group learns from the individual and collective experience of a (constructed) situation. Spatial planning processes can be conceived as sequences of such situations, and can as such be designed as experiential learning processes. On top of this, the structured four-stage-approach of Brown and Lambert allows to both re-interpret (and learn from) finished collective learning processes and to plan processes that are explicitly focusing on collective learning. The

game design models that we did discuss, and that do consider learning, are all conceived to support the design of full-fledged, all-encompassing serious games, oriented at classroom settings. Both of these features do not comply with the selected collective learning model of Brown and Lambert [14]. Collective learning processes need to be structured along four stages, and as such require multiple actions, distributed over a longer period of time. One such action defines the precise objective of the next one. It might, for instance, be that a collective decides that it is necessary to collect even more facts (i.e. remaining in stage 2), or that it can start with the development of future scenarios (i.e. jumping to stage 3), or that a step back is needed to reconsider initial ideals (i.e. returning to stage 1). Single serious games do not support such dynamic and unpredictable processes sufficiently. Consequently, strings of serious mini-games might support collective learning process more accurately providing a safe environment for a collective to set up learning experiments, discuss experiences, conceptualize these experiences and formulate new experiments [49] and [50].

We select the MDA game design model because of its systematic iterative step-by-step approach. This makes it both operational and open enough to support the development of mini-games that can facilitate dynamic and unpredictable learning processes.

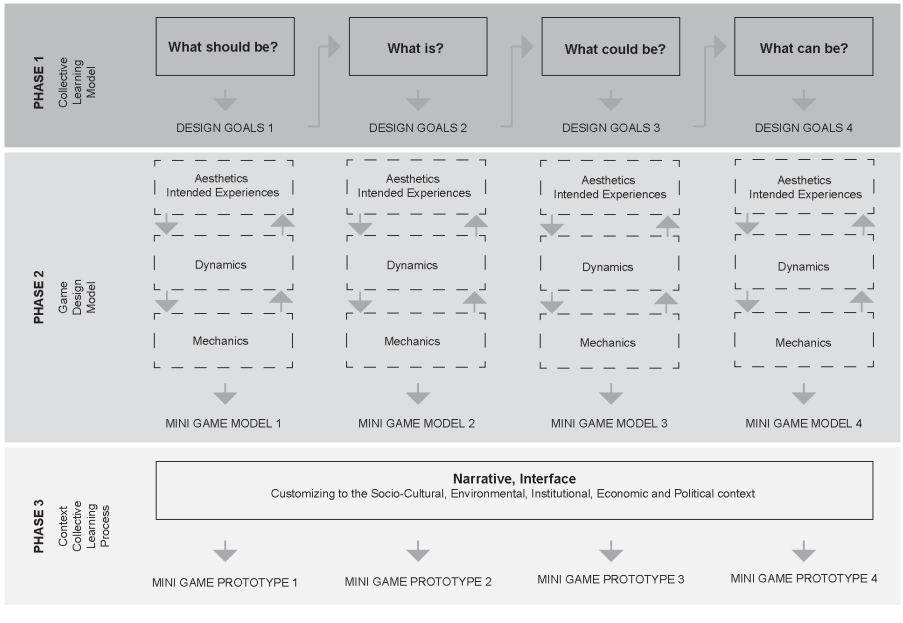

Fig. 1. A conceptual toolbox for serious mini-games. The learning model structures a string of four mini-game models each addressing one learning stage (phase 1). The MDA model structures the design of these mini-game models (phase 2). Phase 3 embeds the mini-games in their context and transforms the generic models into specific prototypes.

The toolbox defines a process of three phases in order to develop a string of serious mini-games to facilitate collective learning on specific complex urban processes.

While the first two phases are generic, the third phase is linked to the specific learning context and turns the generic model into a specific prototype.

Phase 1. Operationalizing the Collective Learning Model. The aim of the first phase is to operationalize the collective learning process on the basis of the four stages defined by Brown and Lambert [14]: 1) What should be?; 2) What is?; 3) What could be?, and 4) What can be? The initial step is defining concrete learning objectives for each stage (e.g. to gain an understanding of the diversity of (spatial) ideals among the participants; to gain insight in the current (spatial) situation). The second step is to define outcomes that each stage should generate (e.g. a list of (spatial) ideals, a description of the current (spatial) situation). Setting the objectives and outcomes for all stages is crucial to ensure a coherent learning process and to monitor whether the participants have reached the learning objectives of a learning stage and are ready to embark on the next one. Outcomes that are produced in one stage (e.g. values, facts) function as input for the next learning stage.

