Center for Behavior, Institutions and the Environment

CBIE Working Paper Series

#CBIE-2018-004

Measuring Learning from Interventions through Participatory Processes

Rebecca E. Shelton
School of Sustainability
Arizona State University, P.O. Box 875502, Tempe, AZ 85287-5502

Marco A. Janssen
School of Sustainability
Arizona State University, P.O. Box 875502, Tempe, AZ 85287-5502

Ruth Meinzen-Dick
IFPRI
1201 Eye St, NW, Washington, DC 20005-3915 USA

April 2, 2018

The Center for Behavior, Institutions and the Environment is a research center located within the Biosocial Complexity Inititive at ASU. CBIE can be found on the internet at: http://cbie.asu.edu. CBIE can be reached via email at cbie@asu.edu.

Measuring Learning from Interventions through Participatory Processes

Rebecca E. Shelton[a], Marco A. Janssen[b], Ruth Meinzen-Dick[c],

[a]School of Sustainability
Arizona State University, P.O. Box 875502, Tempe, AZ 85287-5502;
[b]School of Sustainability
Arizona State University, P.O. Box 875502, Tempe, AZ 85287-5502;
[c]IFPRI
1201 Eye St, NW, Washington, DC 20005-3915 USA;

Corresponding author:
Rebecca E. Shelton
School of Sustainability
Rebecca.Shelton@asu.edu

Abstract:
There is an increasing use of models and games as interventions in participatory processes. Those interventions facilitate exploration and learning in a safe simulated environment. However, how do we measure if learning takes place, whether it results in behavioral change and whether it persists? We review the existing literature on social learning through participatory processes and how the impact of those interventions are measured. We identify a number of challenges and present a framework that aims to explicitly specify operational measurements into different levels of learning.

Keywords:

Measuring learning from interventions through participatory processes

Rebecca E. Shelton[1], Marco A. Janssen[1] and Ruth Meinzen-Dick[2]

[1] School of Sustainability, Arizona State University

[2] International Food Policy Research Institute

Abstract

There is an increasing use of models and games as interventions in participatory processes. Those interventions facilitate exploration and learning in a safe simulated environment. However, how do we measure if learning takes place, whether it results in behavioral change and whether it persists? We review the existing literature on social learning through participatory processes and how the impact of those interventions are measured. We identify a number of challenges and present a framework that aims to explicitly specify operational measurements into different levels of learning.

I. Introduction

In the context of governance of social-ecological systems (SES), human behavior change is critical for achieving desired, or sustainable, system states. When interventions are initiated in social-ecological systems, such as through participatory stakeholder processes or a new governmental regulation, what is the impact on the SES in the short and longer term?

In this paper we narrow our focus to participatory processes that aim to improve community governance of shared resources. It has been demonstrated that communities can manage their shared resources and, if they are able to do so, the performance can be long-lasting (Ostrom, 2010). However, not all communities have the required skills, experience, knowledge and/or resources to self-govern their shared resources. Participatory processes such as combining role games and modeling (e.g. Bousquet et al. 2002), board games (e.g. Speelman et al. 2014) and behavioral experiments (Meinzen-Dick et al., 2018) are used to empower communities but the impact of those exercises is unclear.

One reason is that those exercises do not aim to teach communities a certain solution to their problem, but let communities experience the collective action problem in a safe, simulated environment. Debriefing sessions after the exercise are used to discuss their experience in the process and in relation to their governance challenges. Since no solution is taught, the outcome of the intervention can have different dimensions. Qualitative case study analysis can be performed to evaluate the impact of these types of interventions. However, qualitative case study analyses require long-term time commitments of the researchers, precluding use of those approaches at a broader scale. Approaches to measure learning and increased understanding of how the approaches can be adopted to enable the scaling up of the participatory approaches is needed.

Siebenhuner (2004), drawing upon theory from social psychology and political science, ascribes behavior change to learning, "a long-lasting *change* in the behavior or the general ability of an individual or collective actor to behave in a certain way that is founded in changes in knowledge (cognitive, normative, relational and affective)." Thus, in this context, learning is a normative concept

(Rodela et al., 2012) directed towards system and social change (Deyle and Slotterback; 2009; Pahl-Wostl and Hare, 2004). Given its relevance to influencing the system towards desired states, how learning occurs within an SES, the outcomes of processes designed for learning within an SES, and the role of system context in which these processes occur (institutional, environmental, cultural) have been topics of increasing interest to researchers. Specifically, in natural resource governance, processes designed to foster social learning (as well as the study of naturally occurring, innovative collaborative processes) have gained increasing recognition for their potential to transform management/governance systems. Pahl-Wostl (2002) specifically linked social learning processes to the emergence of adaptive management systems because they impact the human dimension that builds systems rather than solely the capabilities of the infrastructural/engineering system.

Social learning emerged as a recognized concept after it was introduced and defined by Bandura (1977) as learning within individuals in the context of social environments. Thereafter, the concept of social learning was incorporated into different research fields (i.e. natural resource management, educational pedagogy, biology, psychology) and became poorly defined due to the differences both within and between fields of research. Literature reviews produced by several (Reed et al. 2010; Rodela 2011; Rodela, et al., 2012; Rodela, 2013; Gerlak et al. 2018) scholars focused on the evolution of social learning within natural resource management have aided an effort to clarify and offer criteria so that the concept of social learning may be interpreted and implemented with better consistency in this field. However, though improvements in conceptual clarity have been achieved, there remains a dearth of consistency concerning the variables that are measured and the methods that are used to measure those variables to assess social learning processes and outcomes. Thus, the utility of processes designed for social learning is not fully understood. This operational gap proves very challenging for researchers that are trying to understand the social and ecological impact of processes, most commonly multi-stakeholder participatory processes, designed to foster social learning.

