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Building a Theory of Learning in Collaboratives: Evidence from the Everglades Restoration Program

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ABSTRACT

Many of society's most vexing problems must be solved through collaborative arrangements. Growing scholarly interest in collaboratives recognizes that the capacity for collective learning may play a critical role in their success. However, limited theoretical or empirical research exists to explain how learning occurs and the conditions that support learning in this context. In this article, we draw upon a wealth of literature, ranging from organization theory, policy process and change, and network analysis, to establish a framework of collective learning to guide inquiry in learning in collaborative governance settings. We apply our learning framework to a study of learning in a collaborative ecosystem restoration program in the Florida Everglades. We use the framework to guide a study of how learning processes and products are linked within a collaborative using a case-based, inductive approach at two levels of analysis—the larger program level and the subcase level of a learning product case. Our multilevel analysis draws upon survey and interview data to examine how the framework helps diagnose the specific types of learning processes and products that emerge in this setting, as well as the factors that influence these learning processes. In doing so, the analysis illuminates theoretical propositions, not explained by the broader literature on collective learning, around the structural, social, and technological features of the collaborative, which may foster learning.

Collaborative arrangements can address public problems that span multiple political or jurisdictional boundaries, often characterized by uncertainty and difficult social trade-offs, by bringing together distinct actors and organizations to produce or manage these shared problems (Feiock 2009; Kettl 2006; Weber 2009). These arrangements are commonly described under the broader umbrella of network structures, where the participant organizations are dependent upon one another to achieve tasks that reach beyond the individual capacities of independent organizations (Mandell and Steelman 2003; McGuire 2002;

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Imperial 2005; Keast et al. 2004). Additionally, many such arrangements become formalized or managed through the creation of new organizational structures. Such arrangements have come to characterize many sectors of public management in the United States today, from education and health policy to natural resource management (Agranoff and McGuire 2003; Ansell and Gash 2007; Karkkainen 2002). Due to the complexity often underlying the problems addressed by collaboratives, a number of scholars consider the capacity for learning to be an important feature for the endurance and success of these institutional arrangements (Allen 2001; Ansell and Gash 2007; Bressers and Rosenbaum 2000; Daniels and Walker 1996; Gerlak and Heikkila 2007; Innes and Booher 2003; Pennington 2008; Weber, Lovrich, and Gaffney 2005). However, few scholars have studied how learning occurs in these collaborative settings and what factors might foster learning. This article aims to address this gap. It asks: What can we glean from the learning literature to help define, measure, and explain learning in collaborative settings?

As collaborative arrangements cross the intellectual domains of networks, public policy, and organizations, this article begins by exploring theories and frameworks of learning from these fields to define and identify factors that might shape learning in the collaborative context. Across these different fields, we find complementary definitions of learning, which we integrate into a framework that arguably can help guide the study of learning in any collective setting, including collaboratives. The framework defines and operationalizes collective learning, which includes attention to the process of and products of learning. As part of this framework, we also identify the types of structural, social, and technological variables that have been identified as drivers of learning across different collective contexts. The value of the framework is in providing a common language and set of variables needed to organize the inquiry and theory building to study learning within collaborative contexts. We use the framework to guide a study of how learning processes and products are linked within a collaborative using a case-based, inductive approach at two levels of analysis. At one level of analysis, we examine learning across a collaborative restoration program for the Florida Everglades. We chose this case because it involves multiple and diverse actors working collectively, using a consensus-based process, to solve a complex problem. These structural and social characteristics are typical of many collaborative arrangements (e.g., see Ansell and Gash 2007), particularly those in the environmental field (e.g., see Koontz and Thomas 2006; Sabatier et al. 2005). Yet, compared to many environmental collaboratives, the Everglades is large in scale and diversity of participants, structural complexity, and technical scope (Gerlak and Heikkila 2007; Heikkila and Gerlak 2005) and therefore represents more of an "extreme" case (Gerring 2007) on these factors, which, as we later discuss, are factors that may shape learning. As such, the case is a useful starting point to expose relevant mechanisms that can help generate hypotheses (Gering 2007).[1] At another level of analysis, we study a "subcase" that participants in the Everglades program identified most commonly as an example of learning within the collaborative program. This example also represents an "extreme" subcase from among the various examples of learning (the dependent variable) across the larger collaborative program. It is used to

1 Gerring's (2007) typology of cases, in its pure form, is most appropriate when quantitative indicators of the characteristics of the full population of interest are available. Research on collaborative institutions generally or environmental field do not yet offer such indicators as research is still emerging. Furthermore, cases may be "blends" of the typology Gerring offers. For instance, we see the Everglades case as both typical and extreme, based on the knowledge available on the characteristics of collaboratives.

complement the broader case by exploring deeper insights into the critical variables that shape learning by examining the unfolding of a specific learning process (Bennett and Elman 2006). Drawing upon the insights from both levels of analysis, we develop a set of propositions to explain what factors are likely to shape learning in collaborative contexts, thus demonstrating how scholars may move from a general learning framework toward a more context relevant theory of learning in a collaborative setting.

A Framework for Studying Collective Learning

Given that collaborative arrangements involve "collective" or group behavior, understanding learning within a collaborative requires a fundamental understanding of the elements of collective learning. Various scholars have distinguished between individual and collective learning (e.g., see Argyris and Schön 1996; Jones and Glick 1996; Newig, Günther, and Pahl-Wostl 2010; Thomas 1999). Individual learning can occur either solely at the individual level (e.g., a basketball player who practices and improves her dribbling by practicing on her own) or among individuals who are members of an organization or collective group (e.g., members of a basketball team learn to improve their dribbling or passing skills during team practice) but that learning may remain solely at the individual level (e.g., the team does not play any differently together despite individual learning during practice). In contrast, collective learning occurs when learning across members of a group is translated into social or institutional transformation at the group level (Argyris and Schön 1996, 16). For instance, a basketball team adopts a new fast break strategy after team members practice their dribbling and passing skills. Given this distinction, many scholars, including organization theorists, network analysts, and public policy researchers, have begun to emphasize how collective learning can be defined and how it emerges Dixon 1999; Knight 2002; Henry 2009). Below, we integrate and draw lessons from these diverse literatures on collective learning to help frame the key features for studying learning in a collaborative setting.

Defining Collective Learning: Processes and Products

Collective learning involves both *processes* and *products* of learning, with different scholars often emphasizing one of these facets of learning over the other (Argyris and Schön 1996, 3). Among the literature that focuses on the process element of learning, organization theorists commonly describe the process through sequential "steps," such as the acquisition of knowledge, the distribution of knowledge across the organization, the interpretation of information, and translation of that new information into organizational memory (Huber 1991). Similarly, Lipschitz, Popper, and Friedman (2002) define learning as involving an assessment of prior actions, examination of errors and opportunities, and establishment of new opportunities within a group or organization. In other words, the process of learning can be understood as a set of actions that allow new information or knowledge to be acquired, processed and shared, and transferred across individuals within a group. Others draw out more specific actions that underlie some of these steps in the process. For example, scholars from diverse disciplines recognize that the step of acquiring new knowledge or information may involve substantial practice, trial and error, or experiential learning—or "learning by doing" (Fazey, Fazey, and Fazey 2005; Henry 2009; Lee 1993; Levitt and March 1988; Walters and Holling 1990). It may also involve actively seeking out ideas

from external sources (Dixon 1999). In addition, knowledge acquisition, as well as the transfer and dissemination of new information may involve active dialogue among members of organizations, policy coalitions, and networks (Nonaka 1994; Sabatier 1987, 1988, 2005; Sabatier and Jenkins-Smith 1999). Although the process of learning may be rather deliberate (Schneider and Ingram 1988), it can also occur inadvertently (Cook and Brown 1999; Nicolini and Meznar 1995).

