



Benefits of participation in a community of practice focused on evaluation and programmatic improvement for environmental educators



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ABSTRACT

One of the biggest challenges environmental education (EE) practitioners face is having timely and systematically-collected evaluation data to inform the design and improvement of existing programs. One potential way to provide systematic evaluations of programs and build evaluation capacity for practitioners is through a facilitated community of practice (CoP). We developed a CoP involving 37 organizations who were pivoting to online EE programs within the United States due to the COVID-19 pandemic. Our goals were to build organizational capacity in evaluation and adaptive management to improve these organizations' online EE programs. We describe our CoP design, challenges associated with its implementation, and the benefits reported by participants in the CoP. Participants reported that they improved their evaluation skills and attitudes towards evaluation and developed social capital with a new network of colleagues. They also reported positive changes in practice, both individually and organizationally; considered new outcomes for their programs; and learned about using evaluation data to systematically improve programs. Educators shared their learning both within and outside of their organizations. Those who were more regularly involved in this community reported more positive benefits than others who were less involved. We share our reflections on the process and make suggestions for other evaluators to consider in similar CoP designs.

1. Introduction

Program evaluation is challenging for many environmental educators and organizational leaders. Many lack time, resources and/or skills needed to conduct evaluations (Anderson, Stern, & Powell, 2022; Powell, Stern, & Ardoine, 2006; Fleming & Easton, 2010; Norton et al., 2016). Programmatic evaluations can also be seen as an unwanted chore, or a means for satisfying accountability requirements. In contrast, we suggest that regular and systematic evaluations can inform program improvement and organizational learning through adaptive management. Adaptive management involves systematically designing and testing different strategies to reach specific goals. Reflection on evaluation data then leads to a reconsideration of programming, adaptation, and further learning (Salafsky et al., 2001). However, to use evaluation effectively for program improvement and organizational learning, environmental education (EE) practitioners need to develop a variety of skills.

In this paper, we describe an effort to build evaluation capacity and

systematic programmatic improvement by facilitating adaptive management in a Community of Practice (CoP) for nonformal environmental educators. We provided continuous evaluation support and services to facilitate learning about adaptive management and to enable evidence-based program improvement. We called this CoP an "evidence-based learning network (EBLN)," as participants were guided to reflect on evaluation results, learn from scientific research studies, and apply learning to their own contexts. Participants also regularly shared resources and practical lessons of their own with other CoP members. As EE organizations were faced with the challenge of transitioning from in-person to online programs during the COVID-19 pandemic, the CoP created a space to share resources and innovate based on relevant data specific to participants' programs – all in the service of making programs better. In this case study, we answer the following research questions about the learning network:

1. What positive outcomes were reported by CoP participants?
2. Did outcomes vary based on the level and types of participation?

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3. What were the key challenges/barriers to members' participation in the CoP?

In this paper, we define and summarize key outcomes (*value creation cycles*) of CoPs. Next, we highlight key elements and outcomes of Networked Improvement Communities (NICs), which are a specific type of CoP that served as a model for our learning network. We then describe our CoP design. In the results, we summarize the outcomes of participation gleaned from quantitative surveys administered at the conclusion of the network. Finally, we share lessons learned about facilitating a CoP focused on evaluation and program improvement.

1.1. Communities of practice

A CoP is a group of people who work together toward a shared goal or joint enterprise, building knowledge and developing expertise through interactions (Lave & Wenger, 1991; Wenger, 1998). Group members share ideas and resources, solve problems and discuss aspirations. These interactions among members can build trust and social cohesion, leading to a sense of community. Shared practices within the community (e.g., routine activities and demonstrations of expertise) can lead to new knowledge and insights (Iyalomhe et al., 2013). Participants can engage in a CoP to varying degrees based on their goals, interests and levels of expertise (Dennen, 2019). Wenger and others (2011) developed a conceptual framework for the development and evaluation of effective CoPs. CoP outcomes fall within five cycles of value creation (Table 1).

Networked Improvement Communities (NICs) are a specific type of CoP intended to "situate practice improvement efforts in a supportive social architecture to accelerate a field's capacity to learn and improve" (Russell et al., 2017, p. 3). Social networks such as NICs can enhance the development and spread of innovations (Russell et al., 2017; Valente, 1995). One study of teachers who participated in professional learning networks identified several benefits, including improved motivation and positive affect, overcoming isolation, hearing from diverse perspectives, and gaining ideas and teaching strategies (Trust

et al., 2016).