In this paper we first provide a brief review of how, in the natural resource management literature, social learning is defined, initiated, and measured. Second, we attempt to highlight how the concept of social learning has not yet been fully operationalized; we suggest that the conceptualization of social learning is beyond the scope of the methods that have thus far been used to operationalize it. Third, we propose some criteria that may be useful for developing new methods as well as outline some specific kinds of methods that we believe could be tested and further developed to assess social learning.

II. What is Social Learning?

A. Defining social learning

Social learning is widely recognized among those involved in interdisciplinary SES research, but many scholars have previously critiqued that both the interpreted meaning of the term and its operationalization are varied. Reed et al. (2010) attempted to build a definition of "social learning" around which natural resource management research could align and it is from this definition that many researchers have incorporated the concept of "social learning" into their work. Reed concludes that to be considered "social learning," there must 1) be a change in understanding in individuals, 2) the change in understanding must move beyond the individual into wider social units or communities of practice and 3) the learning occurs through social interaction. This definition is commonly used to design methods to confirm whether or not social learning occurs amongst a group of stakeholders.

A critical distinction made in Reed et al. (2010) is that individuals are a unit of analysis and that changes in understanding at individual levels do not necessarily translate into a new group understanding nor does a measured group understanding signify that each individual has been impacted. Handley et al. (2006) explains that individuals that participate in a new group or community have prior-existing identities and norms that may conflict with the group or, even if they do not conflict, the understanding that occurs between group members may not be permanently incorporated into individuals' identities and norms. However, there

remains ambiguity concerning how to define "wider social units or communities of practice." This criterion is often interpreted as learning at the level of the group of individuals involved in a studied participatory process rather than changes that occur throughout connected, existing networks or at the macro, societal scale as a result of the participatory process (Grey et al., 2012; Van der Wal et al., 2014; Van der Wal et al., 2016).

A literature review by Rodela (2013) found that the term "social learning" was actually used to describe learning phenomena focused at three different levels: the individual, a network, or the system. The individual level describes a participatory setting in which individual change is the key outcome. A network approach is interested in the outcomes that may result from organizational or group learning (focused on collaborative, collective action outcomes). A systems approach focuses on learning within a SES that leads to change at a broad level of aggregation beyond that of a specific individual, organization, or network.

Researchers have presented conceptual frameworks for each of these levels of analysis. Pahl-Wostl and Hare (2004) present social learning as an iterative process in which learning outcomes feed into the system in the form of change that affects governance structures and the biophysical state of natural resources. Building on this framework, Pahl-Wostl et al. (2007) further elaborated to show that social learning can be understood as a multi-scale process; micro level learning at which multi-stakeholder collaboration occurs, meso level learning at which organizations and groups interact, and macro level learning of the governance regime and societal system. In contrast, Vinke-de Kruijf et al. (2014) presents a conceptual model in which the first level of learning is at the individual level, which then feeds into the group/network level, and the objective/outcome of the process is "further collaboration (which is often needed to achieve environmental objectives)" rather than explicitly stated as societal level change. Scholz et al. (2014) presents a framework that also integrates three scales of learning: individual, group, and network, but lacks the societal component. This variation in conceptual interpretation demonstrates the utility, universal applicability, and relevance of social learning for natural resource management at multiple scales, but

also has potential to dilute social learning into a less meaningful, poorly operationalized concept.

Briefly, there are two primary learning outcomes that are the focus of social learning; the development of cognitive/technical/substantive knowledge and relational knowledge. Cognitive/technical/substantive knowledge is categorized as facts, skills, and knowledge that can be conveyed through logic. Relational knowledge is developed both in relation to self and in relation to others. Knowledge in relation to self involves changed self-perception in regard to role or identity and knowledge in relation to others means new understanding and/or empathy regarding the roles, beliefs, and values of others (Webler et al., 1995) as well as new mutual understanding among actors regarding dependency and trust (Schneider et al., 2009; Vinke-de Kruijf et al., 2014). In summary, both are important; decision-making relies on actors' mental models of a system which includes technical, substantive components of a system as well as self-awareness for how one is situated within a constellation of actor roles, values, and perspectives (Pahl-Wostl, 2002; Scholz et al., 2014).

B. Initiating social learning

The third part of the definition presented by Reed et al. (2010), "that learning occurs through social interaction," reinforces the connection between social learning and participatory processes. In general, the field agrees that social learning could occur through a multi-stakeholder communicative exchange of beliefs, identities, perspectives, and knowledge systems (Deyle and Slotterback, 2009; Handley et al., 2006; Muro and Jeffrey, 2008). However, there is variation in how researchers interpret the connection between participatory process and social learning. Some research conflates social learning with participatory process, implying that social learning organically and automatically occurs within participatory processes (Siebenhuner, 2004). Others state that while social learning is that which makes a participatory process successful, it should not be an assumed outcome (Van der Wal et al., 2014). Participatory processes must be carefully designed so that the process itself stimulates social learning; formalized

presentations of information or abstract knowledge, as is typical of academia, are inadequate (Pahl-Wostl and Hare, 2004).

Processes are designed to expose participants to both tacit (embodied/experienced) and explicit (logical/abstract concept expressed in words) learning opportunities (Schneider et al., 2009; Tschakert and Dietrich, 2010; Vinke de Kruijf et al., 2014). Learning through tacit experience is achieved through interacting with other persons so as to affect actors' understanding of one another's roles and problem subjectivity (Schneider et al., 2009) or by interacting with a tool such as a model or participatory game to provide an opportunity for role-play embodiment (Pahl-Wostl and Hare, 2004). Positive tacit experience often reinforces or contributes to learning in a manner that explicit knowledge presentation cannot. For example, the perceived quality of the process, (i.e. positive vs. negative, cooperative vs. conflict-ridden), influences how satisfied participants are with the outcome of a process (i.e. a management plan, system goal, etc.) (Pahl-Wostl et al. 2007). However, explicit learning opportunities, or moments built-in to stimulate conscious reflection and idea assimilation are also important. For example, Van der Wal et al. (2016) found that live feedback from a model was less important for participant perspective changes than reflective group discussions.