Even if actors engage in the acquisition of new knowledge and the detection of errors or new opportunities, those steps in the process do not necessarily translate into measurable learning across a group (Nonaka 1994). The dissemination of that knowledge and translation into new collective ideas or actions is where the process of learning links to the products of learning. For organizational theorists, the products of learning can include new shared ideas and/or new strategies or actions among the actors in an organization (Knight 2002). In policy settings, the products of learning processes might also include policy or institutional changes that may result from learning processes, although learning is not the only path that may lead to policy change (Klijn and Koppenjan 2000; Sabatier 1987; Sabatier and Jenkins-Smith 1993; Weiss 1977). In this study, we embrace "products" as a generic term that encompasses many different types of collective changes in knowledge, program strategies, or policies. For instance, in program evaluation terms, learning products could include more immediate outputs, such as the development of a new project, as well as longer term outcomes or impacts, such as the effects of a project on society or the environment. Although we recognize that differentiating between types of learning products is of value to learning scholars (e.g. see May 1992), our analysis in this article does not explore these distinctions.

Regardless of the type of learning product, a common, but often overlooked, assumption in the literature, is that learning results in *improved* products. For example, scholars from diverse substantive fields—ranging from ecological systems research (Jachtenfuchs and Huber 1993; Walters and Holling 1990) to international relations (Haas 2000), to policy change (Bennett and Howlett 1992; Dixon 1999; Grief and Laitin 2004)—have broadly considered learning to be associated with the ability of groups and communities to effectively adapt to new social problems. Although we acknowledge the logic behind this assumption and recognize the role of learning in improving outcomes of collaboratives, we do not argue for including this normative assumption in the definition of learning products. Post hoc evaluations of learning products can certainly be conducted using criteria that are informed by theory or practice. However, such assessments may be highly subjective or even conflictual depending on the criteria chosen (e.g., efficiency, equity, sustainability). Research on policy diffusion has noted that new policies or strategies that cannot be linked to learning processes can be mis-diagnosed as "learning" (Volden et al. 2008). That is, simply viewing the products of learning as an indicator of learning may not be a valid measure of learning. Similarly, assuming learning has occurred simply because a learning process is present, without a clear link to an actual learning product, may lead to inaccurate measures of learning. Therefore, we argue that including both processes and products in the definition of learning can help establish more valid measures of learning when studying collaborative or other collective institutional settings. Indeed, we are not the first to recognize both learning processes and products. Heclo's (1974, 306) seminal work on policy learning states: "learning can be taken to mean a relatively enduring alteration in behavior that result from experience; usually, this alteration is conceptualized as a change in

response made in reaction to some perceived stimulus.'' More recently, we have seen learning defined as the production of cognitive and/or behavioral changes that result from the acquisition and processing of new information or experience (The Social Learning Group 2001). However, as noted earlier, research on learning often focuses on either the process or products without connecting these two elements. To study learning in any collective setting, we therefore adopt the following definition:

Collective learning involves both (1) a ''collective process,'' which may include acquiring new knowledge through diverse actions (e.g., trial and error), assessing information and disseminating new knowledge or opportunities across individuals in a collective, and (2) ''collective products'' that emerge from the process, such as new shared ideas, strategies, rules, or policies.

Characteristics of the Collective Setting that Shape Learning

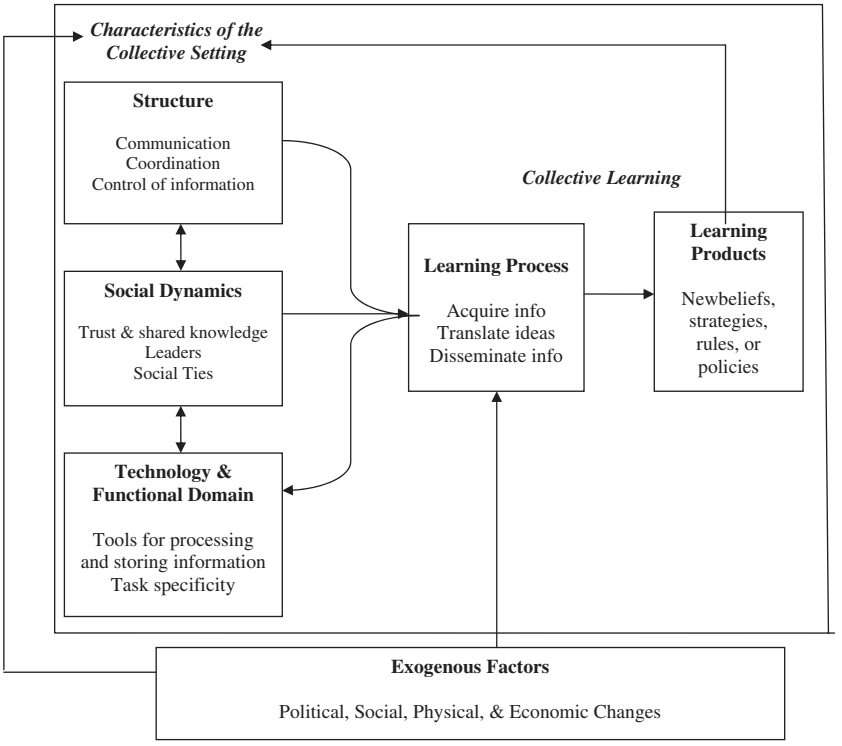
Linking the process of learning to learning products provides a way to operationalize and measure learning but it does not explain what factors shape the learning process. In reviewing the learning literature from organizational, policy, and network scholars, we find that most of the factors likely to influence learning processes and ultimately whether they lead to learning products, fit within the following overarching categories of characteristics of collective settings: structural, social, and technological, as described in more detail below. Much of the literature also points to variables that are exogenous to a collective setting as also influencing whether learning is likely to emerge. Combined with the definition of learning, these factors provide a framework (see figure 1) that can be used to examine learning within collaboratives, as well as a foundation for learning research in other collective settings.

Structure

The design or structure of institutional arrangements is widely recognized as playing an important role in fostering collective learning processes (Huber 1991; May 1992; Ostrom 1999; Schneider and Ingram 1997), as well as in blocking or inhibiting collective learning processes or blocking products from emerging from learning processes (Cashore and Howlett 2007; Newig, Günther, and Pahl-Wostl 2010). Such structural features can include the level integration or fragmentation of the actors in an organization, as well as the complexity and differentiation of actors and roles (Hall 2002). As such, structure can shape how organizational or collective actors share information, disseminate learning ideas in the learning process, as well as determine who has authority to act upon new information and knowledge on behalf of the collective group.