In NICs, practitioners from multiple organizations work to understand a problem of practice with a goal of uncovering practical solutions that may be transferable to diverse contexts. Applied researchers participate and contribute to NICs by anchoring innovations in the research-base of their disciplines. These researchers can serve as network facilitators and can help facilitate learning by providing analytic support, shared data and common measures. The NIC model has been used to improve: beginning teachers' performance (Hannan et al., 2015); performance of community college students in introductory math classes (Yamada, 2014); writing instruction (Whitney, 2008); and literacy skills (Peurach, 2011). The participants in our network were nonformal environmental educators, who were all striving to design and refine effective online programs during the COVID-19 pandemic. Nonformal environmental education is defined as "any organized educational activity about the environment that takes place outside the formal education" (North American Association for Environmental Education, 2009, p. 16). Nonformal EE takes place in settings such as parks, zoos, nature centers, community centers or summer camps. We used elements of NICs in the design and implementation of a CoP focused on evaluation capacity building, adaptive management, and programmatic improvement.

1.2. Program Evaluation in EE

Program evaluation in EE can serve many purposes. Evaluations can be summative, for judging or reporting whether organizational goals have been met, or formative, where information gleaned from evaluation results can lead to programmatic improvements (Heimlich, 2010). Organizations rarely have the time, resources, or capacity to conduct formal evaluations on their own, and often struggle to use evaluations for program improvement (Anderson, Stern, & Powell, 2022; Powell, Stern, & Ardoine, 2006; Chaudhary et al., 2020; Fleming & Easton, 2010; Keene & Blumstein, 2010; Norton et al., 2016). External evaluators can be hired to conduct evaluations, but are often expensive (Bronte-Tinkew et al., 2007), and evaluation efforts are more often summative than formative (Carleton-Hug & Hug, 2010). Moreover, evaluation results often apply only to a single organization at a particular point in time, and thus it is difficult to apply these results and draw broader lessons that may be transferable to other contexts. Adaptive management has been used successfully to improve the management of social-ecological systems (e.g. Fujitani et al., 2017; Weeks & Jupiter, 2013; Westgate et al., 2013). This approach is less common in EE, but shows promise for improving practice (Buchan, 2004; Burger et al., 2004; Jenks et al., 2010).

1.3. Evaluation capacity building

Evaluation capacity building provides practitioners with knowledge, skills, tools, and, ideally, practice to better understand the role of evaluation in adaptive management. Developing evaluation capacity can be challenging for a variety of reasons. Chaudhary et al. (2020) conducted a Delphi study to shed light on the evaluation capacity building challenges faced by evaluation specialists within non formal education organizations and to explore effective strategies for overcoming these challenges. A few key challenges they identified include:

- Educators have limited time and resources and competing demands.
- Evaluation is often an afterthought rather than integrated into the programmatic process.
- Evaluators misunderstand the value of evaluation to program improvement.
- Organizations lack sufficient budgets to facilitate systematic evaluation and evaluation capacity building.

Chaudhary et al. (2020) and Anderson, Stern, & Powell, 2022;

Powell, Stern, & Ardoine, 2006 have suggested several useful strategies to overcome these challenges, including: providing evaluation training to program administrators (not just educators); providing applied, hands-on evaluation training connected to educators' actual programs; creating a peer learning network where educators share best practices and lessons learned; and changing the mindset toward evaluation by helping educators see its value for program improvement, not just reporting. Following these recommendations, we developed and facilitated an EBLN focused on 1) building the evaluation capacity of environmental educators, and 2) improving online EE programming for youth in the United States.

2. Methods

The EBLN focused on the development, evaluation and adaptive management of distance-learning programs for youth provided by 37 diverse nonformal EE organizations in the United States between September, 2020 and September, 2021.

2.1. Design of the EBLN

Originally, 44 organizations (72 individuals) that were developing and providing online programs for youth in grades 5–12, including national parks, state parks, nature centers, aquariums and zoos, and ecological research centers, volunteered to participate in the CoP. Seven of the initial 44 organizations left the CoP before the spring season, leaving 37 organizations with 63 individuals that participated to varying degrees. Reasons for attrition included staffing changes, lack of capacity, and program changes. The overall design for this CoP involved regular meetings to build capacity and provide a forum for participants to discuss and exchange ideas along with cyclical evaluations of programs. For the evaluations, we collected data immediately following programs using a consistent online retrospective survey comprised of 12 outcomes associated with environmental literacy (Powell, Stern, Frenzley, & Moore, 2019), which made it possible to compare student outcomes across the diverse programs in the network.

To begin the process, we met with each organization individually to identify one or two programs for evaluation. We then collaboratively developed a sampling plan (generally either a census or systematic sampling approach) for program participants and discussed online survey data collection protocols including introductory scripts, considerations pertaining to the ethical treatment of human subjects, survey administration timing, and overcoming challenges such as firewalls in school districts and availability of computers (home programs vs. in-classroom programs on large screens). An online survey link was created in Qualtrics for each program and shared with each organization.

