

ABSTRACT

GIBSON, LAUREN MARY. Moving Beyond the Individual: Understanding Community-Level Environmental Literacy and its Link to Collective Action. (Under the direction of Dr. Kathryn Stevenson).

With the planet facing a number of massive socio-environmental challenges—from climate change to environmental injustices to water quality issues—there is an ever-increasing need for positive environmental change. Environmental education presents one avenue for such change. Environmental education works to build environmental literacy in people of all ages both inside and outside of the classroom, fostering knowledge, attitudes, skills, and behaviors that empower individuals to take pro-environmental action. However, environmental education, both in practice and as a field of research, tends to conceptualize environmental literacy and its ensuing behaviors at the individual level. This approach may fall short of the one needed today, given the scope of the earth's problems. These large-scale environmental challenges instead call for large-scale solutions in the form of collective environmental action: actions that occur when people come together to push toward a shared environmental goal.

This research seeks to add to the environmental education field's understanding of collective environmental action and the community-level environmental literacy (CLEL) that precedes it. To add to the conversation on CLEL as a theory, a Delphi study of 25 environmental education scholars was conducted, generating a proposed framework for the conceptualization and measurement of CLEL. This framework focuses on collectively-held knowledge, the value of community connections, intentional inclusion of diverse community perspectives, and deep understanding of community. To contribute empirically to the field's understanding of collective environmental action, models predicting various types of pro-environmental behaviors in high school students were developed. These models were first built using a combination of two

traditional frameworks of behavior prediction: the theory of planned behavior and the environmental literacy framework. Models based on these frameworks used traditional behavioral antecedents of affect (environmental hope, environmental hopelessness, response efficacy), subjective norms, and perceived behavioral control, along with socio-demographic factors. While the models built using these behavioral antecedents were able to effectively predict individual, private-sphere pro-environmental behaviors, they were far less effective at predicting collective pro-environmental behaviors (both collective activist behaviors that seek to change systems and collective non-activist behaviors that seek to change others' behaviors).

In search of a better-suited model for collective environmental behavior, social capital was tested as a behavioral antecedent in addition to and in place of the traditional behavioral antecedents mentioned above. Social capital—conceptualized here as community trust, social networks, and perceived power in the community—was able to predict high school student engagement in collective behaviors substantially better than the previously tested traditional models, but the predictive power still fell short of the traditional models' ability to predict engagement in individual private-sphere behaviors. These findings indicate that additional work is needed to clarify the drivers of collective environmental action, as its behavioral antecedents are clearly different from those of the individual actions on which environmental education scholars have historically focused.

As a whole, this dissertation offers a theoretical framework for community-level environmental literacy and its measurement, and it demonstrates that the social factors emphasized in that framework may be important predictors of collective environmental action.

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Moving Beyond the Individual: Understanding Community-Level Environmental Literacy and
its Link to Collective Action

by
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A dissertation submitted to the Graduate Faculty of
North Carolina State University
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

Parks, Recreation, and Tourism Management

Raleigh, North Carolina
2023

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DEDICATION

This work is dedicated to everyone who helped me in my environmental journey. Your support helped transform me from a disheartened polar-bear-loving middle schooler into an outspoken youth activist and, now, into an outspoken adult advocating for youth empowerment. I am truly grateful for each and every one of you. Thank you.

BIOGRAPHY

Lauren's passion for the environment began in middle school when she first heard Dr. Jane Goodall speak. Less than a year later, Lauren had founded a by-youth, for-youth micro-grant program to provide students in central Indiana with the support they need to lead their own community-based environmental projects. After passing the program onto the next generation of young leaders, Lauren left for Stanford University, where she earned a master's degree in environmental communication and a bachelor's degree in Earth Systems.

In her dissertation work at North Carolina State University, Lauren studies what drives young people to engage in collective environmental action—the type of high-impact action that has the power to change entire communities. She also works part time for the National Oceanic and Atmospheric Administration (NOAA) Office of Education, where she leads the office's first youth summit.

ACKNOWLEDGMENTS

My sincerest thanks go out to Dr. Kathryn Stevenson, my committee chair and the fearless leader of the NC State Environmental Education lab. You somehow manage how to be super relaxed, incredibly productive, and fiercely supportive of your graduate students all at the same time. I am so grateful for all of your guidance, patience, and grace throughout the highs and lows of doing school-based research amidst a global pandemic, and I feel like I learned about far more than just environmental education research with you as my mentor. Thank you.

Thanks, too, to my wonderful committee members Dr. K. C. Busch, Dr. Bethany Cutts, and Dr. Erin Seekamp. You each brought something unique and deeply thought-provoking to this dream team of a committee, and my work and my thinking are better for it. K. C., you were the TA for my first environmental education course in my undergraduate years at Stanford, and you taught my last environmental education class of my PhD here at NC State. Thanks for helping me grow and for showing me what effective pedagogy looks like in the classroom. Bethany, your thoughtful questions always have me delving into new areas of research and reflecting on who I am as a researcher. Thank you for always leaving me scratching my head, in the best possible way. Erin, your attention to language and detail keeps me on my toes, and I am so grateful to have your brain and perspective on this committee. Thanks for everything.