Each stage is supported by one mini-game model. The third step of phase is to translate the learning objectives and learning outcomes of each learning stage into design goals that frame the design of each mini-game model.

Phase 2. Developing the Mini-Game Models. The aim of the second phase is to develop generic mini-games models that comply with the design goals defined in phase 1. The development of the mini-game models is structured by the three-lenses-approach of the MDA game model. Consequently, phase 2 begins with the definition of the intended aesthetic experiences of the players, and this for each learning stage (phase 1). These experiences are triggered and driven by game dynamics. These dynamics describe the games run-time behavior [36] and the observable, tangible dynamics, actions and interactions in the gameplay. To illustrate: the design goal of the first mini-game model is to collectively explore project values. Hence, players are expected to experience that they share (some) values. Subsequently the game dynamics describe the run time behavior, such as the exploration, collection, weighing and clustering of values. Game mechanics are the components triggering game dynamics and game play. Hence, they are also the mechanism that structure and drive the interaction between the players and the game and among the players. In phase 2 play-testing and iterations are crucial for balancing the game mechanics ensuring the game is 'running' and the anticipated learning outcomes attained. The iterations of a single mini-game model design process are completed when playing the game always results in the intended design goals. The outcomes of phase 2 are four functional and tested serious mini-game models.

Phase 3. Contextualizing the Mini-Game Prototypes. The aim of the third phase is to contextualize the mini-game models to the concrete collective learning process: e.g. to the number and type of participants, to the urban context or particular planning processes. This phase transforms the generic mini-game models into tailor-made mini-game prototypes. The mini-games receive their narrative and interface in response to the particular socio-cultural, environmental, institutional, economic and political context. The objective is to establish prototypes that are specific enough for players to recognize a meaningful and well-embedded narrative in order to trigger

focused learning processes [17] and [18], and generic enough to leave action space for the players to generate interesting and relevant output for the next learning stage. Recalling that collective learning processes are dynamic and unpredictable it might be possible that one mini-game prototype is played multiple times in order to reach the learning objectives and outcome of a particular learning stage. Given that each of these playing sessions may have slightly different objectives (and in order to keep things fun) modding the prototypes by the players should be possible.

However, games are not the only tools that can support the design goals defined in phase 1. Also, 'traditional' participatory tools (e.g. charrette, collective walks, design workshops) or pervasive technologies are supporting learning, which can be combined and embedded in the overall learning process. The result is a collective learning process facilitated by a (carefully managed) selection of (a diversity of) enabling tools [51]), of which serious mini-games are only one possible option.

4 Applying the Toolbox to a Collective Learning Process

The conceptual toolbox was developed and implemented within the context of the *Play!UC project*. The aim of Play!UC is to research how serious games can support civic engagement and collective learning on complex urban processes related to sustainability transitions. In this chapter we will illustrate how the conceptual toolbox helped us to facilitate three specific collective learning trajectories, addressing three sustainability topics -smart mobility, renewable energy and circular economy- taking place in three European cities – Vienna, Austria; Groningen, the Netherlands and Genk, Belgium.

Table 1. Summary of the Learning Objectives and Outcomes defined within the Play!UC project

	STAGE 1	**STAGE 2**	**STAGE 3**	**STAGE 4**
Learning Objectives	To gain an understanding of the ideals of the other players regarding sustainable futures	To gain insight in the socio-cultural, political, economic and institutional context and in existing projects	To gain a feeling for possible scenarios for sustainable futures	To gain an understanding of how to operationalize future scenarios
Learning Outcomes	Collected, clustered ideals Valued and weighed ideas	Literacy of strategies, steps & actors required for a given project Knowledge of windows of opportunity	Scenarios for projects Suggestions for alliances, steps & actions	Responsibilities, roles & interests

Phase 1. Operationalizing the Collective Learning Model. The aim of this phase is to specify the learning objectives and learning outcomes of the four stages of collective learning defined by Brown and Lambert [14]. Table 1 summarizes these objectives and outcomes. We decided to keep these generic enough so that they could frame all three learning trajectories, in other words, that they would be independent of the specific sustainability topic. Recalling that the objectives and outcomes together make up the design goals for the mini-game models of phase 2.

