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Can computer models be used for social learning? A serious game in water management

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ABSTRACT

Computer simulation models are increasingly used to support solving complex problems in natural resource management, with social learning as subsidiary goal of the solution process. In this research, a serious game on water management is used where participants receive feedback on consequences of their choices from an Integrated Assessment Meta Model. This study aims to determine if and how social learning takes place and explores the role of the model in social learning. Group discussions were qualitatively analysed to uncover and understand the mechanisms in this process. Results show that social learning took place in 10 of the 12 game sessions. Though model feedback was an important driver for social learning, social learning was driven most by the team's reflection on their perspective. We conclude that using a model can facilitate social learning in a serious-game setting, in particular in combination with reflection on teams' perspectives.

1. Introduction

To cope with complex problems in the management of natural resources such as water and arable land, participatory approaches involving stakeholders are becoming increasingly popular (Parker et al., 2002; Reed, 2008). The expected benefits of a participatory approach can be summarized as (1) improving the quality of the solutions by including relevant non-scientific sources of knowledge and experience, (2) enhancing the relevance, legitimacy and credibility of the solutions by accounting for the diversity of perspectives among the stakeholders and (3) widening the basis of support for the implementation of solutions.

In this context, stakeholders join a participatory process to come to a policy-decision. Where it concerns land use related policy decisions, the focus is specifically on finding a solution for often complex or wicked problems. Such problems are characterized by being open for various interpretations and solutions, hold a strong interconnectedness to other problems, involve various parties with differing interests, and expand over multiple time scales (Gibson et al., 2013; Hisschemoller et al., 2001; Rittel and Webber, 1973).

Computer simulation models are often used as a support tool in understanding and dealing with the complexity of these wicked problems (Inman et al., 2011; Rotmans, 2006). A computer simulation model can support the decision process by allowing joint exploration of the effects of different measures that can be taken to solve the problem. By providing a feedback link between choices, (simulated) actions and consequences in several cycles or rounds, using a model in participatory processes can lead to stakeholder learning in a similar way as Kolb's *experiential learning cycle*, amplified by facilitated dialogue and communication between stakeholders (Jiggins et al., 2007). In this cycle, learners move from

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experiencing the effects of actions to reflecting on these concrete experiences, to (re)forming their abstract concepts of what is observed, and to choosing and testing new actions (Kolb, 1984). This process can result in stakeholder learning by increasing knowledge, promoting better understanding of stakeholders' views, increasing understanding of interconnectedness with other issues and/or allowing for a better understanding of the individual's views.

There are several ways to describe stakeholder learning in participatory processes. In model-supported participatory processes, social learning of stakeholders is increasingly mentioned as an essential component (Muro and Jeffrey, 2008; Pahl-Wostl et al., 2008; Reed et al., 2010). The definition of social learning ranges from "learning that occurs when people engage one another, sharing diverse perspectives and experiences to develop a common framework of understanding and basis for joint action" (Schusler et al., 2003, p. 311) to "interaction among a set of multiple stakeholders in which convergence of ideas takes place with regard to both their goals and the means and methods required to deal with their problems" (Van Bommel et al., 2009, p. 404) The former definition focuses on the learning (at unspecified individual or group level) with the intention of developing a joint framework, whereas the latter focuses on convergence of multiple stakeholders on goals, means and methods to deal with problems. In this context, Reed et al. (2010) pinpoint three observations in the use of the concept 'social learning': 1) participation and interaction of stakeholders does not automatically equal social learning; 2) the process of social learning is often confused with its outcomes; 3) social learning can occur at individual level, at group level or even at a societal level. Using the term social learning also requires specification on these matters.