To my collaborators at the Duke University Marine Lab, particularly Dr. Liz DeMattia, and all of the teachers who participated in this research: none of this could have happened without you. Your willingness to create, test out, and continuously refine the water quality curriculum used in this dissertation work made it all possible. (It certainly didn't hurt that we had some amazing times out in Beaufort, too.) Thank you, too, to the scholars who participated in the Delphi study. What a privilege to get to interact with and learn from you all!

My gratitude goes out to the funders of this research and of my graduate studies as a whole. Funding for the empirical portion of this research, as well as funding for my assistantship, came from North Carolina Sea Grant and was supplemented by the North American Association for Environmental Education (NAAEE) 30 Under 30 Changemakers Grant. On the theoretical side of this dissertation, funding came from the Faculty Research and Professional Development Program within NC State's College of Natural Resources to help us bring people together to begin conceptualizing community-level environmental literacy. Thank you to all of these funders for making these studies possible. I would also like to acknowledge NC State's University Graduate Fellowship, NC State's Provost's Doctoral Fellowship, the North Carolina Recreation and Parks Association's Fletcher Graduate Scholarship, and Golden Key's Graduate Scholar Award. Together, these scholarships helped give me the opportunity to focus on my research without as much in the way of financial stress. Thank you.

Thank you to my NOAA and CELC colleagues for embracing my erratic work schedule over the last three years and helping me balance my studies and my professional work. Christos Michalopoulos, I appreciate you giving me the opportunity to work part-time remotely despite the challenges and learning curves. Lisa Kim, thank you for being the best, most empathetic youth engagement partner-in-crime that I could ask for. Thank you, too, to all of the students who participated in the first CELC Youth Summit. You remind me every day of why this work matters.

Thank you, too, to all of my colleagues and mentors that brought me to this point in my life. Dr. Jane Goodall and my Roots & Shoots family, you helped me see the impact I can have on the world. Carmel Green Micro-Grant Program board members, you had faith in me and helped build a 10-year-long program from the ground up. Dr. Dean Biggins, you gave me my

first taste of research that started me down this journey. Dr. Alexis Mychajliw and Dr. Liz Hadly, you took me on as a research assistant for the entirety of my undergraduate career and set me up for future research success. Tom Hayden and Dr. Nicole Ardoin, you helped me transition into social sciences and gave me the kindest mentorship.

My heartfelt gratitude goes out to my friends and family, near and far, who accompanied me on this roller coaster and encouraged me to enjoy the ride even when I felt like throwing up. Graduate students of PRTM, you are truly the best. I don't have the language to describe the love I feel for and from you all. Friends from other parts of my life, thanks for keeping me grounded and for all of the supportive texts, calls, care packages, and swing dances. I also have to acknowledge the array of people, places, and things that kept me together during the height of my dissertation writing: therapy, my dog Nutmeg, the paths of Lake Johnson, the delicious treats of Brecoatea, and constant support from my partner Justin. I appreciate you.

And of course, the most *enormous* thank you to my family. Mom, Dad, Irene, PJ, and extended family—thank you for your unwavering faith in my ability to do practically anything and for all that you've done to support me throughout my 28 years of life. Words don't suffice.

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CHAPTER 1: Introduction

Socio-environmental challenges riddle the planet today, their scale sometimes so massive that they appear insurmountable from the perspective of any individual person. Climate change pushes global temperatures increasingly higher (IPCC, 2018), simultaneously pushing animal species (Román-Palacios & Wiens, 2020; Kubelka et al., 2022) and human populations (Campbell, 2014; Brown, 2008; Perch-Nielsen & Bättig, 2008) out of their homes and into challenging new circumstances. Tainted water supplies affect communities in the United States (Butler et al., 2016; Patel et al., 2020) and abroad (Onda et al., 2012; Kayser et al., 2015), often posing an especially strong threat to marginalized communities with less privilege. In contrast, those with power—frequently those in the global north benefiting from capitalist economic systems—are often the perpetrators of these problems. Just 90 companies exude over 60% of the anthropogenic carbon dioxide emissions worldwide (Heede, 2014), driving climate change and other environmental justice challenges—frequently at the expense of those in the global south (Akizu et al., 2017; Cotta, 2020). In essence, our planet is faced with global-scale socio-environmental issues, and the most vulnerable populations are often those to feel the most devastating impacts.

Environmental education can serve as one tool for addressing these and other pressing environmental problems. As a field, environmental education works to foster environmental literacy—knowledge, skills, attitudes, and behaviors related to the environment (Hollweg et al., 2011)—empowering people to identify and engage in actions that benefit socio-environmental causes. These actions, called pro-environmental behaviors, are seen as the end result of environmental literacy and are therefore the ultimate goal of many environmental education programs. To give an example of what this might look like in practice, a program aimed at

addressing the issue of ocean plastic pollution might look to increase knowledge of the impacts of microplastics on marine life (Garcia-Vazquez & Garcia-Ael, 2021), instill an attitude in learners that helps them feel ownership over own plastic usage (Hammami et al., 2017), and build skills in identifying possible solutions to the microplastic problem (Deng et al., 2020). When knowledge, attitudes, and skills like these drive behavior change (for example, choosing to bring reusable bags to the grocery store or reducing single-use plastic water bottle consumption), environmental literacy achieves its mission.