Phase 2. Developing the Mini-Game Models. The aim of this phase is to develop four mini-game models that comply with the design goals defined in phase 1. Also in this phase the models remain generic to support all three learning trajectories of the Play!UC project. Hence, all mini-game models are characterized by only a limited number of core game mechanics to ensure the dynamics and run-time behavior of the mini-game models [16] and [33]. Table 2 summarizes the Aesthetics, Dynamics and Mechanics of each model. The following paragraphs sketch the game concepts. Note that the proposed mini-game models are evidently only one possible implementation of the design goals.

Table 2. Summary of the Mechanics, Dynamics and Aesthetics of the four mini-game models developed within the Play!UC project

	MINI-GAME MODEL 1	**MINI-GAME MODEL 2**	**MINI-GAME MODEL 3**	**MINI-GAME MODEL 4**
Aesthetics	Increased insight in the diversity of values among players regarding sustainable futures A feeling of sharing values	Knowledge of current situation, ongoing projects, windows of opportunity Increased insight in interests of other players	A sense for possible future scenarios Increased trust among players	Insight in own role in transformative processes A sense for how to initiate change
Dynamics	Voting for ideas Clustering of ideas	Collecting & managing resources Negotiating Collective reflection on gameplay in relation to actual practices	Exploring possible cooperation's Assessing scenarios Feedback on scenarios of other players	Experiencing different roles & perspectives Weighing other projects Negotiating over support for projects
Mechanics	Weighing Collecting	Resource management & allocation Territorial acquisition Quiz & chance	Collaboration & competition Resource management Chance	Role playing Resource management

The mini-game model, dubbed *Floating City*, focusses on gaining insight in what each participant considers to be his/her ideal sustainable future (see Table 1). In

Floating City players are proposing ideas, needs, wishes, values and visions to adapt or improve their city. Each input is represented in a balloon that is carrying the city. Other players can weigh (thumbs up/down) those ideas and add comments (see Dynamics in Table 2). All ideas are represented as balloons that are helping the city fly higher and higher (see interface on Figure 3). The more votes a balloon gets, the higher it pulls the city. High balloons then represent shared values. The number of balloons is an indication for the diversity of values.

The second mini-game model, *Safari*, focuses on gaining insight into the current of socio-spatial situations: the context, existing projects, windows of opportunity, etc. (see Table 1). To support this, *Safari* simulates a given city which the players have to make more sustainable. In order to do this, they can choose between a series of pre-defined projects. Each project requires and generates particular resources: coins (to co-fund projects and pay annual costs), community points (community value of projects) and CO-2/energy reduction points (environmental aspect). To implement projects players must collaborate, manage resources, develop strategies and deal with formal and informal institutions. The players learn about sustainability strategies by having to manage the resources, by discussing the strategies of other players and by collaborating in projects (see Dynamics in Table 2).

The third mini-game model, *CityMakers*, focusses on the possible development of sustainability scenarios (see Table 1). Hence, *CityMakers* challenges players to set up projects. Each project requires a given amount of steps and generates points. The first player to reach a given number of points wins the game. One can gain points by finishing a project, by contributing to projects of others or by supporting a common 'city-project'. *CityMakers* differs from *Safari* in that the focus does not lie on gaining insight in the particularities of specific transition strategies, but on understanding the logic of initiating and collaborating in projects by learning about alliances, strategies and resources. Hence, game mechanics focus on collaboration, competition and resource management (see Mechanics in Table 2).

PoliCity, the fourth mini game model, focuses on the operationalization of sustainability scenarios (see Learning Objectives in Table 1). Players are in charge of one area of a given city. They have to implement projects, help citizens, negotiate and coordinate their actions with other stakeholder and actors. With each project they earn points. By answering city-specific questions, players gain influence in the city and acquire better projects for their area. The game has three possible endings: failure if one city area drops beneath a certain threshold of points; mayor win - once a player reaches the maximum possible influence; utopia - if the city excels in above a certain threshold. During the game, the players explore procedures, roles, budgets, etc. (see Dynamics in Table 2).