Some debate exists as to the type of structures that would promote learning, however. Network scholars, for example, question whether a more decentralized or diffused design fosters the type of deliberation necessary for learning (Crona and Bodin 2006; Newig, Günther, and Pahl-Wostl 2010). Some evidence suggests that decentralized structures that have a central actor or organization may be effective because such a design fosters indirect interaction among various entities (e.g., see Berardo 2009; Scholz, Ramiro, and Brad 2008). In the policy literature, scholars have similarly argued that in diffused or fragmented settings, learning may be fostered where a professionalized and open structure exists to allow for dialogue and information sharing (Sabatier and Jenkins-Smith 1993; Pedler, Burgoyne, and Boydell 1991). Research examining complex or diffused policy environments, such as collaboratives, recognizes the importance of a ''boundary'' organization or object around

Figure 1
A Framework of Collective Learning



which actors with diverse knowledge and resources can share information and knowledge as a source of learning (Cash 2002; Kallis , Kiparsky, and Norgaard 2009; Lejano and Ingram 2008).

Social Dynamics

Social dynamics are widely discussed in the collective learning literature as influencing the capacity for knowledge generation, as well as the sharing, use, and transmission of information across group members (Contu and Willmott 2003; Senge 1990; Lave and Wenger 1991). These social dynamics are increasingly recognized in the literature as critical factors associated with policy learning (Williams 2009). One aspect of the social dynamics in a collective setting is the influence and power of individual leaders or prominent organizational actors who can jump start learning processes (Dengler 2007; Mahler 1997). Leaders can bring together diverse interests and ensure that new ideas are fostered and that participants are committed to the process of learning, creating a learning culture or openness to sharing information, a willingness to experiment and take risks, a tolerance for error (Lipschitz, Popper, and Friedman 2002), and facilitate communication across organizational boundaries and diverse members (Tushman and Scanlan 1981). This research comports with much of the collective action literature, which recognizes that the presence of strong leaders as instrumental in facilitating institutional or organizational change

(Heikkila and Gerlak 2005; Libecap 1994; Ostrom 1999; Lubell and Scholz 2001; Sabatier and Jenkins-Smith 1993; Weible and Sabatier 2006). Leaders can also play a role in shaping the shared values that can create an organizational culture that may or may not support engagement in collective learning processes (Mahler 1997).

The network literature finds that the social dynamics among the individual members of a group, such as their frequency and intensity of interaction, as well as their ability to relate to one another in multiple contexts, may also influence the ability of actors to engage in the learning process, particularly their ability to trust one another and accept new ideas (Newig, Günther, and Pahl-Wostl 2010). In addition to their interactions within the collective setting, the actors' social connections external to the institutional environment, particularly broad-reaching social networks, can promote more extensive access to external sources of information and knowledge (Bodin, Crona, and Ernston 2006; Liebeskind et al. 1996; Olsson, Folke, and Berkes 2004; Pedler, Burgoyne, and Boydell 1991). This allows for multiple and diverse sources of information, including citizen and local knowledge, which is considered necessary to foster learning (Keen and Mahanty 2006; Schusler, Decker, and Pfeffer 2003; Weber 2009).

Technological and Functional Domain

Technological and/or functional domains can determine the type of information that a collective group will be interested in learning, seek out, or have access to, as well as how frequently and easily information can be shared. For instance, some have argued that organizations or collective groups that rely on fixed operating procedures may become path dependent, or thus blocked from learning, because they do not seek out new or unexpected information (Carley and Harrald 1997; Levitt and March 1988). Others argue that ambiguity and uncertainty in the functional domain (or purpose and goals) and the tasks (technologies or tools for achieving the goals) can challenge learning (Brown and Brudney 2003; Franz and Sato 2005). Such uncertainty can hinder ability of actors to agree on the nature of problems and solutions, or even the relevance of new information, and thus collectively learn (Kingdon 1995; Sabatier and Jenkins-Smith 1993). At the same time, information processing technologies that organizations have available to store, process, and communicate information might mitigate for the challenges posed by ambiguous functional processes in certain contexts (Brown and Brudney 2003). Similarly, technologies, resources, or functional processes that ensure transparency, impartiality, and reliability of information have also been considered important in collective learning (Lipschitz, Popper, and Friedman 2002).

Exogenous Factors

Another frequently discussed category of variables that can influence collective learning includes the exogenous factors, such as political, social, and economic changes, as well as the media and other venues that transmit information about those changing conditions (Howlett and Ramesh 2002; Kingdon 1995; Lipschitz, Popper, and Friedman 2002; Sabatier 1988; Siebenhüner 2002). The literature recognizes that external perturbations may be necessary at times to ignite or foster learning by changing what is known about a group's goals, functions, or outcomes, altering structures and social capacities (Birkland 2006; Sabatier 1988). External information can possess varying degrees of uncertainty or ambiguity that further shapes the capacity for learning. In the case of collaboratives, we do not have clear evidence of how different types of exogenous factors are likely to factor into learning or how they interact with or support other variables in the

collective learning process. Studying the interaction between these events and the sets of variables previously mention will provide valuable insights on the conditional nature of the various factors that shape learning.

STUDY SETTING: EVERGLADES RESTORATION PROGRAM

Although the framework on collective learning provides the foundation for examining learning in a collaborative it does not offer propositions that serve to explain learning processes and products in the context of collaborative settings. We cannot predict, *a priori*, from the broader literature on learning which of the variables in our framework are likely to support learning in collaboratives. For instance, in collaborative settings, although participants are likely to share common collective goals (like an organization), their relationships are likely to be more numerous, permeable, and transient compared to other types of collective settings (Hula 1999). Given this context, the actors within these settings may come with competing interests and demands (e.g., from an organization's individual members or external stakeholders), distinct and perhaps conflicting organizational mandates, missions, cultures, processes, and values, which may shape the types of factors that may foster collective learning. Actors may also have diverse individual values, beliefs, and experiences based on their professional expertise, political backgrounds, and personal experiences. These complicated and diverse combinations of interests within a collaborative create diverse "ways of knowing" involved in these institutions (Lejano and Ingram 2008), which may mean that particular types of institutional, social, or technical factors are needed to foster learning. Thus, although the framework can provide a roadmap for studying learning, inductive analysis is also needed to explore the contextually relevant variables and their relationships in order to develop propositions and a theory of learning in collaborative arrangements.

The collaborative that is the focus of our study, the Florida Everglades restoration program, like many collaborative processes, involves complex formal and informal relationships among a group of organizations that have agreed to share goals. The primary goal of the collaborative program is to restore the ecological integrity of the Everglades—a unique and culturally significant ecosystem that has been impaired after decades of engineering for flood control, agricultural, and urban development (Grunwald 2006). The collaborative effort became institutionalized under the Water Resources Development Act of 2000, which established the Comprehensive Everglades Restoration Plan, or the "CERP." This plan formalizes many of the shared goals of the collaborative program by identifying the operational projects that will re-engineer the existing flood control and water management infrastructure in the Everglades needed to restore, or at least improve, the health of the Everglades ecosystem (US GAO 2007, 5).