Survey administration was managed by each organization and occurred during Fall 2020 and Spring 2021. At the end of each season (fall or spring), we analyzed the data for each organization and developed a confidential evaluation report that summarized demographic information about their youth participants, their mean scores for each outcome, and a comparison of their organization's mean outcomes scores with the overall mean of all organizations within the network (see example in appendix-not included for blind review). Organizations that were unable to collect data still received a report with the network mean scores and basic programmatic outputs (e.g., numbers of programs, students served, etc.) to aid in discussions and build capacity for reading and interpreting evaluation reports.

Facilitating online data collection in the midst of the pandemic proved challenging with issues such as time for survey completion, firewalls in school districts that would not allow the survey to open, and availability of computers or tablets for each student. These challenges resulted in small evaluation sample sizes for most organizations; only a few groups obtained greater than 50% response rates. Despite these challenges, 28 organizations collected data from 57 programs and 4100

students.

In addition to the evaluation components of this project, we also provided regular opportunities for peer-to-peer learning through monthly online meetings and two learning exchanges. Monthly meetings were facilitated by the research team and focused on building evaluation capacity, discussing evidence-based instructional practices that have been demonstrated to enhance student learning outcomes and providing opportunities for participants to share their own emerging lessons from their experiences with distance EE with each other (see Table 2 for list of topics and timeline of events). A two-part learning exchange occurred after each evaluation cycle (fall and spring). These learning exchanges reflected upon evaluation results and involved detailed discussions and brainstorming on potential evidence-based strategies for programmatic improvement.

2.2. Adaptive management components: first data collection cycle

We asked participants to share their confidential evaluation reports internally with their education teams and meet to reflect on the results. For many organizations, this was the first time they had received systematic evaluation feedback from students on their programs. The comparison of their program's performance against similar programs within the CoP enabled these organizations to identify strengths and areas for growth. Many had questions about how the data were analyzed, how to interpret their results, and which practices would help them attain better outcomes. These questions were discussed in calls with the lead facilitator (first author) and in the learning exchanges.

After each season of data collection, the online learning exchange (two 2-hour sessions within a week) focused on further building evaluation capacity, interpreting data, and leveraging data to inform the improvement of programs. During the first learning exchange session, we summarized results from across the CoP and reviewed evidence-based practices from relevant published research for them to consider as they identified potential program adjustments. Next, participants considered what outcomes mattered most to their organization, and

Table 2
Timeline of evaluation activities, meetings and learning exchanges.

Dates	Key Events
July – September, 2020	<ul style="list-style-type: none"> • Network setup • Meeting 1: Orientation and Logistics
October, 2020	<ul style="list-style-type: none"> • Meet with each organization to learn about their programs and develop a sampling plan • Train participants in data collection • Begin data collection • Meeting 2: Technology Tools
November, 2020	<ul style="list-style-type: none"> • Meeting 3: Actively Engaging Learners Part 1 • Continue data collection
December, 2020- January 2021	<ul style="list-style-type: none"> • Data analyses and report writing • Meeting 4: Actively Engaging Learners Part 2
February, 2021	<ul style="list-style-type: none"> • Learning Exchange 1 (Two 2-hour sessions) • Meet with each organization to discuss program modifications, • Review data collection procedures • Informal survey to understand participant experiences
March, 2021	<ul style="list-style-type: none"> • Begin round 2 of data collection • Begin developing website to illustrate best practices within the network • Meeting 5: Building partnerships and finding participants
April- May, 2021	<ul style="list-style-type: none"> • Continue data collection • Session 6: Social and Emotional Learning in Virtual EE • Meetings 7-9: Program Sharing by Participants
June-July, 2021	<ul style="list-style-type: none"> • Data analyses and reporting
August -September, 2021	<ul style="list-style-type: none"> • Second Learning Exchange (Two 2-hour sessions) • Participant survey

what program elements could be added or adjusted to help improve their program's performance. We encouraged participants to focus on manageable changes, which were often small tweaks to programs (e.g., adding an introductory lesson or modifying a specific activity), rather than large-scale changes. They then met in breakout groups with other educators to brainstorm ideas and strategize about plans for program improvement. After the first session, each organization developed an adaptive management plan. In their adaptive management plans, participants addressed the following key questions:

1. What changes in your program will you implement as a result of the learning exchanges? (Be specific and number each change by program).
2. What specific outcome(s) do you think will be enhanced by implementing each change?
3. What specific steps (i.e., training educator staff, curriculum changes, use of new technology, etc.) will you take to implement these changes?
4. What is the timeline for implementation of changes, and who will work on these changes?