Behaviors like the examples given above—small-scale changes made at the individual level as a result of environmental literacy built at the individual level—are generally the types of actions that the environmental education field encourages in practice and researches in academic studies (Ardoin et al., 2020). However, this individual-scale approach falls short of the solutions needed to solve the global-scale socio-environmental problems present today. Even if every individual in the United States were to bring their energy usage and water usage to zero, households only account for 7% and 12% of the country’s energy and water consumption, respectively (U.S. Energy Information Administration, 2022; U.S. Geological Survey, 2016). That means that the rest of the country’s consumption—that from industry, agriculture, transportation systems, and more—would remain unchanged even with the most aggressive individual-level behavior change. One scholar puts it this way: “We need to realize that individual consumption is not the cause of the environmental crisis...it is wrong to assume that it is all the result of our individual choices rather than the result of social, economic, and political forces that have, in large measure, made those choices for us” (Fang, 2021). To challenge these social, economic, and political forces, individuals must work together to push for large-scale change in the form of collective action. Collective action occurs when a group of people unite to

push toward a common goal (Clark, 2016)—in this case, solutions to today’s socio-environmental challenges. However, because of environmental education’s historic focus on individual-level literacy and behavior, little is known about what drives collective environmental action or the type of large-scale literacy that might be necessary to enable it.

This article-style dissertation seeks to address this literature gap by contributing to the environmental education research field’s understanding of community-level environmental literacy (CLEL), both in terms of its conceptualization and in terms of how enabled literacy of this kind might bring people together to work towards a shared environmental goal. To do this, the three dissertation chapters address the following overarching questions, respectively:

1. What is community-level environmental literacy, and how should it be measured?

Though some initial discussions around conceptualizing community-level environmental literacy have taken place (Gibson et al., 2022; Ardoin et al., 2022), the field of environmental education has neither a data-driven definition for CLEL nor specific guidelines for measuring it. The first chapter of this dissertation taps into the existing expertise in the field to help fill this need, using the Delphi method to iteratively solicit perspectives from environmental education researchers about how to define CLEL and what should be considered when measuring it. This contributes to the scholarly conversation about CLEL and provides a foundation on which to build subsequent empirical studies about CLEL, including the third chapter of this dissertation.

2. Do the oft-used behavioral antecedents of attitudes, perceived behavioral control, and subjective norms come together to predict collective action as accurately as they predict individual-level behavior?

In the absence of established strategies for measuring community-level environmental literacy and the behaviors that are a part of it, researchers might consider turning to the field's existing tools on monitoring other types of behaviors to see if these tools may also effectively measure community-level behaviors, too. Chapter 2 tests whether the theory of planned behavior (TPB; Ajzen, 1991) and the environmental literacy framework (Hollweg et al., 2011), two theories often used as a starting point for modeling individual-level behaviors, can be used to predict engagement in pro-environmental behaviors that go beyond the individual. Based on the established multi-dimensionality of pro-environmental behaviors (Stern, 2000; Larson et al., 2015), this paper compares these models' accuracy in predicting three categories of environmental actions: private-sphere behaviors (actions taken solely by one person), collective non-activist behaviors (actions taken in a group context that seek to change other peoples' behaviors), and collective activist behaviors (actions taken in a group context that seek to change broader rules or policies). Because collective action of both types are theorized to be a result of community-level environmental literacy (Gibson et al., 2022), understanding how well current tools measure these behaviors is a key step towards understanding whether the field of environmental education needs to develop new tools specifically for assessing these components of community-level environmental literacy. This study uses high school environmental science students throughout the state of North Carolina as its population of interest due to young peoples' unique ability to influence the adults around them (Lawson et al., 2019; Hartley et al., 2021a; Hartley et al., 2021b).

3. What behavioral antecedents might be better suited to predict a person's engagement in collective environmental action?

In recent years, scholars have proposed a theoretical connection between collective environmental action and social capital (Ostrom & Ahn, 2007; Krasny et al., 2015; Krasny, 2020). However, scholars have yet to empirically test whether social capital might drive an individual's engagement in collective environmental behaviors.

Chapter 4 uses the existing literature, an improved understanding of what comprises CLEL (Chapter 1), and insights into how well our existing theories predict behaviors at this scale (Chapter 2) to formulate a social-capital-based model to predict engagement in collective environmental behavior in high school students. In doing so, it seeks to bring additional clarity into what drives these high-impact, non-individual behaviors in the young people who influence the adults around them today and will soon be adults of influence themselves.

Together, these chapters build on environmental education's increasing focus on the collective (Ardoin et al., 2013) in an effort to solve today's toughest socio-environmental challenges.

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CHAPTER 2: **Using a Delphi study to conceptualize community-level environmental literacy**

Introduction

Large-scale environmental challenges plague the planet today, impacting both human and non-human life. Worldwide, species are going extinct at a rate up to 100 times greater than that of pre-human history (Ceballos et al., 2015)—a rate that will likely continue to accelerate (Cardinale et al., 2012)—destabilizing ecosystems and the benefits they provide to humans through ecosystem services (Daily & Matson, 2008). Climate change is driving increases in sea level, ocean acidification, and extreme weather events that threaten the survival of species and the lives and livelihoods of people globally (IPCC, 2018). These and other social-environmental issues are disproportionately concentrated in areas already experiencing marginalization, further escalating existing inequities (Schlosberg & Collins, 2014; Wilson et al., 2010). Immediate action is needed to combat these challenges and create a more habitable, just planet for all, before it may be too late (Barnosky et al., 2012).