Researchers have also developed growing consensus around several factors that affect learning in the context of the participatory process. The personal (identity, beliefs), motivational (incentives, interest), and resource characteristics (funding, time) of individuals (Cundill, 2010; Vinke de Kruijf et al., 2014), the ability of actors to communicate, actors' awareness of social interdependence (Van Bommel et al., 2009), and other relational variables that affect collaboration (i.e. trust) influence social learning outcomes (Cundill, 2010). For example, Pahl-Wostl and Hare (2004) hired a psychologist to conduct interviews with actors involved in a participatory process and found that a lack of trust in the intentions of the process and its facilitators (academics) negatively impacted learning. However, little attention is given to understanding how learning moves into the wider societal context outside of the participatory process. And, as clearly stated in Tschakert and Dietrich (2010), "it is not sufficient to introduce small-scale revolts, perturbations,

and learning probes in one sub-loop of the system if they cannot be sustained to alter awareness and behavior at larger scales."

In summary, social learning is defined as the acquisition of new cognitive and relational knowledge about a system (often about a specific natural resource in that system) at the individual, group, and system levels as a result of social interaction among stakeholders. Thus, much attention has been given to how social interactions targeted to facilitate social learning should be initiated as well as to the contextual factors that influence learning outcomes. However, though it is important to understand these aspects of social learning, operational research has been somewhat neglected (Reed, 2010). For example, the focus on participatory process has diverted attention away from whether the process, which is embedded in a complex system, supports the system level goal and the attention given to a "yes or no" confirmation of learning has shifted research away from a critical examination of how much learning and what kind of learning is sufficient to bring about social change.

III. How is Social Learning Measured?

The most prominent kind of empirical research regarding social learning is case study research (Rodela, 2013). Case studies almost always lack a comparative control and are rarely replicable, thus efforts to pursue external and internal validity of results are uncommon (Deyle and Slotterback, 2009). Developing learning metrics that can be adapted to each, specific context and that also produce comparative results is difficult given the diversity of possible learning processes. We provide a brief overview of methods that have been used to assess learning. As outlined in Pahl-Wostl et al. (2007), the scale of the learning process affects the time-scale over which learning occurs; a small group of collaborating actors may learn something in a few days but it may take a much longer time for this learning to scale into change or learning at the system level. Thus, different methods have been used to evaluate learning at various levels.

A. Individual Level Learning

Arguably, methods that assess individual level learning are the most prevalent in social learning literature. Implicit in the metrics that these methods employ is that learning is defined as some kind of measured knowledge change from baseline or a self-reported change if a baseline is not collected. Tracking individual level learning pre, during, and post process fulfills two of the social learning criteria defined by Reed et al. (2010); 1) change of understanding at individual level that 2) occurs due to social interaction. Qualitative, quantitative, and mixed-methods are employed by researchers to assess learning at this level. The most common methods include interviews with individual actors at various stages during or after a process (Pahl-Wostl and Hare, 2004; Schneider et al., 2009; Siebenhuner, 2004), pre and post process questionnaires (qualitative) or surveys (quantitative) (Siebenhuner, 2004), and participant observation (Rodela et al., 2012). Other less common methods include self-effectiveness surveys to track how an individual's perception of their role in a process changes (Vinke-de Kruijf et al., 2014), pre and post mental models to identify change in how an actor conceptualizes the natural resource issue (Scholz et al., 2014), and Q-sorting method to track individual perspective shifts (Raadgever, 2009).

B. Group Level Learning

The second most commonly employed method types are those which attempt to capture the third part of the definition given by Reed et al. (2010); a new understanding at the level of the group. At this group level, social learning is often understood as the development of a shared understanding or convergence of cognitions (Schneider et al., 2009; Van Bommel et al., 2009; Van der Wal et al., 2014). Yet, it is quite possible to imagine that learning occurs in ways other than through consensus, such as a developed empathy for or understanding of an alternative perspective without aligning or agreeing with that perspective (Scholz et al., 2014). This nuance is difficult to track at an aggregated group level and may be more easily understood through individual assessments such as interviews and questionnaires. Other research assumes that if learning occurs within individuals, learning emerges at the group level (Rodela, 2011).

Several approaches have been used in attempt to track group level change. Grey et al. (2012) assessed change in the group's mental model by combining individual fuzzy cognitive maps into one group map and then quantitatively assessed change in the map pre and post process. Van der Wal et al. (2014, 2016) developed a perspective scoring table based on dominant archetypal worldviews and asked stakeholders to elect perspective-based statements that most aligned with their viewpoint. Perspectives were elicited pre, during, and post - process and were displayed to stakeholders in aggregated form in order to stimulate further discussion. Similarly, Cuppen (2012) tracked perspectives related to bio-energy using Q-method before and after a learning process in each individual but results were statistically aggregated to assess group change rather than individual change. Instead of evaluating *how much* learning occurred, Radinsky et al. (2017) assessed whether or not the interactions (observed through conversational patterns, body language, argumentation, etc.) between people within a participatory process indicated stagnation and conflict or cooperation, in order to understand how the context for learning might emerge through group interaction. Last, in an effort to seek external validity for social learning processes, Deyle and Slotterback (2009) implemented pre and post process surveys across several similarly conducted workshops intended to develop planning for hurricane management, and aggregated statistics for comparison at the group/workshop level rather than at the individual level. In addition to comparing means, they also tracked changes in standard deviation as a proxy for cognitive convergence.

C. System Level Learning

Methods that track the effects of processes through time to assess whether social change emerges through learning at the system level are poorly developed and rarely implemented. Some authors report on observed policy changes or formation of new institutions (Mostert et al., 2007) but little detail is given regarding how those outcomes affect social change. And, because the learning process through specific metrics of change is not well tracked, links to the participatory process are assumed rather than evidence-based.