During the second learning exchange session later the same week, we met again in breakout groups, and each organization shared their plans with others, receiving feedback before they finalized their adaptive management plan. Next, each organization implemented program adjustments before resuming evaluation data collection during season two (spring 2021).

To further support the participating organizations, we developed a [website](#) hosting resources and information regarding relevant research on what works best in EE and remote learning, examples of programs that utilize these techniques, and best practices for sampling, collecting data, interpreting results, and using data to inform programmatic improvement.

2.3. Adaptive management components: second data collection cycle

After the programs were revised, we repeated a second cycle of data collection, analysis, reporting, and reflection. We refined sampling strategies and data collection plans with each organization for the Spring 2021 season. We had originally hoped that the organizations would collect data from the same program in each season to directly assess the influence of adaptations on participant outcomes. However, some organizations offered different programs in the Spring than in the Fall. Thus, some groups were able to collect data on the same program after revisions were made and compare results, while others could not. Once again, each group received a confidential report and then reflected with colleagues. During this cycle, we also provided opportunities for members to participate in each other's online programs and provide feedback. During the final learning exchange, we reflected together on the second round of aggregated evaluation data. We also continued discussions and sharing of best practices for virtual programs, with an emphasis on elements of culturally responsive programming due to emerging work highlighting the need for training in this area across the EE field (Anderson, Stern, & Powell, 2022). Finally, we shared evaluation tools and strategies for participating organizations to use in the future.

2.4. EE Organization/participant survey

At the end of this yearlong experience, we distributed an online questionnaire to all EBLN participants to evaluate their experiences in this CoP. The survey included sociodemographic questions, questions about their level of participation and barriers to participation, and assessments of the outcomes of participation, which were aligned with cycles of value creation for CoP evaluation (Table 1) and included questions about immediate and potential value; application of learning and changes in practice; and organizational change (See Tables 3–5). We

Table 3
Cycles 1 and 2 of Value Creation through Network Interactions and Activities.

Cycles, Constructs, and Questions	Mean (SD)	Attendance at monthly meetings <i>r</i>	Attendance at learning exchanges <i>r</i>
Cycles 1 and 2: Immediate and Potential Value (Activities and Interactions that Build Knowledge Capital)			
Social Capital¹			
I felt a sense of companionship in facing challenges of distance learning.	8.48 (1.65)	.36	.28
The network enabled me to find a community of people with whom I can share ideas.	7.81 (2.22)	.43*	.38
I felt supported by other members of the network.	7.74 (1.89)	.33	.26
I have made useful connections with others in the network.	7.30 (2.15)	.45*	.38*
Human and Learning Capital Resource and Idea Exchange²			
The resources shared in the network were relevant to my work.	8.78 (1.21)	.43*	.41*
I received useful suggestions from the network.	8.67 (1.21)	.32	.35
I have learned new teaching strategies.	8.26 (1.79)	.55**	.57**
Evaluation Skills³			
Identifying outcomes for our programs	8.08 (1.92)	.33	.42*
How to use evaluation data to better understand our program impacts	7.92 (1.88)	.21	.36
How to use evidence to make adjustments to our programs	7.88 (2.07)	.26	.37
How to interpret evaluation results	7.50 (1.73)	.14	.36
How to measure program outcomes	7.46 (2.21)	.30	.47*
How to collect valid data	7.23 (1.84)	.14	.28
Evaluation Attitudes⁴			
I am more likely to want to participate in evaluation activities for my programs in the future.	8.59 (1.67)	.49**	.34
My attitude towards evaluation is more positive than before participating in this network.	8.26 (1.7)	.26	.49*
I feel more prepared to work with external evaluators in the future.	8.19 (1.96)	.44*	.63**
I feel more confident in my ability to conduct evaluation activities.	7.56 (2.34)	.18	.26

* $p < .05$, ** $p < .01$, *** $p < .001$

Notes: All survey questions used a 0–10 scale with 3 anchors (see below for questions connected with each statement, by number).

¹ To what extent is each of the following statements regarding your participation in the network true for you? (anchors: not at all; somewhat; totally)

² As a result of participating in this learning network, how much do you agree with the following statements? (anchors: not at all agree, somewhat agree, strongly agree)

³ How much have you learned about each of the following through your network experiences? (anchors: not at all agree, somewhat agree, strongly agree)

⁴ As a result of participating in this network, how much do you agree with the following statements? (anchors: not at all agree, somewhat agree, strongly agree)

also asked open-ended questions about what ideas or skills learned from this CoP would be most useful in the future, whether they had shared ideas and resources within or outside of their organizations, their suggestions for improving similar networks in the future, and any additional

Table 4
Cycles 3,4 and 5 of value creation through network interactions and activities.

