Experiential learning based on the NewDistrict asymmetric simulation game : results of a dozen gameplay sessions

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Abstract. NewDistrict is a simulation game designed to improve awareness and foster learning on the impacts of peri-urbanization development on biodiversity. It simulates two layers of complexity: environmental processes (bee colonization, bird migration and water quality) which are simulated by a computer model and social interactions which are simulated through a stakeholder role-playing game involving a mayor, building contractor, farmer, forester and ecologist. Both layers interact and evolve throughout the simulation. As described in our contribution to ISAGA 2014 (Becu et al., 2014) the simulation game is asymmetric as, depending on the role they have in the simulation, the players will have different objectives and information as well as a different range of actions and perception of the game environment, This asymmetry is assumed to influence the participants' learning experience. We have carried out 12 sessions with NewDistrict in France, with executives of construction companies mainly, and to a lesser extent, with students and environmental specialists. Participants were asked to fill up a questionnaire before and after the session in order to evaluate their learning experience.
Results show that participants do not learn that much about ecological processes and biodiversity functioning but learn a lot about the thinking (process) associated with each game role and how to better interact with the stakeholders represented in the roles. After playing the game, participants say they would pay much greater attention to the consultation process, transparency requirements and anticipation aspects involved in multi-stakeholder coordination projects. Hence, these results show that the asymmetric game components amplify/facilitate learning on both collective action and negotiation processes.

1. Introduction

This paper reports on the use of an asymmetric role-playing game to foster learning on the impacts of peri-urbanization development on biodiversity. It focuses on the type of knowledge learned by participants, and how the asymmetry between roles influences the learning experience. The first section of the paper is based on existing literature and presents the different types of learning that can occur in role-play simulations focused on environmental issues. The second section presents the NewDistrict simulation game and the methodology used to assess the experiential learning that occurs during the sessions of this game. The last section reports on our findings in terms of types of learning that occurred during the sessions.

[1] N. Becu, CNRS - UMR LIENSS, La Rochelle, France, nicolas.becu@cnrs.fr
[2] N. Frascaria-Lacoste, University Paris-Sud - UMR ESE, Orsay, France, nathalie.frascaria@u-psud.fr
[3] J. Latune, University Paris-Sud - UMR ESE, Orsay, France, julie.lombard-latune@u-psud.fr

2. Learning experience in role-playing games based on environmental issues

Type of learning objectives

For more than 15 years, the use of games/simulations to foster learning on environmental issues has been discussed/studied by several authors such as (Barreteau et al., 2007; Eisenack and Reckien, 2013; Ulrich, 1997). These contributions illustrate the great variety of tools that exist in different domains (natural resource management, biodiversity conservation, adaptation to climate change…). One of the most convincing arguments for using game/simulation is that it favors experiential learning cycle, which is a particularly effective process for long-term knowledge retention (Kolb, 1984). It should also be noted that role-playing is the most common type of simulation game used to address environmental issues. The multitude of actors involved in these inherently complex socioecological systems, may explain the game developers' preference for role-playing setting. As (Kikkawa, 2014) states, assigning roles facilitates immersion and activates players' preconceptions even before the game starts. It fosters deeper learning such as in the Keep Cool role game. Kikkawa also mentions that this game first became known as an educational game to raise awareness on global warming and, later, as a negotiation game (Kikkawa, 2014). This suggests that there may be two different types of learning objectives in role-play games based on environmental issues: either learning about the environmental system, its functioning and outcomes, or learning about how to deal with the issue, including how to negotiate with other stakeholders to resolve the problem. This dichotomy between objectives can also be found in (Ulrich, 1997) who classifies a set of simulation games according to a list of learning objectives which have been drawn up by the original game developers. On the one hand, Ulrich finds learning objectives such as understanding environmental mechanisms and addressing scientific knowledge. On the other hand, he identifies the objectives of acquiring communication and negotiation skills which have more to do with how to address the environmental issues in question. With regards to role-playing games used in the companion modelling approach - a standard participatory approach for environmental management - , Daré et al. (2014) distinguished several types of learning: learning about the issue under consideration (how the system works), learning about the technical options available in order to change the system, learning about others (understanding their viewpoints, beliefs etc..), communication learning (acquiring skills to better share information and communicate with others) and learning about the organizational options available to change to the system. Here again, some learning objectives are more to do with the functioning of the environmental system while others focus on how to interact with others.

Review of learning experience in a few role-playing games used in the Companion Modeling approach

The "motte picquet" role-playing game focuses on interactions between socio-economic and natural dynamics present in the island biosphere of Ouessant in West France. The players interact through a board game that shows the vegetation dynamics on the island and the different actions taken by players. Even though the objectives and the actions performed by the different roles vary, the visualization of the game environment and the access to information on the ecological processes are the same for all the players. According to the game designers, the players learn mostly about scrub dynamics and land

management issues (Gourmelon et al., 2011). Other types of learning concern the technical options available to counter landscape closure and its impacts on accessibility and visibility.