The Everglades restoration program has become a network of multiple organizations that institutionalizes communications and joint decisions among various actors that share responsibilities for managing the Everglades and those who are affected by the restoration efforts. One of the lead agencies in the collaborative restoration program is the US Army Corps (Corps), charged with development and implementation of approximately 60 distinct restoration projects that fall under the restoration plan. The South Florida Water Management District (SFWMD), the second lead agency, is tasked with designing projects and accessing and providing land for restoration. After the Corps and SFWMD complete the initial planning and design for specific restoration projects, they must submit the proposed projects to the Congress to obtain authorization and funding for construction

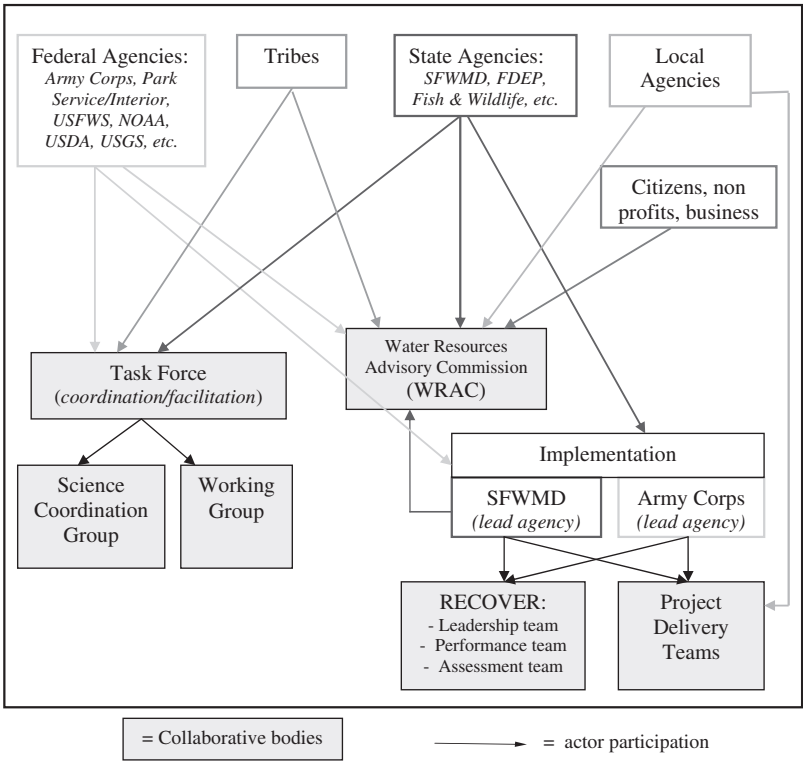
(US GAO 2007, 5). The two lead agencies also coordinate implementation efforts that involve numerous state, local, tribal, and federal actors. It can be seen as the one of the most extensive types of collaborative networks—an "action network" that engages in collective action by formally adopting courses of action and delivering services (Agranoff 2003) and is goal directed, as outlined by the CERP (Kilduff and Tsai 2003).

Several new organizations and groups were crafted to facilitate and formalize communication and coordination among the actors involved in the Everglades restoration effort. Central to the coordination and communication for the overall restoration effort is the South Florida Ecosystem Restoration Task Force (Task Force). As shown in figure 2, the Task Force is composed of federal, state, local, and tribal representatives. The Task Force is supported by a "Working Group," whose mission is to help facilitate the restoration, and the Science Coordination Group (SCG), composed of senior scientists and managers, designed to coordinate the scientific aspects of the restoration effort. Another group, which coordinates science and technical issues related to project implementation between the lead agencies, is the Restoration COordination and VERification Team—known as "RECOVER." To foster the technical coordination of project implementation on the ground, the implementing agencies also appoint staff to serve on project delivery teams (PDTs). Although most of these coordination and communication venues focus on the planning, technical, or implementation issues, there is also a state-sponsored venue, the Water Resources Advisory Commission (WRAC), designed to bring together citizen, business, tribal, and local agency input into the restoration process. Figure 2 displays the complicated interactions between traditional administrative bodies and stakeholder groups along with the newly crafted institutional arrangements in terms of both coordination and implementation of the broader restoration program.

Since passage of the congressional legislation in 2000 and creation of the various organizational bodies outlined above, the greater restoration program has been marked by project delays (US GAO 2007, 3), conflicts over the program's priorities, legal requirements and its impact on the ecosystem (Grunwald 2006; The Economist 2005), and concern over the capacity of the program to adequately coordinate its scientific bodies and research (US GAO 2003). Insufficient funding from Washington, litigation, and stalled efforts by the state to buyout lands held by US Sugar have all hampered progress (Cave 2008; Grunwald 2006; Walsh 2008; VanNatta and Cave 2010). The Obama administration signed a new deal with the state to share costs and responsibilities[2] and provided an influx of federal stimulus monies to the program (Quinlan 2009a, 2009b), with the expectation that the funds would reinvigorate many of the stalled projects (Morgan 2009). Support from the Obama administration did not eliminate the complex array of challenges facing the Everglades restoration efforts. In 2010, a federal judge ruled that clean water standards were still not being met in the Everglades, ordering federal and state governments to amend existing permits for discharges in the Everglades and construct new marsh treatment areas (US Environmental Protection Agency 2010). Despite some of these delays and criticisms, the program has survived for 10 years and some projects have moved forward. The question is has learning emerged during this process in the face of these challenges?

2 The new "master agreement" requires the Corps to value state land acquisitions at fair market prices thereby, resolving a long-standing dispute between the two parties regarding how the state would be credited for the land purchases.

Figure 2
Actors Involved in the Everglades Restoration Program



METHODS

To assess the question whether learning has emerged in the Everglades collaborative program, we adopted the operational definition of learning, developed from the learning framework, to identify and measure learning. This definition requires evidence of learning products that are linked to the different processes of learning. In this study, we identified learning products that are presented as collective changes in program strategies or policies (also known as collective behaviors).[3] We identified learning processes that were linked to these products, which include processes of acquiring new information (e.g., program reports, dialogue, or experimentation) about the program and its goals, and processes for sharing and disseminating such information. Where these processes were absent, we did not measure changes in program strategies or policies as learning products. We further identified and measured those features of the structure, social dynamics, technological/functional domain, and exogenous conditions that either precipitated or interacted with the learning processes to better understand what leads to learning in the collaborative context.

3 Changes in beliefs or cognition are also products of learning that the literature identifies. We chose not to evaluate cognitive changes for this article. In a follow-up article, we explore cognitive changes as products in more depth.

The primary source of data used to identify learning products and processes for our first level of analysis—the Everglades restoration program—came from an online survey of program participants, conducted between January and March 2009. The population of survey respondents came from lists of official representatives serving on the primary coordination, decision-making, and implementation bodies of the collaborative restoration program (as described above and depicted in figure 2).[4]Primary and secondary documents, from Congress, program participants, media, and academic sources and 12 in-person and telephone interviews between 2007 and 2009 with key informants and staff involved in the collaborative process, were used for background data prior to developing the survey questions. The survey instrument asked participants in the collaborative process to identify up to three program policies or implementation strategies within the Everglades Restoration Program that had changed in response to new information.[5] We then followed up with questions to further connect the learning product to learning specific learning processes, including how new information was acquired and how that information was processed and shared within the collaborative program. The range of potential sources of information and mechanisms for sharing information identified in the survey questionnaire were informed by the interviews and document analyses conducted prior to the survey. Using the survey data that pinpoints where learning processes emerge within (or external to) the collaborative program, allows us to then draw inferences about the role of structure, social dynamics, and technological and exogenous factors that may be shaping these processes.