Phase 3. Contextualizing the Mini-Game Prototypes. In this phase the transformation of the generic mini-game models into mini-game prototypes that are tailor-made to facilitate specific collective learning processes, is taking place. In order to illustrate the flexibility of the toolbox, we will not discuss the contextualization of all 4 mini-game models in all three learning trajectories, but rather focus on two contextualization-scenarios, on the one hand, the contextualization of one mini-game model to two different collective learning trajectories, and on the other hand, the

contextualization of two different mini-game models to one collective learning trajectory.

In this phase we played the games in real world settings. By monitoring gameplay and debriefing the players after playing, we could get an indication as to whether playing the mini-game prototypes indeed resulted in the intended learning objectives and output [18].

Table 3. Contextualization of the mini-game model Safari to the context of energy transition in Groningen (Netherlands) and smart mobility in Vienna (Austria)

Phase 3: Contextualization & Customization of the Safari mini-game model		
Learning Context	Energy Transition	Smart Mobility
Spatial Context	Town in the rural North of the Netherlands	Central European Capital
Scales	Region – City – Neighborhoods	City – Districts – Development Areas
Policy Context	Energieakkoord (Agreement on Energy for Sustainable Growth)	Smart City Vienna
Narrative	Players have to implement projects on renewable, sustainable energy on micro, local and regional scale (energy saving, energy production, bio-based/agriculture, services)	Players have to implement projects on sustainable mobility on urban, neighborhood and individual scale (mobility co-operations and shared mobility projects)
Interface (see Figure 2)	Analogue, board game Board game resembles the province of Groningen and colored tiles indicate policy tiers, special zoning: risk zones (e.g. flooding, earthquakes) and development foci	Analogue, board game Board game resembles city of Vienna and colored tiles indicate different project types and special zoning (e.g. urban development zones, TOD hotspots)
Resources	KW points, community points, coins	CO2 reduction points, community points, coins
Mini-Game Prototype	**Energy Safari**	**Mobility Safari**

Phase 3 / scenario 1. Contextualizing one mini-game model to two collective learning trajectories. The aim of this scenario is to illustrate how one mini-game model, *Safari*, can be customized to support collective learning on two different complex processes: (i) one is the energy transition, spatially located in the province of Groningen, which is considered as one of the key arenas where this transition will manifest in the Netherlands [52] and [53]; and (ii) a second process explores smart mobility within the Smart City Strategy of Vienna. Recalling that in the customization phase, we design the narrative and the interface of the mini-game prototype. Table 3 summarizes the customization of the game models. The narrative of *Energy Safari* is

built around energy projects addressing the urban/regional scale and the narrative of *Mobility Safari* is built around mobility projects focusing on the city scale. In spite of the differences in theme and scale, both are supported by a similar interface, as Figure 2 illustrates.

Fig. 2. Images of the play sessions of Energy Safari (left) and Mobility Safari (right). The colors of the tiles indicate different project types and special zoning (e.g. urban development zones, Transport Oriented Development hotspots).

Phase 3 / scenario 2. Contextualizing two mini-game models to one collective learning trajectory. The aim of this scenario is to illustrate how two mini-game models, *Floating City* and *CityMakers*, can be customized to support collective learning on the complex issue of circular economy. The spatial context is the city of Genk, Belgium, an industrial city that experienced two major economic crises in the past fifty years: the closure of coal mines in the 70s and 80s and the closure of an automobile industry in 2014; both leading to major unemployment among the local population. The aim of the learning trajectory was to explore (spatial) potentials to establish local entrepreneurship supporting circular economy. We decided to focus on two learning stages: the collective exploration of values related to entrepreneurship (stage 1) and the collective development of local and circular scenarios (stage 3). For the other two stages, we did not use games, so we will not discuss these here. Table 4 sketches the context of the learning trajectory and summarizes the customization of the game models. Table 4 elucidates that both game prototypes are framed by the same narrative. The players have to take up the role of entrepreneurs and (collectively) develop projects that stimulate the local economy and at the same time increase the livability of the neighborhood. As Figure 3 suggests, the interfaces of both prototypes are quite different. This difference is based on the hypothesis that a collective learning trajectory requires a diversity of instruments in order to address the diversity in learning styles, types of knowledge, etc. Note that the output of the first mini-game prototype, *Floating City Genk*, is the input of the second prototype, *CityMakers Genk*. *Floating City Genk* namely produces entrepreneurial values that the projects, which are generated in *CityMakers Genk*, have to comply with.