Environmental education presents one avenue for pursuing positive environmental change. With a goal of “provid[ing] a wide range of practical skills required in the devising and application of effective solutions to environmental problems” (UNESCO, 1977), environmental education positions itself as an action-oriented field of practice. To accomplish the field’s mission, environmental education organizations typically focus on building environmental literacy in learners of all ages—both in formal settings such as schools (Ardoin et al., 2018) and in informal settings such as museums, nature centers, and everyday life (Ardoin & Heimlich, 2021)—to empower them to take informed action. Environmental literacy is seen as a prerequisite of pro-environmental action, with environmentally literate individuals possessing the knowledge, dispositions, and competencies necessary to engage in environmentally responsible

behavior (Hollweg et al., 2011). For example, an environmental education initiative working to reduce household water usage might boost knowledge about water scarcity (Middlestadt et al., 2001), nudge learners towards a disposition of commitment to conserve water (Barata et al., 2017), and build skills that allow for critical thinking about which water-saving behaviors might be most appropriate (Addo et al., 2018). When these factors come together to empower a person to take individual pro-environmental action—in the case of household water conservation, perhaps taking shorter showers or taking the time to repair leaky faucets—environmental literacy is seen as reaching its goal.

While these individual pro-environmental behaviors are certainly a step in the right direction, they are a small drop in the metaphorical bucket when compared to the size of the environmental problems at hand. Continuing with water as an example, even if every household worldwide cut its water use to nearly zero, the largest drain on water supplies would remain unchanged; agriculture soaks up 70% of extracted water worldwide (OECD, 2020), making individual efforts to reduce household water usage miniscule in comparison. To create truly impactful change, individuals must push for solutions beyond their household walls, a task that requires people coming together to wield a group power that is greater than the power any single individual can conjure on their own. Collective action offers a way for people to come together to advance a shared goal (Clark, 2016), pushing toward solutions that match the large scale of today's environmental challenges. Collective action might take the shape of a grassroots campaign to regulate the quantity of water that large agricultural companies can use each year, putting pressure on the industry to develop more efficient irrigation practices so that they can save both water and money. In this way, collective action has the power to create system change that an individual alone could not create.

Despite the demonstrated need for collective action cited in the environmental education literature (Gibson et al., in review; Gibson et al., 2022; Ardoin et al., 2022; Aguilar, 2018; Clark, 2016; Ardoin et al., 2013) and beyond (Barth et al., 2021; Ostrom & Ahn, 2007), environmental literacy and the resulting pro-environmental behaviors are largely conceptualized at the individual scale. Just two pieces of literature, both published in 2022, have worked to disentangle what environmental literacy might look like at a scale beyond that of the individual. Gibson et al. (2022) detailed the findings from a day-long convening dedicated to discussing how community-level environmental literacy (CLEL) might be defined and measured. The 24 scholars in attendance largely agreed that community-level environmental literacy related to collective action in the same way that individual-level environmental literacy related to individual-level action; both forms of literacy must, by definition, precede their respective forms of action. Most of the other results of the convening, though, were points of tension rather than consensus, with ranges of how CLEL could be conceptualized and quantified depending on community and study context (Gibson et al., 2022). Ardoin et al. (2022)'s concept of collective environmental literacy aligns strongly with that of CLEL, with agreement that this larger-scale literacy can support (and help researchers to better understand the drivers of) collective environmental action. The paper examines literature related to collective topics from across many disciplines and dozens of theories, weaving together the most salient of these ideas to create a working definition for collective environmental literacy. Four key characteristics of this collective environmental literacy emerged: the dynamic nature of the process, the synergy that empowers participants to reach higher goals than they could working alone, the shared resources and knowledges needed to accomplish these goals, and the multi-scalar nature of the literacy ranging from an individual to a group (Ardoin et al., 2022). Though Gibson et al. and Ardoin et al. use different terms, both

of them describe similar ideas of environmental literacy beyond the individual and underscore its importance in understanding how to push toward collective action.

Given the extremely limited amount of literature written about CLEL and its theorized role in fostering large-scale environmental action, additional research on the topic is desperately needed. The Delphi method provides a promising way to build on the existing research on CLEL through systematically probing the expertise of scholars across the field of environmental education. Delphi studies involve iteratively and systematically gathering the insights of experts, working to build consensus amongst the group over the duration of the study (Linstone & Turoff, 1975; Okoli & Pawlowski, 2004). This technique has been used extensively in environmental education research to understand everything from the core outcomes that unite the environmental education field (Clark et al., 2020) to barriers elementary school educators face in teaching about the environment (Fox & Carpenter, 1992). Compared to other approaches, Delphi studies serve an especially useful methodological role in the early stages of attempting to understand a new concept because it can systematically organize the reflections of a select group of experts and provide the scaffolding to move towards greater levels of agreement (Linstone & Turoff, 1975). Because of the nascency of community-level environmental literacy as an idea and the potential usefulness of soliciting additional perspectives on this topic from experts in the field, a Delphi approach would be particularly useful in the case of CLEL.