To further investigate the structural, social, technological, and exogenous factors that drive these processes, we then explored learning at another level of analysis, or subcase, of one of the learning products that was identified most commonly by the survey participants as an example of learning. The case study allows for tracing or following the process of the factors that precipitated learning, as well as an exploration for how these factors interrelate. Data for the subcase came from interviews with key informants from the program and program documents. In the discussion section of the article, we then analyze how the findings from the case study comport with and help explain the survey findings. In this section, we also draw inferences from the survey findings that help develop propositions around the factors that influence those processes. These multiple sources of data and methods of analysis help bolster the validity of our case-based approach (Lieberman 2005).

4 All relevant members of the teams were identified from program participant lists received from the administrative staff involved in these entities. Names of 668 individuals were provided on these lists; however, upon initial contact, we found that approximately 10% of the individuals were no longer participating in the program. Another 2% of the individuals notified us that they were not actively involved enough to provide an informed response to the survey. Of the remaining 580 individuals, we received 99 responses after 3 separate follow-up reminders from the Principal Investigators (17% response rate). The survey was pretested with a staff member of the Everglades Restoration program prior to survey implementation. We recognize that there may be self-selection biases among the respondents, perhaps due to their interest of involvement in the program. Among the survey participants who responded, the average length of time of their involvement was 6.8 years. However, there is wide dispersion in the level of experience within of respondents, with the minimum number of years involved being 1 year and the maximum 19 (standard deviation = 4.3). It is also possible that participants chose to respond because they felt they had experience and knowledge around learning. In fact, among those who responded, more seasoned respondents chose to answer questions on learning compared to less seasoned participants.

5 Those who participate only in the Task Force related bodies and program planning/policies only responded to those questions, whereas those involved in the implementation side only responded to questions involving program strategy changes and anyone involved in both had the opportunity to respond to both types of questions.

LINKING LEARNING PROCESSES TO LEARNING PRODUCTS AT THE PROGRAM LEVEL

The main findings from our survey suggest that learning products in the collaborative Everglades Program are associated with diverse learning processes that are both internal and external to the collaborative. Among the 96 survey respondents, 68% responded to the questions on learning (identifying up to three products per respondent). Those respondents identified a total of 89 learning products that were linked to learning processes. Not surprisingly, learning products were statistically more likely to be identified by individuals with a longer history of participation in the collaborative program versus more recent participants.[6] These products range from very broad programmatic or program planning decisions (e.g., a new program initiative to kick start projects or reallocate funds) to very technical decisions (e.g., the engineering or design of a particular feature of the restoration effort).

As shown in table 1, the primary sources of information within the learning process include reports and studies, as well as dialogue and debate, from both within and outside the collaborative subgroups in this program. Whereas just slightly more of the sources of learning come from internal reports from the member agencies involved in the restoration program (42%), a significant portion of the learning products were also associated with dialogue or debate within the subgroups of the collaborative (40%). At the same time, external sources of information were associated with learning products including debate from groups external to the collaborative process (36%) and reports or studies from external groups, not directly participating in the program (25%). Notably, respondents identified multiple sources of learning for each of the learning products (although no correlations were found among the different types of information sources).

Another potential avenue for acquiring information and engaging in a learning process is through trial and error or experimentation. When asked about experimentation with existing processes, respondents provide somewhat mixed responses. On the one hand, the specific program implementation features that participants identified as open to experimentation were closely aligned with many of the learning products they also identified. Given the nature of the Everglades Restoration Program, we observed some of the learning products linked to pilot testing, modeling, or monitoring efforts. On the other hand, 10% of the total survey respondents felt that none of the program elements had been open to experimentation and that the program is instead risk averse. Of those respondents who specifically commented on the role of experimentation in the program, some 30% expressly stated that they see little to no experimentation in program implementation. Thus, in this collaborative, although it appears that experimentation may be

Table 1
Information Acquisition Sources Associated with Learning Products

Internal reports from individual agencies	42%
Dialogue or debate within meetings or teams	40%
Outside debate	36%
External reports	25%
Internal reports to the subgroups	8%

6 Learning instances were identified by participants with an average of 8.4 years of experience with the collaborative, whereas those who did not identify learning had an average of 5.5 years. The difference is statistically significant ($F = 19.3$, $p < .01$).

a potential component of the process that leads to learning products, it is viewed as a less commonly used learning process than other forms of information or knowledge acquisition.

In addition, participants identified the vehicle of dissemination of information, as presented in table 2, further linking the learning products to processes. The majority of respondents note that implementing teams or agencies were the main vehicle for disseminating information to collaborative members (44% of cases), followed closely by program leaders (42%). External groups and advisory bodies (e.g., the WRAC, SCG, and the Working Group) were also involved in disseminating information in nearly a quarter (24%) of the cases, followed by the Task Force, which is the collaborative body that guides program collaboration and policy (15% of cases). Our data indicate that the Task Force and advisory groups, as well as the Task Force and external groups, are frequently identified together as vehicles of dissemination for the same instance of learning.[7] This suggests that just as multiple sources of information are important, so too are multiple venues of dissemination in the learning process. However, the individuals and agencies leading the initiative were more likely to disseminate information than the collaborative subgroups.

As the sharing of information and dissemination of information are identified in the literature as key steps or actions involved in the learning process, we asked program participants their perceptions of information sharing and integration both within the subgroups of the collaborative and across the entire program. Comparing across the subgroups might elicit insights on whether differences in the technical nature of these groups or their resources or capacities might explain differences in their capacity to engage in learning processes. However, no statistically significant differences across the subgroups were identified in terms of capacities to engage in learning processes. Moreover, we did not find differences across the subgroups in the number or types of learning products. On average, the members of the subgroups all reported having moderately well-established processes, such as internal communication procedures between group members and administrative staff (average rank of 7.1 on a scale of 1–10, with 10 being the highest), moderately effective communication with advisory groups, dedication to diverse sources of information and resources, periodic review of program performance, and dedication of staff and resources to coordination among group members (all ranking in the 6.0–6.5 range on a scale of 1–10). Compared to the within-group responses, most respondents to the survey have a slightly lower opinion of the extent to which different subgroups of the collaborative program share and integrate information between or across subgroups (mean response score was 5.8 [83 responses, standard deviation 2.1]). This comports with the finding that the program leaders or lead agencies are more likely to be engaged in disseminating new information across the program than the subgroups.