D. Critique of current methods

Arguably, methods for measuring social learning sufficiently assess change within a process, but have not been adequately developed to track what is learned outside the process in order to understand if and how system level change is stimulated. Rodela (2011) reports that social learning publications often provide conclusions to inform theory, but do so without providing empirical evidence for the scale/level of learning that is discussed. Though it is critical to understand the dynamics of a social learning process, it is equally important to understand how that learning embeds into a societal context (Handley et al., 2006). Therefore, as a starting point for stimulating operational and theoretical discussion, we offer five critiques of current methods.

1. They do not measure whether changes in perspective persist into changed behavior, intentions, or sense of self for those that participated

Learning outcomes assessed at individual and group levels within reported processes may be better framed as potential seeds for social learning rather than the ultimate outcome itself. Often given little attention is the fact that these processes are comprised of individuals that have a mental schema that has been constructed over their entire lifetime (Parkes, 1975). It contains pre-existing senses of self, identities informed by roles in other groups/networks, and perceived rational justification for behavior patterns. As Handley et al. (2006) describes, an individual may reject knowledge and opportunities if they are in conflict with or cannot be aligned with their pre-existing identity/self. And, though an individual may report a change in attitude, belief, or intention, they may not actually change their behavior (Muro and Jeffrey, 2008). Longer-term analysis to assess changes in attitudes, behavior, and roles outside of the facilitated learning process are needed (Scholz et al., 2014).

2. They don't assess whether the learning moves into wider society beyond those who were active in the participatory process

Even if learning persists in individuals, the system context, which they are within, may enhance or suppress the implementation and dissemination of knowledge to

the wider community thereby influencing how much momentum is built towards wider collective action (Scholz et al., 2014). For example, Vinke-de Kruijf et al. (2014) observed a collaborative process for water basin management between Dutch and Romanian actors. Because of a variety of factors, the collaborative process was unsuccessful and Dutch actors reported that they did not want to collaborate with Romanian actors in the future. These attitudes were likely disseminated to others in the Dutch actors' social networks and might have long-term consequences for water management and relationships between the two countries but this longer-term trajectory did not fall within the scope of the study.

3. They typically don't provide a baseline measurement of current community practice or knowledge.

Though it is common to provide baseline measurements of individual or group knowledge prior to a participatory process, rarely does research provide baseline measurements of the wider community context in terms of knowledge or as related to that which change is directed such as the structure of governance institutions or state of the natural resource. This limits the ability of research to provide reports of evidence-based impact.

4. Existing methods are resource intensive

Current metrics for assessing change are resource intensive in terms of time and money. This has several consequences. First, it limits the kinds of research such as reported in Deyle and Slotterback (2009) that provides comparative evaluation of multiple cases. Second, if learning is tracked outside of participatory processes and community baselines become standard practice, resource intensive metrics are not easily applied to community/societal level scales. Third, if social learning processes are implemented with increasing frequency around the globe and tracked long-term, impact evaluation must be assisted and managed by people outside of academia such as practitioners and community based organizations that often have limited resources in terms of time, money, and personnel. This means that practitioners can learn the methods that they can implement in the field via a brief training session.

5. They don't ensure that no harm was done

Often overlooked, longer-term impact tracking is necessary for interventional processes, including those that seek to incite learning, to ensure that no harmful consequences result. This is especially true given that outcomes are context dependent and interventions/processes that are beneficial in one circumstance may have negative effects in another (Wandersman et al., 2016). McCullum et al. (2004, cited in Muro and Jeffrey, 2008), describes a process in which the most powerful actors persuaded other participants into a consensus that was not positive for system level sustainability goals. Other research reports that efforts to build collaborative initiatives between diverse stakeholders can actually increase conflict and decrease the likelihood of future collaborative efforts (Handley et al., 2006; Muro and Jeffrey, 2008; Vinke-de Kruijf et al., 2014). Though referring to field-based randomized controlled trials, Barrett and Carter (2010) acknowledge that when academics intervene in systems, they may unconsciously introduce ideas or resource imbalances that incite or compound harmful behaviors and thus should rigorously seek to ensure that more good than harm comes from their work. For example, if a researcher facilitates a role-play game from which they hope to encourage discussion around cooperative resource governance, they could accidentally introduce the idea of free-riding into a system in which the benefits of this practice were not previously explicit.

IV. Moving methods and theory forward

After identifying a number of challenges, we present some criteria that might be considered when developing new methods to measure learning. Second, we argue that in order to further develop our empirical understanding of social learning processes, specifically how niche level learning through a participatory process is capable of instigating system level change, a framework must be developed that explicitly integrates operational measures into different levels of learning. This framework should make clear that learning outcomes at each level indicate progression towards the ultimate goal of system level change (but are not the goal in themselves). We present a first attempt at constructing this framework. Last, we identify methods that are already employed within the social learning literature as

well as potential new measurable variables and methods to track learning outcomes at each respective level.

A. Suggested criteria for new methods

We suggest and explain six criteria to inform exploratory method development.

1. Methods should be as non-intrusive as possible in order to respect participants' time and minimize disruption.

2. As suggested by the critiques given above, methods should be longer-term and forward in time from the completion of the process designed to stimulate learning.

3. Methods should be inexpensive in terms of resources.

This is important so that a) the implementation of social learning processes, both initiation and long-term follow-up evaluation, is not limited by available funding and b) especially relevant in periods of limited resources in which projects must explore how best to evaluate the impact of learning processes as typically it is more difficult to justify exploratory work to funding agencies (Rodela, 2013).

4. Methods should be operable/implementable by individuals with all levels of research expertise.

When long-term community involvement and evaluation is needed, it is logistically, and perhaps ethically, best conducted when researchers are able to partner with practitioners that have a pre-existing relationship with the community. However, one needs to be careful and assess the current power asymmetries between practitioners and communities prior to implementation. Thus, metrics should be transparent, easily learned and understood, have low-technological requirements, and designed so that the results are useful for both practitioners and researchers.