Research questions

This study uses a Delphi method to build on past theoretical work on CLEL, systematically gathering ideas and feedback from experts across the field of environmental education to iteratively work towards greater consensus around CLEL. Given that this topic is so

new to the published literature, our research seeks to build a general conceptualization of CLEL through answering the following two questions:

1. What constitutes community-level environmental literacy (CLEL)?
2. What needs to be considered when trying to measure CLEL?

By bringing together an expert panel to help us address these broad questions, we hope to gain greater insight into how CLEL can be defined and measured, supporting future efforts to build CLEL and achieve collective environmental action.

Methods

About the Delphi method

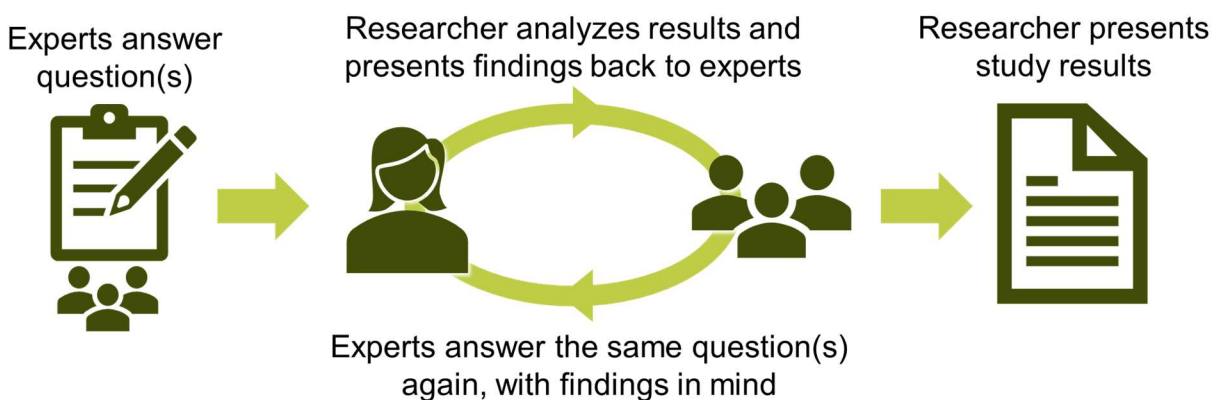
The Delphi method is a systematic technique for determining the opinion of a group of experts, also referred to as an expert panel, on a given topic, usually one seen as complex or ill-defined (Linstone & Turoff, 1975). It is defined by four major characteristics: *repetition*, *anonymity of opinions*, *controlled feedback*, and *group statistical response* (Landeta, 2006). The researcher initiating the Delphi process selects a group of experts whose opinions they seek regarding a specific topic and asks them one or more questions related to that topic, with each expert being consulted individually rather than as a group (*anonymity of opinions*). The researcher then gathers and analyzes the responses from all experts, finding commonalities across answers and discarding any irrelevant comments, and reports the aggregated relevant results back to the same group of experts (*controlled feedback*). The experts then have the opportunity to respond to the original question or questions once again with this new aggregated information in mind, choosing to stick to their original response or revise their opinion based on group opinion (*repetition*). This process of researcher analysis of expert opinions, presentation of aggregated results back to the experts, and opportunity for modified expert responses can be repeated as many times as desired; typically, the study ends when the group of experts comes to a certain level of agreement, as determined by the researcher before the study begins and as measured by one or more numerical factors (*group statistical response*). See Figure 2.1 for a graphical representation of the Delphi method.

The Delphi method has been used for decades in the social sciences (Landeta, 2006; Green, 2014), including in environmental education research in the United States (Clark et al., 2020; Fox & Carpenter, 1992) and beyond (Seo et al., 2020; Chou et al., 2010; Lee & Lee, 2009;

Ahmadi et al., 2020). It is seen as particularly useful in cases where a question might not be able to be answered through less subjective techniques, where experts on the question at hand may not have a strong history of communication and discussion about the topic, and where it is desirable to retain anonymity and diversity of responses to ensure all voices are heard (Green, 2014; Linstone & Turoff, 1975; Christie & Barela, 2005). We selected the Delphi method for this study for those very reasons, as we sought to bring a geographically- and epistemologically-diverse group of environmental education scholars together in (asynchronous) conversation about the relatively novel concept of CLEL for the first time.

Figure 2.1

The Delphi method.



Selection of expert panelists

As is typical for Delphi studies, this research effort used purposive sampling to determine study participants (Hasson et al., 2000; Palys, 2008). To be considered an “expert” for the purposes of this study, individuals must have been engaged in scholarly discussions related to community-level environmental literacy (CLEL), collective action, community-level outcomes

in the environmental space, and/or definitions of environmental literacy. This engagement could take one or more of the following forms:

1. invitation to and/or participation in the 2020 Convening on Community-Level Environmental Literacy, hosted by NC State University (as described in Gibson et al., 2022);
2. engagement in conference sessions focused on CLEL (e.g., 2021 NAAEE Research Symposium session entitled “Perspectives on Community-Level Environmental Literacy: Theories and Operationalization,” 2020 NAAEE Research Symposium session entitled “Conceptualizing Community-Level Environmental Literacy”);
3. publication of peer-reviewed literature and/or white papers related to the topic; or
4. attestation of engagement on the topic from an academic colleague who meets one or more of the above criteria.