A second application is ButorStar, a role-playing game about the collective management of reedbeds in Camargue wetlands in the South of France. In this game, there is a central board game that all players can look at, but unlike with the previous application, the ecological dynamics indicators used by players to take decisions differ between roles. Visualization of the game environment is thus symmetric but access to information is asymmetric. The game facilitators found that much of the learning is related to: managing water levels in the wetlands, the ecological dynamics of reedbeds and the related impacts of reedbed cutting and pasture mowing (Mathevet et al., 2008). Yet, the authors also found that two thirds of the players mention learning a lot about the interrelations between roles, and especially about the constraints and requirements associated with other roles. They even mention that, thanks to the game, one particular player realized the importance of good negotiation skills to deal with other integrated management stakeholders and decided to undertake a training course on environmental mediation. Similar findings were noted in the SimParc role-playing game for which participants report that the main knowledge they gained after playing the game is related to the territorial zoning process of parks (Vasconcelos et al., 2009). These participants also mention that the game could be considered as an exercise on negotiation processes and techniques.

3. NewDistrict rolegame and methodology to assess learning experiences

NewDistrict is a simulation game designed to improve awareness and foster learning on the impacts of peri-urbanization development on biodiversity. It simulates two layers of complexity: environmental processes (bee colonization, bird migration and water quality) which are simulated by a computer model, and social interactions which are simulated through a role-playing game including the following roles: mayor, building contractor, farmer, forester and ecologist. Both layers interact and evolve throughout the simulation. The simulation game is asymmetric in the sense that players do not have the same objectives, information, range of actions and perception of the game environment depending on the role they have in the simulation. The game interface is loaded onto several computers which are all located in the same room and one computer serves as a server. Therefore, on the computer used by the ecologist role-player, the interface displays the locations of birds and hives, while the interface used by the building contractor displays the real estate value map and the map of local urban development plan. More details on NewDistrict simulation/game and its asymmetric features can be found in our contribution to ISAGA 2014 (Becu et al., 2014).

A typical session of the game lasts 2 hours followed by a 1-hour debriefing. The number of participants can vary from 6 to 20 who are each assigned to one of the 6 groups corresponding to the 6 roles used in the game. Usually, we assign more people to the roles of ecologist and mayor because they are the most complex. The participants sit at different desks, one for each role and the desks are placed in a circle as shown in Figure 1 below. Computers are connected by Wi-fi to the simulation server operated by the game facilitator. Once the game starts, players are allowed to move around the room to speak to the other players. In practice, players spend little time at their desk to enter their actions in the simulation, but prefer to move around the room interacting with other players. Thus, the initial location of players does not significantly impact the behavior and interactions

between players. The numerous movements of players around the room are certainly facilitated by the fact that players use tablet pcs which they can carry with them while going to see other players.

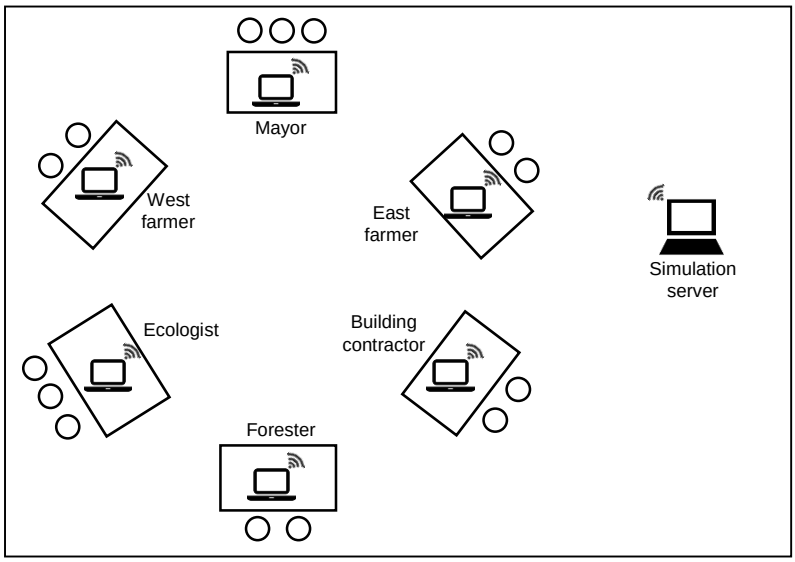

Figure 1: Typical initial seating arrangement of players for a session with 14 participants

We have carried out 12 sessions of NewDistrict with executives of construction companies mainly, and to a lesser extent with students and environmental specialists in France. All together, approximately 180 people played the game. We asked participants to fill up a questionnaire before and after the session in order to assess what participants had learnt during the game. The questions asked prior to the game concern their knowledge of biodiversity issues in peri-urbanization development projects and of ecosystem services. We also ask them what major actions should be taken when carrying out a development project. At the end of the session, we question them again on: ecosystem services, biodiversity issues, the role of birds and bees in the ecosystem, and the strategies they followed in relation to biodiversity. We also ask them what they have learnt the most during the session and what is the added value of the session for them.