5. Ideally methods and their associated measured variables for assessing learning would best be co-produced with cultural insiders who might better detect and understand subtle changes in roles and attitudinal and behavioral practices

Though research on social learning processes and contexts has increased, the majority of this research has been produced by European and North American countries and thus is biased towards those cultures and contexts (Rodela, 2013). Lessons learned from this research may not be globally applicable and cultural

insiders should be consulted prior to making universal assumptions. Not only should community and cultural insiders be consulted before, during and after the intervention in order to moderate conceptual/theoretical assumptions about learning processes, but they should be consulted in order to determine what is an 'outcome' or 'change' given their specific context as an outcome deemed small in one society may be pivotal in another (Wandersman et al., 2016).

6. Social learning processes should be assessed using a suite of methods that are purposefully designed to track learning as it moves from the niche participatory process into the system context.

This criterion is best explained by the framework described in the following section.

B. A framework to re-align empirical evidence with claimed outcomes

We need standardized methods approaches for assessing learning outcomes at different points in a learning pathway that ultimately leads to social learning rather than methods that assess one or two levels of learning and assume that change at one level will scale up and stimulate change at broader, community or societal levels. Although we desire standardized methods, *which* methods are used and *how* they are implemented may depend on the local context. Researchers must uniformly recognize that learning, such as perspective change or new relationships, observed in a facilitated context does not necessarily exist or persist outside of that process. Figure 1 presents a new conceptualization of the points at which methods may be used to assess if and how learning progresses through a system. This framework incorporates the various levels of learning described by other researchers – the individual, the group, and society- (Fig. 1A) but situates those levels of learning within the context outside of participatory processes to define points at which learning may be suppressed or progressed (Fig. 1B). We suggest that methods can be designed to assess whether learning progresses through the system (1: individual within the context of a process, 2: group, 3: individual outside of process context, 4: social network, 5: system/societal) and that by making these measurement points/levels that denote progression and the metrics that describe

them more explicit, research will recognize that it cannot straightforwardly measure change in participatory processes with societal change (Table 1).

As described in prior sections, methods to assess individual and group learning within the context of a participatory process are the most developed (Table 1). If knowledge changes are confirmed at these levels (1 and 2), we suggest that the outcome of the process is an achieved *potential* for social learning. The next point at which measurement of learning might be applied is in a follow-up with individuals after the cessation of the facilitated participatory process (level 3). Positive outcomes at this level suggest that learning and commitment to what was learned *persists* within the individual. Tools such as interviews, surveys, and questionnaires are commonly used in longitudinal studies to follow research participants through time and could be used to track roles, attitudes, and behaviors. However, we suggest that in addition to these tools, less resource intensive methods might be employed. For example, continued membership or commitment to the group that was convened by the participatory process may be indicative that the individual has incorporated that group membership into their identity and the norms of that group into their belief systems and practices (Handley et al., 2006).

Participation as an observational metric may be more beneficial than other forms of measurements that capture changes in 'knowledge' because knowledge and information are constantly evolving and may not be best assessed statically. Deyle and Slotterback (2009) observed that in processes where there were higher levels of membership continuity, shared understanding increased. Lam and Ostrom (2010) reported that in an irrigation system, as long as minimum levels of collective action and leadership were maintained after a learning intervention, system function performed well. Observing the emergence of new leadership may also serve as an observational metric- if individuals from the process arise as community leaders and espouse the values, norms, and shared understanding created within the convened participatory process (group D in Fig. 1B) this may be indicative of change.

Few efforts have been made to assess that which we categorize as level 4, or social network, learning. Ideally, one might be able to elicit the social networks of

participants and, while conducting follow up research with participants, also evaluate if any of that knowledge has *disseminated* into these networks, the other social groups in which they participate. However, this is likely infeasible in many cases because social networks may be expansive and thus require many resources to evaluate. Therefore, methods that assess the broader community in which the learning process was facilitated may be sufficient for assessing whether learning disseminates to those who did not participate in the process. If this approach is implemented, critical examination should be given to how a representative sample is chosen as a random sample may not capture a sufficient number of people within participants' social networks.

This kind of method would require either a comparative baseline measure of knowledge collected prior to the learning processes or control communities against which to compare results from 'test' communities (and preferably both). Though few in number, some researchers have used surveys and interviews in this way in projects meant to stimulate learning. Meinzen-Dick et al. (2018) experimented with metrics to assess outcomes from an experimental game conducted to stimulate learning about groundwater use. Twenty-six habitations were divided into treatment sites where the game was conducted and control sites without games. Interviews to elicit mental models from four individuals in each habitation were collected a year after the games were first played. The mental model respondents had not played the games, but were used as indicators of whether there was a spillover effect of the games at the community level. Analysis showed that there were some differences between the groups, but many variables showed no significant change—perhaps not surprising because the mental model respondents had not played the games. Lam and Ostrom (2010) evaluated the impacts of a farmer-to-farmer training program in Nepal over 2 decades with interview data from three time points (one time point is baseline). However, they comment that statistical analysis does not sufficiently capture the "time dimension of social phenomena."

Other examples of similar kinds of methods come from disciplines such as psychology that study learning interventions through experiments designed with

control and test classrooms (Kellam and Anthony, 1998). An alternative method to assess this learning level may be to build on the observational metric (proposed for level 3) of studying participation by assessing whether original participants invite and incite other community members to join in meetings and initiatives.

Quantifying change at the system level, *impact*, may be the most difficult outcome to support through empirical evidence. Some researchers report on observed policy change and changed governance structures but this is not applicable to all cases and contexts, especially those that initiate learning processes to affect informal rather than formal governance institutions. One possible method would be rigorous assessment of biophysical changes but this is resource intensive and requires technical expertise, and the biophysical conditions are affected by many other factors beyond the governance structure. However, long term research programs such as the International Forestry Resources and Institutions Program (e.g. Chhatre and Agrawal, 2008). One promising approach that could be employed to evaluate learning at the system or societal level is to apply a methodology called the participatory assessment for development evaluation. As described by Pouw et al. (2017), this assessment reveals, "The systematic way in which historical information on development is gathered in combination with the discussions on why things happened leads to a comprehensive and collectively shared understanding of how the current situation has come about and what role development interventions did or did not play." It is an evaluation approach built from community formed criteria and assessment in which intersubjectivity, interpreted experience or understanding that is shared and confirmed as true by multiple individuals, among community members is the basis for causal inference. Though currently designed to assess development initiatives, it could be applied to evaluate social learning interventions. This method may have particular utility in cases where community organizations/practitioners with long-standing relationships and history exist; they could receive feedback not only on one specific initiative, but on a history of initiatives.