Cycles and Questions	Mean (SD)	Attendance at monthly meetings <i>r</i>	Attendance at learning exchanges <i>r</i>
As a result of participating in this learning network, how much do you agree with the following statements? (anchors: not at all agree, somewhat agree, strongly agree)			
Cycle 3 Changes in Practice			
I have tried new techniques in my programs that I learned in this network.	7.96 (1.99)	.51**	.55**
I have implemented suggestions made by others in the network.	7.48 (1.93)	.37	.30
Cycle 4 Performance Improvement			
I have improved my teaching because of what I have learned in the network.	8.04 (2.12)	.39*	.39*
My organization has more clearly identified the goals of our programming	7.00 (2.50)	.18	.34
Cycle 5 Redefining Success			
I have reconsidered what a successful program looks like as a result of participating in the network. ²	7.70 (2.25)	.18	.40*
My organization has reconsidered the importance of evaluation to enhance our programming.	7.30 (2.74)	.17	.36

* p < .05, ** p < .01, *** p < .001

Table 5
T-test results comparing full participation in adaptive management to other participants (Only statistically significant findings are reported).

CoP Outcomes	Full participation ¹ Mean (SD)	Partial participation Mean (SD)	t	p	Cohen's d
Cycles 1 and 2					
I received useful suggestions from the network.	9.36 (1.03)	8.19 (1.11)	2.79	.01	1.08
How to use evidence to make adjustments to our programs	8.82 (1.33)	7.20 (2.27)	2.11	.046	1.94
Cycles 3 and 4					
I have implemented suggestions made by others in the network.	8.64 (1.36)	6.69 (1.89)	2.93	.007	1.70
I have improved my teaching because of what I have learned in the network.	9.27 (1.42)	7.19 (2.13)	2.83	.009	1.88
I have tried new techniques in my program that I learned in this network.	9.09 (1.58)	7.19 (1.91)	2.73	.01	1.78

¹Full participants (n = 11) were those who collected fall data, made program adjustments based on results from evaluation reports, and then collected spring data. Other participants either participated in data collection for just one season (n = 13) or not at all (n = 4).

feedback they wanted to provide.

2.5. Data analyses

Survey results were downloaded from Qualtrics to an SPSS 27 file. To answer our first research question about outcomes, we analyzed

descriptive statistics of all survey items. To explore relationships between levels of participation and outcomes, we used two approaches. We examined bivariate correlations between the number of meetings attended (monthly meetings and learning exchanges) and outcomes (Tables 3 and 4). We also used independent sample t-tests to compare outcomes for those who completed the full adaptive management process compared to those who did not (Table 5). The full adaptive management process consisted of data collection in both rounds, with alterations to the program made after receiving the first report to evaluate the impacts of these changes in round two. To further answer research questions 1, 2, and 3, we used thematic analysis to analyze responses to open-ended questions (Braun et al., 2018). The first author developed codes that aligned with key constructs in guiding literature. We iteratively refined codes and their definitions as a team (Creswell & Miller, 2000).

3. Results

Twenty-eight out of 63 network participants (44 %) responded to the CoP retrospective survey. These participants included 25 females and three males. Twenty-five participants were white/Caucasian. Two identified as Latinx/Hispanic, one identified as Middle Eastern, and one identified as Asian. Twenty-two were program managers or education coordinators, and six were educators/interpreters. Overall, this group of respondents was generally representative of the sociodemographic backgrounds and roles of the broader participants in this CoP.

4. Immediate and potential value

Table 3 includes survey items and mean scores for all outcomes related to immediate and potential value. The two most positively scored items included 'the resources shared in the network were relevant to my work' and 'I received useful suggestions.' The two lowest scored items included how to collect valid data and 'I made useful connections with others in the network.' All items scored well above the midpoint of 5 on the 0-to-10 scale.

Responses to open-ended questions provide some additional nuance to these quantitative trends. Themes related to Immediate and Potential Value included: social capital development, resource and idea exchange, evaluation skills, and evaluation attitudes.

4.1. Social capital: feelings of connection and inspiration

Participants reported feelings of camaraderie and inspiration throughout a difficult year of the pandemic. Eleven educators mentioned the value of connecting with others. For example, one person responded, "I also really appreciated an opportunity to gather with colleagues who were experiencing similar challenges, frustrations, and opportunities. I think it helped me to proceed with more grace and be gentle with myself, and it was inspiring." Three others also mentioned being inspired by their peers, and three more also mentioned the importance of being with others who shared the same challenges.