We use the above-mentioned definition of Van Bommel et al. (2009), defining social learning as an interactive process, leading to convergent change in the stakeholders' perspectives on a specific problem, possible solutions and/or their role in solving the problem at stake (De Kraker et al., 2011; Van der Wal et al., 2014). Our definition implies a focus on the social-cognitive dimension of social learning, which is common in the environmental and natural resource management literature (Muro and Jeffrey, 2008; Reed et al., 2010; Schusler et al., 2003; Van Bommel et al., 2009). Changes in the social-relational dimension such as development of trust, improved communication and better working relations (Mostert et al., 2007; Pahl-Wostl and Hare, 2004), and changes in stakeholders' behaviour and actions (Collins and Ison, 2009), are outside the scope of our definition and measurement approach. Social learning, in the sense of convergence of perspectives, creates a basis for integrated, sustainable solutions that require collective support or concerted action of multiple stakeholders (Röling, 2002). The context of policy making for natural resource management creates a focus on convergence that is often described as "appreciating, understanding other viewpoints and create new insight through joint reflective deliberation" (Stringer et al., 2006), and reaching beyond the individual, into communities of practice (Reed et al., 2010). As already noted in the definition of wicked problems, there is no 'one solution' or 'one problem definition'. Consequently, social learning is approached as a process that takes place at group level. Given the focus on convergence in defining social learning, the dynamics within the group of stakeholders are of more interest than the individual positions.

Computer models deployed in participatory approaches are expected to support the stakeholder learning process (De Kraker et al., 2011; Dreyer and Renn, 2011), and are often seen as the way forward (Hisschemoller et al., 2001). In model-supported social learning, stakeholders go through the experiential learning cycle together, aided by the model by simulating the 'experience'. The use of such a model allows for rapid iteration between policy measures and consequences, which may result in reconceptualization. The exchange among stakeholders, in combination with dialogue and reflection, can lead to a convergent change in the perspectives of the participants (De Kraker et al., 2011). This convergent perspective change can lead to the objective of participatory processes: joint reconceptualization of a specific problem, and exploring possible solutions before making decisions. Following Cash et al. (2003), an important condition for a model to facilitate convergent perspective change is that the model is accepted by the stakeholders as a credible representation of the system; that is to say, in accordance with their causal beliefs (De Kraker et al., 2011; Stalpers et al., 2009; Tuinstra et al., 2008).

Research on the role of models has shown that in general, the model can have multiple roles in such participatory processes (De Kraker et al., 2011; Sterk et al., 2011). However, the mechanisms through which social learning occurs when using computer models to reach a joint policy decision are still unclear. This study contributes to the understanding of the role of a computer model in social learning for natural resource management by (1) determining if and how social learning took place during game sessions and (2) exploring if, and how, the simulation model played a role in social learning.

We selected a simulation game setting resembling a participatory integrated sustainability assessment to examine several assumptions about model-supported social learning, but without the constraints of a real-life process. This simulation game *Sustainable Delta*[1] concerns river management in the context of climate change for identifying sustainable and robust management strategies (Valkering et al., 2012). Without the constraints of a natural situation, the simulation game gives ample opportunity to understand the role a model can play in the convergent or divergent perspective changes of the participants.

The study starts from two assumptions about model-supported participatory integrated assessments: The first is that the simulated consequences of management strategies that are not in line with expected model feedback will result in changes in the participants' perspectives on the situation to be managed. The second is that perspective change as a response of the participants to the model feedback will depend on whether they consider the model credible. Data that supports or helps adjust these assumptions will yield insight in the role of the model in the social learning of the participants.

2. Game description

To assess the role of a computer simulation model in social learning, we selected a game setting where a computer simulation model is providing continuous feedback and where the participants are invited to review their perspective at various points following this model feedback. This game provides a laboratory-like setting where there is opportunity to assess, track and analyse perspective change and the discussions concerning these changes. At the same time, since this game is not used to reach a certain outcome or goal for the participants other than to experience dynamics of the water system in the future, the research did not disrupt any other primary processes. It is the setup of the game which makes this game very suitable to research the role of a computer simulation model on perspective change and social learning.

[1] www.deltares.nl/en/product/1518666/sustainable-delta-game.