Evaluation H, developed by Guy and Inglis (1999) is a method that could be used for a participatory development evaluation approach. The question of interest

is posed to the community group such as, "did they games played in this community affect the way the resource of interest (i.e. water, forest) is managed?" A line is drawn on a piece of paper with one end that represents no impact ('0') and the other end of the line that represents high impact ('10') and each participant makes a mark on the line to designate their chosen score. Then, participants are given paper upon which they write a) the negative reasons they have for giving the project an imperfect score and b) the positive reasons they have for giving the project a score greater than '0.' These reasons are posted and then each person shares what they have written. Then, a discussion is opened so that the group may take into consideration the range of perspectives and give a single, group score. Once this is completed, the group may be asked what could be done to improve the initiative in the future. Though these approaches require resources in terms of time, they are financially inexpensive. They are also relevant given that the process of social learning, itself, is intersubjective and context dependent (Van Bommel et al., 2009). Though some form of standardizing methods so as to compare outcomes is desirable, researchers recognize that learning processes and outcomes are very contextual (Rodela et al., 2012) and that participants should be able to design their own measurements of success (Tschakert and Dietrich, 2010), including whether or not the intervention caused more harm than benefit.

V. Conclusions

It is increasingly important to find assessment methods to determine the impacts of interventions like the use of games and models on abilities of communities to solve collective action processes. The measurement of learning at multiple levels has been our focus for determining impact. Our review shows that there are various methods to measure learning at individual and group levels, but one may also like to evaluate dissemination of knowledge and system level changes due to learning. Furthermore, many methods cost substantial amounts of time and resources from participants and researchers. More cost-effective methods are needed that could be applied by practitioners. Such cost-effective methods may lead to rapid feedback as well as longitudinal measurements of the consequences of the

intervention. Furthermore, it may enable the adoption of intervention approaches using games and models at a broader scale as well as a more nuanced understanding how interventions are effective in different social and ecological contexts.

It is exciting to explore how we might improve our assessment and reporting on social learning because increasing quantities of anecdotal evidence suggest that learning processes are impactful. For example, in a working paper, Lopez (2010) describes that after conducting a framed field experiment in the form of a game, members of NGOs reported that in later conversations, community members used the game as a reference point for decisions about real life management and cooperation. Our hope with this contribution is not to offer a singular pathway forward for evaluating social learning processes, but to incite rigorous discussion and inspire exploratory research regarding how social learning frameworks may be better integrated with methods to assess learning at multiple scales.

Acknowledgements

This work was undertaken as part of, and funded by, the CGIAR Research Program on Policies, Institutions, and Markets (PIM) led by the International Food Policy Research Institute (IFPRI). PIM is in turn supported by these donors. This manuscript has not gone through IFPRI's standard peer review procedure. The opinions expressed here belong to the authors, and do not necessarily reflect those of PIM, IFPRI, or CGIAR. We also acknowledge the National Science foundation for funding this work under Grant No. 1414052.

References

Barrett, C.B. and M.R. Carter. 2010. The power and pitfalls of experiments in development economics: some non-random reflections. *Applied Economic Perspectives and Policy* 32(4): 515-548.

Bandura, A. 1977. *Social learning theory.* Prentice- Hall, Englewood Cliffs, New Jersey, USA.

Bousquet, F., O. Barreteau, P. D'Aquino, M. Etienne, S. Boissau, S. Aubert, C. Le Page, and D. Babin. 2002. Multi-agent systems and role gams: Collective learning Processes For Ecosystem Management, in M.A. Janssen (ed). Complexity and Ecosystem Management: The Theory and Practice of Multi-Agent Approaches, Edward Elgar Publishers: 248-285.

Chhatre, A. and A. Agrawal. 2008. Forest Commons and Local Enforcement. *Proceedings of the National Academy of Sciences* 105(36): 13286-13291.

Cundill, G. 2010. Monitoring social learning processes in adaptive comanagement: three case studies from South Africa.

Cuppen E. 2012. A quasi-experimental evaluation of learning in a stakeholder dialogue on bio-energy. *Research Policy* 41(3): 624–637.

Deyle, R. and C.S. Slotterback. 2009. Group learning in participatory planning processes: an exploratory quasiexperimental analysis of local mitigation planning in Florida. *Journal of Planning Education and Research.* 29:23-38

Gerlak A.K., T. Heikkila, S.L. Smolinski, D. Huitema, and D. Armitage. 2018. Learning our way out of environmental policy problems: a review of the scholarship, *Policy Sciences*, in press

Grey, S., A. Chan, and D. Clark, and R. Jordan. 2012. Modeling the integration of stakeholder knowledge in social-ecological decision-making: Benefits and limitations to knowledge diversity. *Ecological Modelling*. 29: 88-96.

Guy, S. and A.S. Inglis 1999. Tips for trainers: Introducing the 'H-form' – a method for monitoring and evaluation, In: Gujit, I., and Braden, S. (Eds) (1999) *Learning from Analysis, Participatory Learning and Action Notes,* Issue 34, International Institute for Environment and Development, London: 84–87

Handley, K., A. Sturdy, R. Finchan, and T. Clark. 2006. Within and beyond communities of practices, making sense of learning through participation, identity, and practice. *Journal of management studies.* 43(3): 641-653.

Kellam, S.G., and J.C. Anthony. 1998. Targeting early antecedents to prevent tobacco smoking: findings from an epidemiologically based randomized field trial. *American Journal of Public Health*. 88(10): 1490-1495.