4.2. Resource and idea exchange: learning about principles of effective programs

Fifteen participants discussed the value of sharing resources and ideas. In particular, they appreciated the presentations, discussions, and examples of evidence-based teaching principles. One participant reported "a deeper understanding of the elements of program design and, perhaps most reassuring, not all of them need to be undertaken at one time for program improvements." Examples included ideas for active engagement of students, integrating social and emotional learning, and enhancing cultural relevance. One participant mentioned, "the importance of preparation as a part of the learning cycle; autonomy; understanding what it means to actually facilitate a sense of place." Two

participants mentioned the value of sharing programs with each other. For example, one wrote, "I really appreciate the efforts to make full programs available. This is the best way to get new ideas and see in action what is working for others."

4.3. Evaluation skills: considering new outcomes and program changes that lead to those outcomes

When asked about skills and knowledge that will be useful in the future, eight educators discussed a new focus on aspiring to reach different outcomes in programs. One participant expressed appreciation of the survey outcomes directly, "getting familiar with the EE21 outcomes was fantastic." Another mentioned considering a different outcome for a program, moving beyond knowledge to stewardship: "rather than just focusing on the topic, making sure the students get the bigger take away - like environmental stewardship." Three referenced a key adaptive management skill – linking program elements to outcomes, for example, "finding ways to intentionally structure the program to match our desired outcomes," and "small changes in presentation can have large impacts on engagement and outcomes."

4.4. Evaluation attitudes: the value of evaluation

Five participants articulated the value of evaluation. One noted that "evaluation is an organizational culture and part of the growing and learning process." Another highlighted "the value of evaluations, we'll be incorporating those into our future programming." One organizational leader discussed how the network had helped others in her organization change their attitudes towards evaluation. She wrote, "I have a strong foundation in evaluation and have been promoting a culture of evaluation in my organization for many years - but by having other staff participate with me in this program has helped them understand the value of evaluation tremendously and has given us common language to discuss our programs and desired outcomes." Four participants expressed a desire to continue the network. For example, one educator wrote, "I wish The Learning Network could continue! I'd love to continue to share ideas, best practices, and examples! This has been extremely worthwhile. I feel I could still learn a lot from the process and have just started to dive into it. This year went by very fast for me in regards to this network."

4.4.1. Cycles 3–5: applied, realized and reframing value

Table 4 includes descriptive statistics for individual questions that assess Value Creation Cycles 3, 4 and 5. Participants reported changes in practice, performance improvement, and redefining success. The two most positively scored outcomes were 'I have improved my teaching because of what I have learned in the network' and 'I have tried new techniques in my program that I learned in this network.' The two lowest scored items were 'My organization has more clearly identified the goals of our programming' and 'My organization has reconsidered the importance of evaluation to enhance our programming,' although both were scored above 7 on a 10-point scale.

4.5. Program improvement, direction, and inspiration

Open-ended comments referenced changes in practice, performance improvement and/or redefining success in their open-ended survey responses. One education coordinator mentioned several changes in practices, "We have already begun to incorporate many of the practices and principles we learned into our in-person programming. I imagine I will refer to the website to review the principles as I develop lesson plans and train our PT educators. We plan to use the in-person paper survey for every in-person grade 5 + program we lead this season." Another network participant mentioned goal setting, stating "I think having the list of the defined outcomes on paper clearly spelled out is HUGE for me! These really help me focus in on my goals for specific programs and give

me something specific to evaluate with." With regard to performance improvement, a network participant said, "This is SO valuable and helps us improve and serve students and teachers better!" One participant used language from value creation cycle 5 when she said, "I learned so much and was inspired by all the other organizations. It's so easy to get jaded and burnt out in this field. It reignited my passion for EE and helped me to redefine the term success."

4.6. Sharing ideas and resources beyond the network

Twenty-five participants reported that they had shared resources or ideas from the network with others in their organizations, and seven reported sharing network resources with others outside of their organization, including educational partners, regional educator groups, and undergraduate students. Specific resources they shared included evidence-based teaching practices and principles, our website with examples of effective practices, the outcomes and survey questions, the evaluation reports they received from our team, data collection strategies, and stories about program improvements from network educators. One administrator reported, "We used some of the best practices identified in the first learning exchange to create a template for things to think about when staff are creating virtual learning opportunities."

4.6.1. Participation in the network

On average, survey participants attended six out of nine monthly meetings (range = 1–9) and 3 out of 4 (range from 1 to 4) learning exchange meetings. Eleven members participated in the full adaptive management process, which included two rounds of data collection with program adjustments made after receiving the first evaluation report. Nine collected fall data only. Four collected spring data only, and four of the respondents did not collect data. Survey respondents overall were more engaged in the network than nonrespondents; over half of network members who had completed 1 or 2 rounds of data collection responded to the survey, while only 22 % of those who were less involved in evaluation processes responded to the survey.