Using the above criteria, we purposively invited 43 individuals to participate in the study as experts—22 attendees of the 2020 Convening on CLEL, 9 invitees of the 2020 Convening on CLEL who were not able to attend, 3 researchers who presented on CLEL at professional conferences, and 9 scholars who wrote about related topics in published literature. Based on recommendations from our original list of experts, we later invited an additional 43 individuals via snowball sampling (Morgan, 2008). This resulted in a total of 86 scholars receiving study invitations, anticipating an acceptance rate of approximately 25-75% (Gordon, 1994) with the goal of a final panel size of 15 to 35 individuals (Clayton, 1997; Gordon, 1994), as panels tend to reach saturation at approximately 30 members (Delbecq et al., 1975).

See Table 2.1 in “Results” for more detailed information on the study participants and “Limitations and Future Research” for a discussion of possible implications for engaging this particular group of experts.

Delphi process

Round 1

Survey content. All 86 scholars meeting the above criteria received an invitation to participate in the Delphi study via email in January 2022. Upon consenting to participate in the study, scholars were invited to complete the first part of the study (hereafter Survey #1) either as an online survey via Qualtrics or as a structured interview via Zoom videoconferencing; the content remained the same across both formats. Survey #1 involved open-ended brainstorming (Uhl, 1983), inviting participants to offer their thoughts on CLEL in their own words. In line with the overarching research questions of this study, the two main questions of Survey #1 were as follows:

1. In your opinion, what constitutes community-level environmental literacy (CLEL)?
2. In your opinion, what needs to be considered when trying to measure CLEL?

In Question 1, respondents were given the opportunity to complete the statement “CLEL is...” up to 15 times in a free response format, writing a single characteristic or phrase to complete the statement each time. In Question 2, respondents completed the statement “When measuring CLEL, we need to consider...” in the same way, with 15 opportunities to respond with different considerations.

In addition to answering these two content questions, we asked respondents a series of demographic questions, asking them to self-identify their gender, race/ethnicity, area of

expertise, number of years of experience in their field, and geographic location (country and state, if applicable). This provided us with information about the voices this Delphi survey captured as well as those it failed to represent.

Participants were given two weeks to complete Survey #1, with an additional two-week extension provided to those who had not completed the survey by the initial deadline; this aligns with general guidelines on Delphi study timelines (Uhl, 1983; Gordon, 1994). Further extensions due to extenuating circumstances (e.g., travel away from email, illness, family difficulties, etc.) were granted on a case-by-case basis. See appendices for full text of each survey.

Analysis. Responses to each of the two main questions were collated, anonymized, and presented in randomized order for qualitative analysis. Two coders performed iterative collaborative coding (Cornish et al., 2014) in an insider/outsider team approach (Louis & Bartunek, 1992; Thomas et al., 2000; Court & Abbas, 2022); one coder was the lead author of the project and had published on CLEL in the past, and the other coder was a scholar in science, technology, engineering, and mathematics (STEM) education with more limited exposure to past CLEL discussions. These two differing areas of expertise allowed for both contextual interpretation of the responses based on past CLEL discussions and publications (the “insider” perspective) as well as a priori, context-free interpretation of the qualitative data without bringing in the assumptions gathered from past CLEL work (the “outsider” perspective) (Louis & Bartunek, 1992). Independently, the two researchers inductively coded the same half of responses into themes (Thomas, 2003), each coder creating a list of themes present in the responses to the question about CLEL conceptualization and a separate list of themes present in responses to the question about CLEL measurement consideration. After this individual analysis, the two coders came together to compare and contrast their coding, discussing the reasoning

behind their assignments of codes for each line of data and their definitions for each code that emerged (Cornish et al., 2014). The researchers reconciled any differences in their coding choices and their codebooks, resulting in a mutually-agreed-upon codebook with shared definitions for each theme, and then coded the rest of the data independently. They then came together again, repeating the process of reconciling codes and codebooks, until they reached consensus on a final list of themes that emerged from each of the two questions in Survey #1 (Cornish et al., 2014).

Round 2

Survey content. The second round of the Delphi study took place entirely via online surveys on Qualtrics. All scholars who participated in Survey #1 were again invited to participate in Survey #2, wherein they had an opportunity to react to the results of Survey #1. Survey #2 presented out the themes from each of the two main study questions, giving the theme name, a description of that theme, and several examples of word-for-word participant responses that were coded as belonging to that theme. Themes were presented in random order, anonymously, and without information on the frequency with which the theme appeared so as to avoid privileging certain voices over others and to increase inclusion of diverse perspectives (Christie & Barela, 2005). Survey respondents were then asked to rate, on a 7-point Likert scale from “strongly disagree” (-3) to “strongly agree” (3), the degree to which they feel that the presented theme aligns with their conceptualization of CLEL and its measurement. They were then encouraged to elaborate on their stated level of agreement in an open-response format. They also had the opportunity to specify, again in an open-response format, whether they felt anything was incorrect or missing from the description of the theme.

After reacting to each theme individually, respondents were asked to consider the themes all together. Participants rated the level of importance of each theme as part of a complete conceptualization of CLEL (for themes related to the first research question) or a complete list of measurement considerations for CLEL (for themes related to the second research question) on a 7-point Likert scale from “not at all important” (-3) to “extremely important” (3). They were also invited to provide comments on whether they felt any themes were missing from the list or whether they had any final thoughts they wished to share.