Lam, W.R. and E. Ostrom. 2010. Analyzing the dynamic complexity of development interventions: lessons from an irrigation experiment in Nepal. *Policy Science.* 43:1-25.

Lopez, M.C., 2010. Combining experiments and participatory rural appraisal tools in the field: exploring new techniques to study the management of the commons in Colombia. Working paper.

McCullum, C. 2004. Mechanisms of power within a community-based food security planning process. *Health education and behaviour*, 31(2): 206–222.

Meinzen-Dick, R., M.A. Janssen, S. Kandikuppa, R. Chaturved, R.K. Rao, and S. Theis. 2018. Playing games to save water: collective action games for groundwater management in India. *World Development* 107: 40-53.

Mostert, E., C. Pahl-Wostl, Y. Rees, B. Searle, D. Tabara, J. Tippett. 2007. Social learning in European river-basin management: barriers and fostering mechanisms from 10 river basins. *Ecology and Society*. 12(1): 19.

Muro, M. and P. Jeffrey. 2008. A critical review of the theory and application of social learning in participatory natural resource management processes. *Journal of Environmental Planning and Management.* 51(3): 325-344.

Ostrom, E. 2010. Beyond Markets and States: Polycentric Governance of Complex Economic Systems. *American Economic Review* 100 (3): 641-672.

Pahl-Wostl, C. 2002. Towards sustainability in the water sector – The importance of human actors and processes of social learning. Aquatic Sciences 64: 394-411.

Pahl-Wostl, C., M. Craps, A. Dewulf, E. Mostert, D. Tabara, and T. Taillieu. 2007. Social learning and water resources management. *Ecology and Society*. 12(2):5.

Pahl-Wostl, C. and M. Hare. 2004. Processes of social learning in integrated resources management. *Journal of Community and Applied Social Psychology.* 14: 193-206.

Parkes, C.M. 1975. What becomes of redundant world models? A contribution to the study of adaptation to change. *British Journal of Medical Psychology.* 48(2): 131-137.

Pouw, N., T. Dietz, A. Belemvire, D. de Groot, D. Millar, F. Obeng, W. Rijneveld, K. Van der Geest, Z. Vlaminkck, and F. Zaal. 2017. Participatory assessment of development

interventions: lessons learned from a new evaluation methodology in Ghana and Burkina Faso. *American Journal of Evaluation.* 38(1): 47-59.

Raadgever, G.T. 2009. Does collaboration enhance learning? The challenge of learning from collaborative water management research. Dissertation, Technische Universiteit Delft.

Radinsky, J., D. Milz, M. Zellner, K. Pudlock, C. Witek, C. Hoch, and I. Lyons. 2017. How planners and stakeholders learn with visualization tools: using learning sciences methods to examine planning processes. *Journal of Environmental Planning and Management.* 60(7): 1296-1323.

Reed, M.S., A.C. Evely, G. Cundill, I. Fazey, J. Glass, A. Laing, J. Newig, B. Parrish, C. Prell, C. Raymond, and L.C. Stringer. 2010. What is social learning? *Ecology and Society*. **15**(4): r1. [online].
URL: http://www.ecologyandsociety.org/vol15/iss4/resp1/

Rodela, R. 2011. Social learning and natural resource management: The emergence of three research perspectives. *Ecology and Society.* 16(4): 30.

Rodela, R. 2013. The social learning discourse: trends, themes, and interdisciplinary influences in current research. *Environmental Science & Policy*. 25: 157-166.

Rodela, R., G. Cundill, and A. Wals. 2012. A reflection on research design and methodologies used in social learning literature. In Lotz-Sisitka, H.B. (Ed.) *(Re) Views on Social Learning Literature: A monograph for social learning researchers in natural resources management and environmental education.* Grahamstown / Howick: Environmental Learning Research Centre, Rhodes University / EEASA / SADC REEP.

Schneider, F., P. Fry, T. Ledermann, and S. Rist. 2009. Social learning processes in Swiss soil protection- the 'from farmer-to farmer' project. *Human Ecology*. 37: 475-489

Scholz, G., G. Dewulf, and C. Pahl-Wostl. 2014. An analytical framework of social learning facilitated by participatory methods. *Syst Pract Action Res.* 27: 575-591

Siebenhuner, R. 2004. Social learning and sustainability science: which role can stakeholder participation play? In: Frank Biermann, Sabine Campe, Klaus Jacob, eds. 2004. *Proceedings of the 2002 Berlin Conference on the Human Dimensions of Global Environmental Change "Knowledge for the Sustainability Transition. The Challenge for Social Science"*, Global Governance Project: Amsterdam, Berlin, Potsdam and Oldenburg. pp. 76-86.

Speelman, E.N., L.E. Garcia-Barriosm, J.C.J. Groot, and P. Tittonell. 2014. Gaming for smallholder participation in the design of more sustainable agricultural landscapes, Agricultural Systems 126: 62-75.

Tschakert, P. and K.A. Dietrich. 2010. Anticipatory Learning for Climate Change adaptation and resilience. *Ecology & Society.* 15(2): 11

Van Bommel, S., N. Roling, N. Aarts, and E. Turnhout, 2009. Social learning for solving complex problems: a promising solution or wishful thinking? A case study of multi-actor negotiation for the integrated management and sustainable use of the Drentsche Aa area in the Netherlands. *Environmental Policy and Governance.* 19 : 400-412.

Van der Wal, M., J.D. Kraker, A. Offermans, C. Kroeze, P.A. Kirschner, and M. van Ittersum. 2014. Measuring social learning in participatory approaches to natural resource management. *Environmental Policy and Governance.* 14: 1-15.

Van der Wal, M.M., J.D. Kraker, C. Kroeze, P.A. Kirschner, and P. Valkering,. 2016. Can computer models be used for social learning? A serious game for water management. *Environmental Modelling & Software.* 75: 119-132.