4.6.2. Outcome variability based on level of participation

We examined whether outcomes varied based on level of participation (Tables 3–5). Bivariate correlations in Tables 3 and 4 show that higher participation in monthly meetings was positively correlated with six outcomes measures in Value Creation Cycles 1 and 2 reflecting social capital, resource and idea exchange, and evaluation attitudes, and two measures in Cycles 3 and 4, reflecting trying new techniques in EE programs and improved teaching. There were no statistically significant relationships between monthly meeting participation and questions related to enhancing evaluation skills or redefining success (cycle 5). Attending more learning exchange sessions was associated with positive outcomes across all five value creation cycles, including enhancing evaluation skills and redefining success.

Table 5 shows statistically significant differences in outcomes between the eleven participants in the full adaptive management process and the rest of the network members. Those who fully participated in adaptive management reported more positive outcomes for five items across value creation cycles 1, 2, 3 and 4. No statistically significant differences were observed for Cycle 5 outcomes.

Overall, more complete participation was linked to more positive outcomes. Two open-ended comments from the survey further supported these findings. One participant who joined the network late, after the first few meetings, wrote, "I felt like I was trying to play catch up the whole time and wasn't able to fully grasp everything." Another participant said, "I regret that I couldn't participate in more of the learning network this year, but I found it very informative, insightful, and inspiring. I would love to be able to participate in something like this again when I don't feel like I'm just trying to survive a crisis." This participant's statement is a reminder that full participation was challenging for many during the pandemic.

4.6.3. Barriers to evaluation

Table 6 summarizes respondents' assessments of key barriers to participation in the evaluation component of the CoP. The most noted barrier was coordinating survey administration with teachers and schools that participate in their programs. Other barriers were reported to a lesser extent with mean scores below the midpoint (5) on the 0–10 scale.

5. Discussion

We designed this CoP with the goals of improving virtual EE programs and building evaluation capacity. We applied a Community of Practice framework (Wenger et al., 2011) to evaluate the experience. Participants reported positive outcomes across Wenger's five cycles of value creation, which included measures of social capital, human and learning capital (resource and idea exchange, evaluation skills and attitudes), changes in practice, performance improvement, and organizational change. Those who attended more meetings and/or participated more fully in the adaptive management learning process benefited more from the experience.

We used several strategies suggested by Chaudhary et al. (2011) to enhance evaluation capacity building, including creating a peer learning network that provided opportunities for educators to 1) share practices and lessons learned, 2) put program evaluation training into practice, and 3) use evaluation results to inform program improvement. Other NICs have been typically conducted in formal education contexts (Russell et al., 2017). Our design approach aligned with NIC processes in several ways. We created a supportive community that encouraged sharing of ideas and resources, provided analytic support, and gave participants data to reflect on as they designed program innovations. The community included researchers and practitioners, and each group contributed to the processes that led to capacity building and program improvement. The use of a common outcome measure allowed educators to reflect together on shared goals, and to consider together which program elements might lead to better outcomes. Thus, we posit that this CoP model focused on adaptive management is a promising approach for building evaluation capacity in other nonformal EE communities. However, we are unsure of which network elements led to the reported outcomes. Future work is needed that better unpacks the specific mechanisms that lead to positive changes.

5.1. Lessons learned and implications

Five key lessons that can help guide similar networks in the future are summarized below. These perspectives come from our reflection on survey responses, our participation in breakout groups during monthly meetings and learning exchanges, and conversations with participants throughout the year.

5.2. Thinking aspirationally about outcomes

Educators in our network appreciated the opportunity to consider

Table 6
Barriers to Participation.

Survey questions	Mean (SD)
(On a scale from 0 to 10, how much do you agree with the following statements about your organization? 0, not at all agree, 5, somewhat agree, 10, strongly agree)	
Staff have difficulty coordinating survey participation with teachers and schools.	6.30 (2.67)
Staff have inadequate time to participate in evaluation activities	4.52 (1.99)
Staff have difficulty recruiting participants for our programs	4.00 (2.92)
Staff turnover limits our ability to participate in evaluation activities.	4.00 (3.54)
Staff have negative feelings about evaluation.	3.48 (2.61)
Participating in evaluation activities takes away time that could be spent on programming.	3.41 (2.52)

outcomes that they had never assessed or strived for in their programs. The survey that we used assessed 12 different outcomes, extending beyond factual knowledge to skills, attitudes and behavioral intentions. This shift is important, since EE programs typically focus more on knowledge acquisition than other outcomes that are more critical components of environmental literacy (Anderson et al., 2022; Stern et al., 2014).