4. Results: type of knowledge learned by participants

The results presented and discussed below are drawn from the analysis of questionnaires, and it is appropriate to first draw attention to their main limitation. Results are primarily based on a collection of opinions and it is clear that participants are not always aware of the different types of learning that occurred during the session. Moreover, knowledge retention evolves over time. A deeper sociological study, which will be conducted during the next step of our work, should help clarify the elements of learning occurring at different time intervals (immediately after the session and a few months later).

Our first findings show that participants learn more about the thinking processes of the different roles simulated, and about the difficulties and pitfalls of negotiation processes, than about ecological processes and biodiversity. Indeed, Table 1 shows that learning about biodiversity dynamics and ecosystem services is poor (scores of 1.07 and 0.89 out of 3) even though the general learning score (all topics included) is around 1.5 out of 3.

Learning about biodiversity	1.07
Learning about ecosystem services	0.89
Learning about impacts of development projects	1.40
Learning in general	1.53

Table 1: self-evaluation of topics learned – scores are on a scale of 0 (no learning) to 3 (intense learning)

We find a similar trend when analyzing the responses to the question "What is the main thing you learned during the session". 57% of the answers refer to learning about others (better understanding of the position and the viewpoints of other roles in the simulation) or to learning associated with communication processes. On the other hand, 33% of the answers concerned learning on biodiversity issues and technical solutions available for biodiversity conservation.

Learning about the issue	21%
Learning about technical options	12%
Learning about others	12%
Communication learning	44%
Learning about organizational options	10%

Table 2: Type of the main aspect learned by participants according to the classification of Daré et al. (2014)

After playing the game, participants say they want to pay greater attention to: the consultation process, the need for transparency and the anticipation skills required in multi-stakeholder coordination projects. Indeed, to the question "What are the most important aspects to consider to successfully undertake a peri-urbanization development project integrating biodiversity issues?", before starting the game 33% of participants answered that 'stakeholder consultation' was a key aspect and this percentage rose to 55% after playing the game.

Other results show that learning varies from one role to another. While the mayor role is the one that accounts for the most adaptive strategies during the game (74% of mayor players said they had to change strategies during the course of the game), it is also the role for which we recorded the most communication learning (table 3).

	Did you change strategies during the course of the game?	Did you change opinion about the other roles after the game?
Mayor	74%	72%
building contractor	25%	56%
east farmer	58%	37%
west farmer	55%	44%
Forester	47%	48%
Ecologist	48%	52%

Table 3: self-evaluation of individual adaptation – percentage of positive answers

On the other hand, the building contractors less changed strategies but this did not prevent them from changing opinion about the other roles of the game.
Table 4 shows that biodiversity is the topic that accounts for the most differentiate learning between roles (standard deviation of 0.21, compared to 0.1 and 0.14 for the other topics). The west farmer – which farm is oriented towards organics farming - is the role that learn the most about biodiversity and ecosystem services while the building contractor role learn

less on these topics. The ecologist role shows average scores, which tend to demonstrate that it is a multifaceted role that needs to deal with multiple issues.

	Learning topic		
	Biodiversity	Ecosystem services	Impacts of development projects
Mayor	0.95	0.95	1.64
building contractor	0.86	0.84	1.41
east farmer	1.00	0.93	1.25
west farmer	1.48	1.05	1.27
Forester	1.10	0.78	1.40
Ecologist	1.05	0.80	1.40
Std deviation	*0.21*	*0.10*	*0.14*

Table 4: Differences between roles regarding topics learned – scores are on a scale of 0 (no learning) to 3 (intense learning)

These different results tend to highlight that the asymmetric components of the game amplify learning on collective action and negotiation processes. In the last section we discuss these results and compare them with the other applications of role-playing games on environmental issues presented in section 2.

5. Conclusions

In section 2, we examined other role-playing games (‘Motte Piquet’, ButorStar and SimParc) used in the companion modelling approach and reported on the learning experience of the participants. NewDistrict is different from these other games as both information access and the visualization of the game environment are asymmetric. This is thanks to the distributed setting of the simulation with the presence of the interface on several computers, each of which provides a specific viewpoint of the socioecological system (Becu et al., 2014). Our results in terms of types of knowledge learned show that NewDistrict participants learned most about interrelations between roles; which is different from most other role-playing games but similar to the ButorStar game. However, we also have found that learning about the others and how to deal with them, including how to communicate and negotiate, is actually the main learning experience in NewDistric application; while in ButorStar the main learning experience concerns the environmental dynamics and the technical options available to manage them. These results would tend to demonstrate that when asymmetry between roles increases, learning is more effective on negotiation processes and on communication between actors and less effective on understanding environmental dynamics. Yet, NewDistrict remains an environmental simulation game and is very different from a negotiation game. It allows participants to experience and understand the multiple aspects of environmental management in peri-urbanization development projects.

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