Vinke-de Kruijf, J., H. Bressers, and D.C.M. Augustijn. 2014. How social learning influences further collaboration: experiences form an international collaborative water project. *Ecology and Society*. 19(2) 61.

Wandersman, A., K. Alia, B.S. Cook, L.L. Hsu, and R. Ramaswamy. 2016. Evidence-based interventions are necessary but not sufficient for achieving outcomes in each setting in a complex world: empowerment evaluation, getting to outcomes, and demonstrating accountability. *American Journal of Evaluation*. 37(4): 544-561.

Webler, T., H. Kastenholz, and O. Renn, O. 1995, Public participation in impact assessment: A social learning perspective. *Environmental Impact Assessment Review* 15: 443-463.

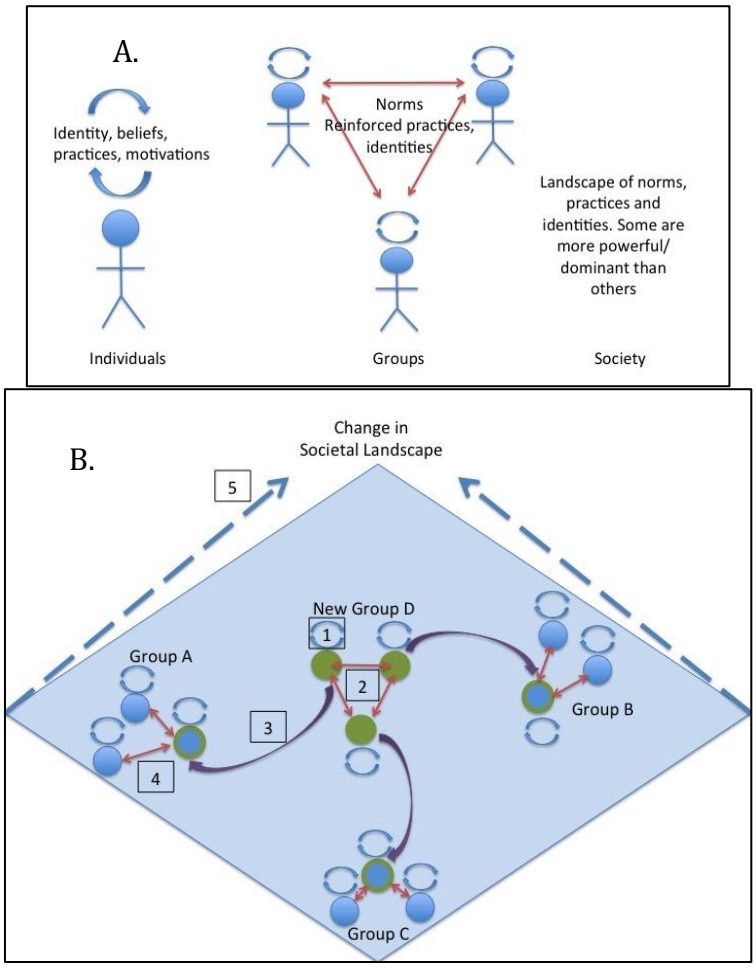

Figure 1: Levels of learning incorporated into societal context outside the participatory process. Level 1 is learning at the individual level with the participatory process, level 2 is learning at the group level which leads to the emergence of shared understanding and norms that create "new group D", level 3 is whether individual learning persists and is incorporated into an individual's way of life (attitude is maintained or attitude is transferred into behavior) in spite of possibly running counter to the norms of other groups in which they are members (groups A,B, and C), level 4 is whether learning is transferred from group D participants to other individuals in their communities/groups, and level 5 is societal learning that may organically emerge from changed practices at group levels or be achieved through concerted, collective action through which groups pursue institutional change.

Table 1: Learning levels and their unit of analysis, existing and suggested methods, and associated outcome as it relates to the system level goal of social learning.

Level	Unit of analysis	Metric timeline	Metrics (used)	Metrics (suggested)	Metrics' contribution for assessing social learning
1	Individual	Pre-process baseline, during the participatory process, post- process	-Interviews -Questionnaires -Surveys -Self-effectiveness Assessment -Participant and non-participant observation -Mental models		**Potential** for social learning. Potential that new learning will manifest in an individual's identity, practices, beliefs, and motivations.
2	Group that participated in learning process	Pre-process baseline, during the participatory process, post-process	-Group fuzzy cognitive mapping -Group negotiated perspective shifts -Q-method -Dialogue analysis -Interviews -Surveys (statistical analysis of means as well as standard deviations to assess group convergence)		**Potential** for social learning. Potential that a new societal subset/ niche of norms exists and that those norms may be reinforced through group/ community dynamics.
3	Individual	Follow-up after learning intervention/process (months, years, etc.)	-Surveys -Interviews -Questionnaires	Use observation to assess: -Continued membership or participation in the new group -Community leadership emerges from those who participated in the process	**Persistance**. Learning persist within an individual, it has become incorporated into individual's identity, practices, beliefs, and motivations outside of the process. Maintained even when exposed to pre-existing group norms.
4	Individuals that did not participate in learning process but are within participants' social network	Follow-up after learning intervention/process (months, years, etc.). Best practice would include a baseline measurement.		Requires community level assessment, could be done via: -Survey of practices, beliefs, individuals' awareness of community interdependence -Observing whether individuals that participated in the process	**Dissemination**. An individual's modified identity, practices, beliefs, and motivations are incorporated into other individuals in their social network.

				invite new people into continued community interactions, meetings, etc.	
5	System	Follow-up after learning intervention/process (months, years, etc.). Best practice would include a baseline measurement.	-Evolved governance networks -Policy outcomes	-Measure the biophysical changes in natural resource quality or availability -Participatory evaluation/ Evaluation H: intersubjectivity as causal inference. Community assesses whether or not the process affected the community positively, negatively, or not at all.	**Impact**. Learning become powerful enough to influence state of the system and new system level norm emerge = social learning.