Survey #2 was open for two weeks initially, with a two-week extension automatically offered to any scholars who had not completed the survey by the initial due date. Other extensions were given on an ad hoc basis, if necessary.

Analysis. To determine the level of consensus on the themes presented out in Survey #2, we calculated mean and standard deviation of 1) the level of agreement that the participants expressed that each theme fit into their conceptualization of CLEL or its measurement and 2) the level of importance the participants expressed each theme held in the complete conceptualization of CLEL or its measurement considerations. Higher means and lower standard deviations were seen as desirable and indicative of greater agreement on the themes, with a standard deviation of 1.5 or lower considered to be a threshold for adequate consensus (Christie & Barela, 2005; Giannarou & Zervas, 2014). As a secondary measure of consensus, we also calculated the percentage of respondents who reported a value of 2 or 3 on the scale of -3 to 3 (corresponding to “agree” or “strongly agree” for questions of agreement, and “very important” or “extremely important” for questions of importance). If more than half of the respondents ($\geq 51\%$) reported these high values, we considered adequate consensus to be reached (Giannarou & Zervas, 2014).

Themes that met both of this criterion and the standard deviation cutoff were considered to have reached strong consensus.

In addition to calculating quantitative levels of consensus, we qualitatively analyzed the open-ended feedback received about agreement with each theme and about what might be missing or incorrect on each theme. Each piece of feedback was read, and concerns that arose multiple times were grouped together for use in Survey #3.

Round 3

Survey content. Survey #3, conducted online via Qualtrics, presented the quantitative level of consensus reached in Survey #2 and proposed themes modifications based on the qualitative feedback received in Survey #2. We presented conceptualization themes first, beginning with the themes that had the highest mean value of importance and lowest standard deviations, based on the second survey, and continuing on to the themes with lower levels of stated importance and higher standard deviations. With each theme, we provided the original theme name and description followed by the mean and standard deviation of the theme's importance. We then summarized the participants' qualitative feedback received about the theme, proposing specific changes to the theme name and/or description to address any identified issues. We ended by offering a full modified version of the theme name and description that incorporated all feedback.

After reading all of the above information for a specific theme, participants were asked the same 7-point Likert scale questions that they were asked in Survey #2 regarding how much they agreed that the modified theme aligned with their conceptualization of CLEL and how important they felt the theme was in a complete conceptualization of CLEL. They were also

asked to what extent they agreed that the modified theme put forward in Survey #3 was an improvement upon the original theme presented in Survey #2. This process was repeated for measurement considerations of CLEL, with original themes, levels of consensus, main points of feedback, and modified themes being presented to participating scholars and the scholars being asked to state their level of agreement with and their perceived importance of each theme.

In addition to detailing the individual themes related to CLEL conceptualization and measurement, Survey #3 attempted to integrate all themes into a coherent framework about CLEL (similar to the approach used in Clark et al., 2020). Study participants reacted to this synthesis statement by rating the degree to which the statement aligned with their conceptualization of CLEL (again on a 7-point Likert scale).

Because this was the final survey of our 3-part Delphi study, it asked for less in the way of open-ended responses in an attempt to work toward a final list of themes and theme descriptions. However, participants were given the option of adding any final open-ended thoughts on the themes or on the study as a whole at the end of the survey.

Analysis. The levels of agreement and theme importance received in Survey #3 were analyzed in the same manner as Survey #2, with the research team calculating each theme's mean, standard deviation, and percentage of respondents that assigned it with a high value of importance and agreement. Consensus was again determined through the criteria of a standard deviation of less than 1.5 (Christie & Barela, 2005; Giannarou & Zervas, 2014) and over half of respondents falling into the “agree” or “strongly agree” category for questions of agreement or the “very important” or “extremely important” categories for questions of importance (Giannarou & Zervas, 2014). The same measures of consensus were applied to the synthesis framework.

Results

Round 1

Expert panelists

Out of the 86 environmental education scholars invited to take part in the study, 34 participated in Survey #1 (40% response rate). This group was made up of more women than men (74% and 24%, respectively), with 79% of respondents identifying as White, 9% identifying as Middle Eastern or South Asian, 6% as Asian or Pacific Islander, and 3% each as Black, Hispanic, or something else. The vast majority of participants held doctoral degrees (76%), with another 12% currently working towards their PhD and the remaining 12% holding master's degrees. A plurality of experts in this study were university faculty members (38%); 32% were practitioners outside of academia, 21% were non-faculty researchers, and 9% were doctoral students. With this range of positions came a range of years of experience within the field of environmental education. Approximately 15% of Survey #1 respondents brought 10 or fewer years of experience, 33% brought 11-20 years, 36% brought 21-30 years, and 18% brought more than 31 years of experience. Most participants worked in the United States (82%), with other scholars coming from Australia (9%), the United Kingdom (6%), and Taiwan (3%). Reasons for study inclusion varied, from participation in the 2020 CLEL convening (29%), invitation to that convening (3%), publication of CLEL-relevant literature (21%), presentation of CLEL-relevant conference sessions (3%), or referral from another scholar with CLEL-relevant expertise (44%). See Table 2.1 for details.