Table 2
Vehicles of Dissemination and Information Sharing Associated with Learning Products

Via implementing agencies or teams	44%
Via leaders	42%
Via external groups	24%
Via Advisory groups	20%
Via the Task Force	15%

7 Phi correlation = .50 and .30, respectively, $p < .05$.

Some of the challenges associated with disseminating information across subgroups within the collaborative may possibly hamper overall program. Such challenges could be related to the diversity of positions and goals that the members of the collaborative hold. In fact, a substantial proportion of respondents (38%) identified these diverging political positions or conflicting agendas as a major impediment to the sharing and integration of information. Although this points to a fundamental challenge known to these types of collaborative processes, it further underscores the importance of both the structural and social dynamics in these settings to foster learning in collaborative settings. Not surprisingly, another 28% of the respondents mentioned that the lack of adequate processes, linkages, or direction from leaders as impediments to learning. A much smaller proportion (16%) mentioned inadequate resources (technical or financial) as impediments, whereas only 12% mentioned that sharing is impeded by a lack of knowledge or understanding by individuals of data. These barriers, however, should not suggest that information sharing and integration is not occurring across the collaborative group. As table 3 summarizes, many participants reported using diverse communication tools to share information. These tools suggest that social factors, in particular frequent face-to-face communication, as well as technical factors, such as electronic information sharing, can play a role in facilitating the learning process.

To summarize, at this larger program level of analysis, we find significant diversity in terms of the sources of information within the learning process, vehicles of information dissemination, and tools for information sharing as identified by program participants in the survey. Notably, survey respondents identified both internal (e.g. reports from the member agencies involved in the restoration program, dialogue, or debate within the subgroups of the collaborative) and external sources of information (e.g., debate from groups external to the collaborative process and reports or studies from external groups, not directly participating in the program). In addition, respondents identified implementing teams or agencies and program leaders as the main vehicles for disseminating information to collaborative members.

THE FACTORS THAT SHAPE LEARNING PROCESSES: THE SUBCASE OF ACCELER8

As our survey data provided an opportunity to identify learning products that are linked to learning processes, as well as pinpoint the sources of these processes in the Everglades program, we now turn our attention to another level of analysis where we investigate one particular learning product to more clearly illuminate the factors that support and shape

Table 3
Tools for Information Sharing Across the Collaborative

Key Tools for Information Sharing	Percent of Identified Tools
Regular meetings among collaborative members	53%
E-mail	45%
Internet or Intranet	36%
Informal dialogue	25%
Phone calls	24%
Workshops/Conferences	15%

Note: Number of responses to open-ended questions on information sharing tools and barriers = 70.

learning processes and, ultimately, products. Among the learning products that the respondents identified in our survey, the one identified by the most respondents is a program called "Acceler8." Initiated by the state of Florida in the fall of 2004, Acceler8 was designed to accelerate the restoration of the Everglades through the funding, design, and construction of eight specific Everglades restoration projects, totaling some $1.8 (SFWMD 2009a). Those respondents who identified Acceler8 as a learning product came from diverse professional backgrounds, including social sciences, planning, and bio-ecology, as well as from different subunits of the collaborative program, including the Task Force, Working Group, and PDTs. We trace the process of learning in Acceler8 as a case study here, drawing forth evidence from our survey and interviews as well as literature and document analyses to better understand the structural, social, technological and functional, and exogenous factors that shape learning in a collaborative program. Overall, we find evidence of all of these factors helping to facilitate the learning process. It is how these factors feed into different phases of the learning process and how they interrelate that can help develop theoretical propositions on collaborative learning, which we discuss in the next section.

The structural factors within the collaborative restoration program that fostered the learning process around Acceler8 include the centrality of lead member agencies with ties to leaders external to the program, as well as the presence of diverse collaborative subgroups that cut across program participants (see figure 2). The genesis of Acceler8 started with internal brainstorming sessions within one of the lead agencies, the SFWMD namely by SFWMD top officials who working with then Governor Jeb Bush to initiate the plan. These leaders were largely responding to a lack of federal funding and engagement in the larger restoration program and concerns that public interest was waning (Ammon 2009). By advancing the design and construction of these projects with state dollars, state officials hoped to more quickly realize restoration benefits and jump-start the overall CERP effort (US GAO 2007, 9). Although the initial idea to create Acceler8 was not hatched through the broader collaborative process, multiple groups, including the Task Force and the various functionally specialized subgroups, provided a forum for generating new ideas, as well disseminating and translating these new ideas, prior to establishing and implementing Acceler8 (Ammon 2009). Respondents to the survey who identified the Acceler8 case as one of the learning products of the program support these findings, noting that information sources on the problems and proposed program included the state agencies, subgroups within the collaborative process, and external reports.

Later the restoration program's formal and informal structural arrangements and processes would continue to support the learning process by eliciting and sharing more specific information on how to modify schedules and priorities of the Acceler8 program in line with participant concerns and suggestions. This included a mechanism for acquiring and processing information from the concerned public, via the WRAC, which conducted public meetings around the Acceler8 program (Light 2006, 956). Over time, the subgroups of the collaborative program would come to serve as vehicles to update participants on the status of the program, and thus, the structural design features played a key role in shaping information dissemination in the learning process. Although these subgroups indeed played a role in information dissemination, the main vehicles for communicating new information across the collaborative about Acceler8, as identified by our survey participants, as with program initiation, were program leaders as well as the lead state agency (SFWMD).

The structural factors in this case also feed into the social dynamics, most notably trust, building interactions, and leadership, which fostered the learning process that led to Acceler8. In particular, the lead state agency, SFWMD, made an effort to actively engage the lead federal agency in the program, the Corps, to design a project approach where the state would adopt practices that would be consistent with Army Corps procedures regarding the planning, design, and operation of projects, which helped allay fears or threats to the federal partnership that Acceler8 might have posed (Ammon 2009). In addition to their discussions with Corps officials, both locally and nationally, SFWMD leaders worked to ease concerns about the program with other federal officials and environmental groups, using the structure of the collaborative process. Some federal officials even saw the program as a way to help propel further federal investment and attention to the Everglades in the face of competing environment crises and disasters (Duke 2007). The context of the broader state-federal leadership relationship, characterized by then Governor Jeb Bush and President George W. Bush, also helped facilitate approval of the initiative (Ammon 2009). This is not to say everyone was happy. Some environmentalists argued that the Acceler8 largely represented water supply projects that essentially abandoned the environmental components of restoration (The Economist 2005). Despite some opposition, these social dynamics played a role in helping not only disseminate information and new ideas but also in garnering support, and arguably the trust, needed to translate these ideas into learning products.

Finally, the Acceler8 case highlights collaborative technology and resource factors that influence learning processes. First, the well-constructed functional domain and task plan, established by the CERP, arguably helped move Acceler8 from the process of gathering and disseminating information into a learning product. The functional domain was defined clearly enough that the new strategy could be viewed and understood as feasible and compatible with the program. State leaders also relied on technical processes to promote experimentation and innovation by harnessing their relationship with a joint venture engineering company. As part of the broader collaborative effort, the joint venture assisted state officials with project planning for Acceler8. Then state officials saw an opportunity to use this resource to assist with the engineering and design of the restoration projects. This played a considerable role in the state's confidence to move ahead with Acceler8 and to obtain the approval of state leaders and federal partners (Ammon 2009).