Table 4. Customization of the mini-game models Floating City and CityMakers to the context of local and circular entrepreneurship in Genk (Belgium)

Phase 3: Contextualization & Customization		
Learning Context	Local & circular entrepreneurship	
Spatial Context	One of the 13 central towns in Flanders, Belgium	
Scales	City – Districts – (Entrepreneurial) street	
Policy Context	Strategisch Actieplan Limburg Kwadraat	
Narrative	Players have to act as entrepreneurs and develop local initiatives such as food hubs (urban farming, urban foresting, community kitchens), energy hubs (heath nets, driverless car), community hubs (skill building, open platforms)	
Interface (see Figure 2)	Digital game The interface is a collage of iconic buildings in the city of Genk	Analogue, card game The projects are applicable to the entrepreneurial street and the city of Genk (e.g. opening a new business, extending a shop, investing in street furniture)
Resources	(all resources are generated by the players)	Materials, permits, locations
Mini-Game Prototype	**Floating City Genk**	**City Makers Genk**

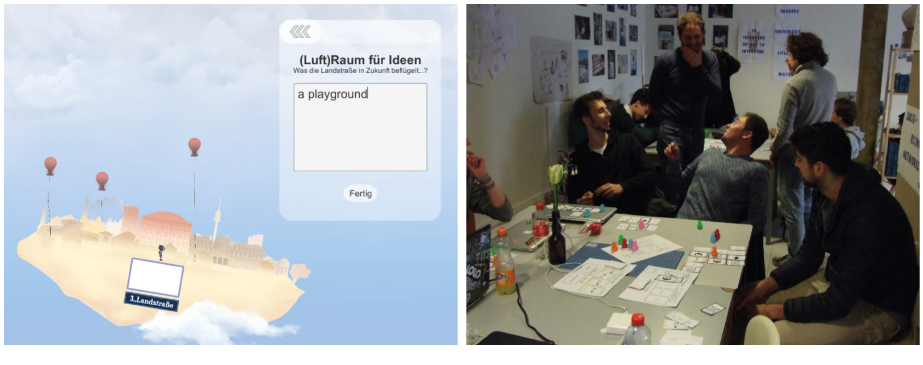

Fig. 3. Images of the play sessions of the serious mini-game prototypes Floating City Genk (left) and City Maker Genk (right) to illustrate the difference in Interface and Resources.

5 Conclusion

We began our article with the claim that spatial planning projects can be conceived as processes of collective learning that are increasingly being supported by serious games. Subsequently we argued that planners play the wrong games. Complex planning processes do not necessarily request complex serious games (as is common

practice), but instead strings of comparatively simple mini-games that are developed to target precise learning objectives, and that are played at those moments that the collective learning process requires their utilization. The paper presents a conceptual toolbox that helps to develop, combine and contextualize serious mini-games in order to facilitate collective learning on specific (complex) urban processes. We illustrated the toolbox by developing mini-game models for the four learning stages defined within the collective learning model of Brown and Lambert [14] - *Floating City, Safari, CityMakers* and *PoliCity* - and by customizing these models to three collective learning trajectories organized within the Play!UC research project.
The toolbox can be considered as a conceptual development model to consciously design embedded learning processes for governance or participatory planning. Different to existing planning practices, the toolbox proposes to not structure the planning process around final deliverables, or the stages of plan-development, but instead around the stages of collective learning. As a consequence, we argue that consciously designed mini-games that cater these learning stages are more suitable tools, than full-fledged serious games that only target the final project deliverable. The structuration process and the customization of the mini-games to the socio-economic and spatial context triggers the players to re-construct (spatial) issues and develop knowledge and skills in an experiential fashion [23].

We argue in our conceptual model that mini games are suitable tools to organize, structure and implement collective learning process. However, suitable tools for collective learning and re-constructing knowledge to improve civic engagement and urban governance need to be explored further. Interesting routes to embark in the future are transmedia- and location based games, pervasive technologies and pervasive serious games, that are interacting with public space, or of games immersing the players in simulations of real world settings. Think also of pervasive technologies that support the monitoring of the behavior of the users of a given location or the measuring of the externalities of a spatial project. The possibilities are endless. We just need to keep it serious and mini.

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