5.3. Learning about evidence-based practices

Many network participants reported that they enjoyed learning about and applying evidence-based practices from research to their programs. These principles from prior research (Merritt et al., 2022; Powell et al., 2023; Stern et al., 2014) were shared by network leaders early in the first months of the network and discussed throughout the year. Environmental educators and evaluators have accumulated a lot of knowledge about practices that lead to better outcomes for students (e.g. Jorgenson et al., 2019; Merritt et al., 2022; Powell et al., 2023; Stern et al., 2014). For educators to utilize their evaluation results to inform programmatic improvement, having a solid understanding of evidence-based practices can be an important part of completing the adaptive management cycle. Participants' strong interest in each other's programs led us to develop a website highlighting examples of these practices, and to set up meetings where educators shared their full programs. Through the website and full program exemplars, educators got new ideas and reflected on applications to their own programs. Without knowledge and concrete examples of best practices, educators may waste time trying ineffective strategies that do not lead to better outcomes.

5.4. Spread of innovation

Our results align with prior research showing that CoPs can enhance the development and spread innovations (Russell et al., 2017; Valente, 1995). Our survey results also showed that many participants shared resources and ideas both within and beyond the network. The timing of this network may have further catalyzed idea sharing and rapid spread of innovation; the start of a global pandemic necessitated a transition to online EE, and many organizations were in the midst of designing new programs. We had some experienced online program developers in the group who served as resources to those who were just getting started.

We suggest that other network leaders should consider networks focused on problems of practice that matter to educators. For example, culturally responsive practices or climate change education initiatives may be topics of interest that inspire educators to participate in a CoP and take up and spread innovations quickly.

5.5. Researcher-practitioner partnerships in innovation

We started the network with the goal of building a community of diverse participants who had a variety of skills and knowledge to contribute to the group. After the first round of meetings and learning exchanges, we better understood the strengths and skills that many educators brought to the group. In the second round of meetings and data collection, we made an effort to shift away from having our research team lead monthly meetings to scheduling panels and individual presentations from educators during each session. By the end of the year, we were co-creating the meeting agendas, and co-constructing knowledge about the application of evidence-based practices in virtual settings. A CoP that included applied researchers and practitioners allowed for active translation of research into practice. This approach aligns with the synergistic partnerships described by Russell et al. (2017) in NICs.

5.6. Evaluation capacity building

Program evaluation requires extensive knowledge and skills. Most formal evaluators have advanced degrees and have spent many years learning and applying research methods (Christie et al., 2014). Our approach to capacity building helped develop skills in adaptive management, which is a holistic approach to evaluation that can lead to program improvement. We focused on data collection processes, interpretation of results, and use of results to improve practice. Our findings showed that many participants' evaluation skills and attitudes, as well as their ability to interpret and apply evaluation results for programmatic improvement, improved through our process. As the network wrapped up, participants showed variability in their readiness to conduct their own rigorous evaluations.

Many participants expressed interest in continuing the network. While the funding for this project did not allow for an extended duration, many CoPs-NICs work together for several years which can further enhance knowledge and skill development over a longer period of time (Hannan et al., 2015; Russell et al., 2017; Yamada, 2014).

6. Limitations

This CoP-NIC occurred during a global pandemic and forced transition to online learning, which provided a unique context for this effort and subsequent evaluation. This network was funded for only one year, skill development and relationship building are typically enhanced with longer duration NICs. Similar efforts in the future should consider how to sustain relationships over several years, despite funding limitations and staffing changes.

Only 44 % of participants responded to our end-of program survey. The group of survey respondents was generally representative of sociodemographic backgrounds and organizational roles of network participants. However, survey respondents were generally more involved in evaluation activities than nonrespondents.

Finally, key challenges for organizations included how to collect valid data from student participants in online educational programs. Because of these challenges, we were not able to draw clear conclusions about whether program improvements led to more positive student-reported outcomes.

7. Conclusion

Overall, this CoP proved a valuable approach for (1) shifting attitudes about evaluation from a required element of reporting (for accountability) toward a promising way to develop clear goals and improve programs' abilities to achieve them (for improved organizational performance and adaptive management); (2) building new relationships between practitioners that both enabled the sharing of effective practices and innovations and providing camaraderie through a challenging period (COVID-19); and (3) developing new understandings and capacity in evaluation. We hope that other researchers will utilize the lessons of this CoP and partner with practitioners to form other CoP-NICs to support the improvement of environmental education programs worldwide. Also, since the most positive outcomes came from more engaged participants, a smaller network of committed educators may be more fluid and efficient than a larger network.

CRediT authorship contribution statement

Eileen G. Merritt: Project Administration, Investigation, Writing-Original Draft Preparation, Data Management and Analysis. **Marc J. Stern:** Conceptualization, Funding Acquisition, Investigation, Writing-Review and Editing. **Robert B. Powell:** Conceptualization, Funding Acquisition, Investigation, Writing- Review and Editing. **B. Troy Frenzley:** Investigation, Writing- Review and Editing.

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