Ultimately, the lead agencies in the restoration program were able to integrate Acceler8 with the Corps' implementation processes, which enhanced the available tools for accessing and processing reliable information needed for learning across the broader restoration program (Ammon 2009). For instance, state and federal officials collectively designed specific engineering criteria for dam construction in South Florida, which became transferable to other projects in the restoration effort. Second, SFWMD and the Corps initiated use of a shared computer program related to project design criteria. This has allowed for improved project integration across the two agencies and will presumably assist with cost sharing and other components of design (Ammon 2009). In this way, the Acceler8 program provided a basis and capacity for future technical learning in the broader restoration effort.

In the end, the learning processes in this case arguably led to not one but multiple learning products including the program's eight projects, or new collective strategies,

as well as new shared ideas or consensus about the value of the program across the diverse set of participants in the restoration efforts (Ammon 2007), coupled with new shared knowledge about the science and benefits of using stormwater treatment areas to address the phosphorous contamination issues in the Everglades (May 2009).Efforts to proceed with eight Acceler8 projects were ultimately hampered by a series of external or exogenous events, including a lawsuit and a shift in state attention on restoration toward a plan to buy out US Sugar holdings (Cave 2009). The suite of eight projects once known as Acceler8 is now referred to as the "expedited projects" by the SFWMD (SFWMD 2009b). However, experience with the Acceler8 program arguably helped raise awareness of the procedural and policy challenges at the federal level that have hampered restoration (May 2009). This awareness provided fodder for changes in federal land valuation policies in the Everglades program, thereby removing a significant hurdle to progress in the broader collaborative as land acquisition is a critical component to the goals of the program. In other words, the learning products from Accceler8 provided information that fed into new learning processes and products for the broader restoration program.

To summarize, this level of analysis focused on the learning product as a subcase by identifying the processes that led up to the learning product and the variables that played a role in that process. Our examination of the Acceler8 sub-case points to the role of both internal and external sources of information on the problems and proposed program within the learning process. In tracing the case, we found interrelationships between these structural factors and social dynamics like trust, building interactions, and leadership, which fostered the learning process that led to Acceler8. Finally, the subcase highlights collaborative technology and resource factors that influence learning processes, including a well-constructed functional domain and task plan, established by the CERP, that arguably helped move Acceler8 from the process of gathering and disseminating information into a learning product.

DISCUSSION

Building off the insights from our two levels of analysis—larger program level and subcase level—this section offers initial propositions toward a theory of learning in collaborative settings. We identify how the key categories of variables from our framework can be narrowed down and honed to identify more specific factors that fostered learning processes. By doing so, we further identify how these factors may differ depending on the phase of the learning process. We also consider how some of these variables may interact.

Starting with the structural factors, the evidence suggests that the information acquisition component of the learning process is fostered by a structure that accommodates diverse sources of knowledge, such as linkages to technical resources and leaders from within individual members of the collaborative, as well as to leaders or sources of knowledge that are external to the collaborative. At the same time, it points to the value of structures internally within the collaborative that may allow for open dialogue from diverse members of the collaborative as a way to generate new knowledge and information. For instance, the initial idea for Acceler8 developed through dialogue that emerged through the lead state agency and its linkages to state leaders but was further shaped and informed by ideas generated from the program's subgroups, including advisory bodies and technical teams. This

might suggest that a more porous and decentralized structure is supportive of information acquisition.

However, the structural characteristics that are important in acquiring information may differ from those that are important in disseminating information. Indeed, although information dissemination identified by participants across the program and in the subcase of Acceler8 point to diverse structures as sources, the lead agencies in the collaborative, as well as individual leaders, are more commonly seen as critical in the process of disseminating information. Having a more open structure that allows for debate from both internal and external participants may support information production that contributes to learning; whereas having a structure that is capable of linking all program participants together, or that can speak authoritatively to the internal decision processes from member agencies, may be more critical for the phase of disseminating information. This supports literature pointing to the importance of boundary spanning "groups" or actors in collaboratives (Lejano and Ingram 2008), at least during the process of information dissemination. This finding also calls attention to some of the emerging literature on the role of member agencies more generally in collaboratives, which recognizes that actors and agencies take on different roles with varying degrees of weight or authority in collaborative settings (Agranoff 2006; Koontz et al. 2004) and the role of central agency culture in the collaborative dynamics (Bardach 1998; Mahler 1997).

Given our findings, we would expect that *learning is more likely in a collaborative that has a more open and decentralized structure, while also maintaining actors in positions who are linked and connected across multiple members of the collaborative.* (Proposition 1) We draw this proposition based on the assumption that it will allow multiple and diverse actors to be positioned to acquire new information from both internal and external sources, while also providing a mechanisms to foster the dissemination of information across the collaborative.

In applying the framework, the data also provided valuable insights into the nature of the social dynamics that support learning processes. For instance, the case study of Acceler8 highlights the role of establishing trusting relationships through trust building activities, evidenced by the explicit attempt of the state leaders to foster a sense of shared goals around the program. Additionally, these trust building activities involved multiple interactions among the diverse participants in diverse venues over time. Although we were not able to retroactively measure the degree of trust and patterns of interaction leading up to the learning products identified in the participants in the Everglades program, our survey findings indicate the importance of multiple sources of information production and dissemination in the process of learning, further underscoring the importance of diverse and frequent interactions. Additionally, our research adds valuable insights into the interplay between these social dynamics and the structural features previously discussed. For example, the Acceler8 example suggests that the structure where dialogue and learning processes take place can depend upon the leaders who manage these processes (or even strategically go outside of these processes), as well as how they rely upon the trust and social capital established as part of the larger collaborative effort.

Therefore, we may expect that *learning is more likely in a collaborative where (a) actors interact frequently, (b) members have or can establish shared goals, and (c) leaders are engaged in nurturing shared goals and frequent interactions*. (Proposition 2) This proposition, in line with Proposition 1, is based on the assumption that more diverse interactions will support the information acquisition step in the learning process. At the same time, those

diverse interactions, combined with the sharing of goals, or the presence of leaders it will be easier to translate learning processes into products because they may support the trust building activities that move the learning process toward the products of learning, where collective agreement can be made on new ideas, strategies, or policies.

The third category of variables in the framework draws the analysis to the features of the technological and functional domain that influence learning. In looking at the overall Everglades restoration program, it is clear that the functional setting involves substantial uncertainty, complexity, and interrelationships that may challenge experimentation across the entire restoration program. Thus, it is not surprising that some survey respondents, particularly newer participants in the program, did not identify learning products. However, in examining the individual learning products, there is evidence that individual learning products are sometimes characterized by functionally discrete domains, where they emerge through pilot testing or are linked to modeling or monitoring efforts. As such, they may be more amenable to experimentation, which the learning literature considers part of the learning process.

Another relevant feature of the technological and functional domain that emerged in this study was the diverse set of tools for sharing information between the coordination teams and implementation teams in the program, both electronic and in-person. Notably, design features that are tied to the internal decision processes from member agencies seem critical to information dissemination. In the Acceler8 subcase, existing technologies for assessing and processing reliable information were built upon and eventually improved (shared computer design software), which appeared to not only enhance communication but also help create a greater sense of trust and shared experience and provide new tools for leaders in managing complex data and personnel. This supports not only the broader literature on the role of technology in collective learning but also the policy literature, which recognizes the importance of access to impartial, reliable, and transparent information for collective learning (Haas 2000; Karkkainen 2002; Sabatier 2005). Notably, in a case like the Everglades, which is highly politicized, there may be an important role for exogenous actors, outside the process, to aid in this process. The National Academy of Science has an external scientific and technical review panel (Committee on Independent Scientific Review of Everglades Restoration Progress or CISREP) that now provides biennial congressionally authorized external evaluations of the CERP's progress.

Thus, we would expect that *learning is more likely across a collaborative when (a) functional settings are more discrete and amenable to experimentation, and (b) technology is available to reliability and transparently gather, store, and help disseminate disparate sources of information.* (Proposition 3) This proposition is based on the assumption that more discrete functional settings, such as those that involve a smaller geographic scale or a more limited set of professional expertise that is required for understanding the issues at hand, can help reduce complexity in information acquisition. Whereas access to reliable and transparent technology, such as shared databases and electronic file sharing systems, can help reduce the complexity in both the information acquisition and dissemination process. Doing so, arguably can help grease the wheels of the process needed to translate new information into shared collective products of learning. Of course, many collaborative programs are formed precisely because of the complexity of the functional domain, which crosses multiple boundaries and authorities. Thus, it is important to consider that these

factors are relative and may vary depending on the issues that a collaborative may address at any given time.

The role of exogenous factors in the learning process goes beyond technical features. As many critics of the restoration have pointed out, the program has had limited success in implementing projects, which theoretically should provide information and experience upon which learning can develop. Part of the project delays stem from limited funding that the federal government had promised, but not delivered, for a number of years, whereas lawsuits over project design features and other legal debates over processes ensued. At the same time, the lead agencies tasked with implementing and constructing restoration projects face their own internal bureaucratic processes and budgeting hurdles that can delay implementation (National Academies of Science 2008). The Army Corps is required to conduct multiple levels of internal and external reviews that the projects under CERP must all go through before implementation.[8] Not surprisingly, the survey respondents in our study commonly recognized these factors, especially internal agency politics and policies, as hindrances to experimentation, implementation, and program learning. Since we did not research "nonlearning" or blocked learning events in this study, we cannot say whether exogenous events alone can hinder learning. However, it is clear that those external events seen as detrimental to learning process are typically those that are more "negative" in nature, such as funding delays or political conflicts.

Evidence from the Acceler8 subcase, however, points to the fact that not all negative exogenous events as hinder the process of learning. What is clear is that it may depend on the structural, social, and technical factors that may be deployed in response to the exogenous event. When federal funding and participation appeared to be blocked, state leaders in the collaborative process stepped up and utilized their linkages outside and within the program to reinterpret the program's goals and provide an infusion of new ideas that fostered the learning process. One important caveat, is that in large collaborative settings like the Everglades Restoration Program, the lines between what is exogenous versus endogenous to the program become blurred. That is, project delays can be seen as the result of broader congressional funding battles but also as the result of internal agency bickering and resistance to change. Finer analysis may be necessary to tease out the factors that are truly external to the program.

Based on our findings here, we observe that exogenous factors perceived as negative, notably decreased financial resources or political support, may hinder collective learning by blocking the translation and dissemination of new information across the collaborative or limiting the capacity for members of the collaborative to adopt new practices. Yet, exogenous factors may also foster learning in the presence of structural, social, and technical factors that are supportive of learning. This finding calls attention to some emerging research tackling the nuances of the role exogenous factors in policy process research (Nohrstedt and Weible 2010; Williams 2009). Because we are not sure the conditions under which exogenous factors may hinder or promote learning, we hesitate to offer a proposition.

8 The internal review for the individual projects included technical review by another district, by the Corps' Office of Water Policy, by a regional implementation team in headquarters, and the Corps' Civil Works Review Board. External review of project costs and risks is done by the Office of Management and Budget and by academics. To receive needed funding to construction projects after review, Corps' headquarters must approve of the projects in a budget bill (subject to internal agency politics over resource allocation for different regions and programs) and finally those appropriations must be approved by Congress (subject, of course, to larger political debates).

In the case of learning in a collaborative context, further research is necessary to better understand the conditions around which exogenous factors might shape learning processes.

CONCLUSION

This article set out to understand learning in collaborative settings, by applying a broader framework of collective learning to the context of the Everglades Restoration Program. Building upon organizational theory, network studies, and policy process and change research, the framework emphasizes the features of collective settings that may shape learning. We adopted the operational definition of learning that requires evidence of learning products that are linked to the processes of learning. We identified learning products that are presented as collective changes in program strategies or policies. We identified learning processes that were linked to these products, which include processes of acquiring new information (e.g., program reports, dialogue, or experimentation) about the program and its goals, as well as and processes for sharing and disseminating such information. We also then identified and measured those features of the collaborative structure, social dynamics, technological/functional domain, and exogenous conditions that either precipitated or interacted with the learning processes to better understand what leads to learning in the collaborative context.

Applying the framework to study learning in a collaborative offers a more nuanced understanding of the variables that are relevant to learning in this particular setting, allowing us to identify propositions that can be tested in other collaborative settings. The propositions derived from this study, however, are just a starting point. Because the larger Everglades case study and the Acceler8 subcase both represent extreme cases (Gerring 2007), there are limitations to the generalizability of these cases. Notably, collaboratives that differ in scale and diversity of participants, structural complexity, and technical scope from the Everglades restoration program may exhibit variation in how these types of factors influence learning processes and associated learning products. The relative importance of the factors posited in our propositions should be tested in other cases, starting within the context of environmental collaborative.

We also acknowledge that further research is needed to tease out whether some variables play a more important role in the different steps of the learning process. For instance, some of our data suggests that more technical or functionally specialized, subgroups may be more influential at the stage of the learning process centered around identifying new information. Yet, member agencies may play a more direct role in the dissemination of that information. Our findings also suggest that it is important to develop a sharper understanding of the interplay between the different categories of variables identified in the framework. As the Acceler8 subcase suggests, the social dynamics defined by the leaders may depend heavily on access to diverse structures (e.g., subgroups) as forums to develop trust needed for acceptance of new ideas. Additionally, the technical domain was enhanced in the Acceler8 subcase as a result of the social dynamics that led to more trust, which combined led to enhanced information sharing. In future research, it will also be valuable to examine the applicability of the framework to study the obstacles to learning. Although the Everglades case highlighted some of the exogenous variables that may impede learning, the internal structure, social dynamics, and technical domain can also create an environment that may hinder the process of information acquisition, information sharing and dissemination, as well as the translation of those processes to learning products.

In sum, this article highlights the need for iterative theory building between the learning framework, which can guide variable selection and analytical approaches, and theories of learning in particular collective contexts. A framework allows for theories from diverse collective contexts to be grounded in a common language, which ultimately allows the theory to be compared more readily to other collective learning contexts (Schlager 2007). As Ostrom (2005) has argued, without some initial synthesis and identification of the general concepts that underlie any shared phenomena, it remains challenging to compare theories and develop testable models grounded in a common language and analytic structure. Our efforts to synthesize a shared definition of learning from the literature, around both a process and an products, as well as to identify the key categories of variables that shape learning, thus provides an initial attempt to ground a theory of learning in a collaborative setting within a broader learning framework.

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