The expertise of these scholars largely centered around environmental education, in alignment with the goals of the study and the recruitment strategy discussed in “Methods.” Within this broad field, participants focused on topics ranging from culturally responsive and

equitable evaluation practices to resilience to natural hazards to community engagement in urban communities. See Figure 2.2 for a word cloud of common language that the 34 experts who completed Survey #1 used to describe their specific areas of expertise.

Figure 2.2

Word cloud of self-reported areas of expertise of Delphi participants.



Table 2.1. Demographics of study participants.

Demographic	<u>Survey 1</u>		<u>Survey 2</u>		<u>Survey 3</u>	
	n (34)	%	n (28)	%	n (25)	%
Gender						
Man	9	26%	8	29%	7	28%
Woman	25	74%	20	71%	18	72%
Race / ethnicity						
White	27	79%	23	82%	20	80%
Black	1	3%	1	4%	1	4%
Hispanic	1	3%	0	0%	0	0%
Asian or Pacific Islander	2	6%	1	4%	1	4%
Middle Eastern or South Asian	3	9%	3	11%	3	12%
I identify another way	1	3%	0	0%	0	0%
<i>Multi-racial*</i>	<i>1</i>	<i>3%</i>	<i>0</i>	<i>0%</i>	<i>0</i>	<i>0%</i>
Years of experience						
<10	5	15%	4	14%	4	16%
11-15	6	18%	4	14%	4	16%
16-20	5	15%	5	18%	5	20%
21-25	4	12%	2	7%	2	8%
26-30	8	24%	8	29%	6	24%
>31	6	18%	5	18%	4	16%
Position						
Faculty	13	38%	9	32%	8	32%
PhD student	3	9%	3	11%	3	12%
Practitioner	11	32%	11	39%	10	40%
Researcher	7	21%	5	18%	4	16%
Degree						
Masters	4	12%	4	14%	3	12%
PhD (in progress)	4	12%	4	14%	4	16%
PhD	26	76%	20	71%	18	72%
Location						
United States	28	82%	23	82%	21	84%
Australia	3	9%	2	7%	1	4%
United Kingdom	2	6%	2	7%	2	8%
Taiwan	1	3%	1	4%	1	4%
Reason for study inclusion						
2020 CLEL convening participant	10	29%	7	25%	7	28%
2020 CLEL convening invitee	1	3%	0	0%	0	0%
Conference presenter	1	3%	1	4%	1	4%

Table 2.1 (continued).

Publication author	7	21%	7	25%	6	24%
Referred by one of the above	15	44%	13	46%	11	44%

**Multi-racial participants were counted both as multi-racial and in the different racial categories they identified with.*

Findings

CLEL conceptualization. From the 34 participants, we received 247 open-response answers to our question about CLEL conceptualization (an average of approximately 7 responses per expert). Through collaborative qualitative coding, 8 main themes emerged from these data: *a focus on environmental issues, mindfulness around power, knowledge / skills, attitudes / feelings, behavior / action, connection, interdisciplinarity, and a continuous iterative process.* A description and several examples of each of these themes is provided in Table 2.2.

Table 2.2. Themes related to CLEL conceptualization arising from Delphi Survey #1.

<u>Theme</u>	<u>Description</u>	<u>Examples (Direct Quotes from Participants)</u>
A focus on environmental issues	CLEL holds environmental issues as its core subject matter.	<ul style="list-style-type: none"> • CLEL is based on the environmental issues pertinent to the boundaries of the community. • CLEL is essential to sustainable resource management in a growing population. • CLEL is a community norm of desiring and working toward improved environmental quality.
Mindfulness around power	Because of its scale, CLEL inherently affects and is affected by power dynamics. CLEL must be inclusive of diverse voices and identities within the community, embracing multiple perspectives including Indigenous ways of knowing. CLEL must be justice-oriented and decolonized, and intentional effort and coordination is required to make it so.	<ul style="list-style-type: none"> • CLEL is reflective of diverse, equitable, and inclusive ideas and beliefs. • CLEL is respect and acknowledgment of Indigenous knowings. • CLEL considers the assets and strengths of different cultures, races, sexual orientations, gender identities, social groups, religious traditions, classes, ages, abilities, language groups, and religious traditions in bringing about change that addresses environmental quality and long-term sustainability
Knowledge / skills	CLEL requires a degree of knowledge, awareness, understanding, and/or wisdom. It also requires to critically analyze and act on that knowledge. Knowledge and skills involved in CLEL can be distributed throughout the community; in other words, not everyone needs to have the same degree or type of knowledge and skills. Some of the skills required for CLEL that were brought up in Survey 1 included systems thinking skills and communication skills.	<ul style="list-style-type: none"> • CLEL is a reflection of knowledge, skills and abilities that are organized for collective benefit. • CLEL is collective knowing. • CLEL is knowledge of ecosystems impacted by the community members. • CLEL is positive development of skills and attributes to include a joint identification of issues and analysis and evaluation of these in a critical way, as part of a group.

Table 2.2 (continued).

<u>Theme</u>	<u>Description</u>	<u>Examples (Direct Quotes from Participants)</u>
Attitudes / feelings	CLEL involves the affective in addition to the more concrete knowledge and skills previously mentioned. In this theme, words like values, norms, motivations, intentions, dispositions, ethics, trust, responsibility, and respect came up frequently amongst survey respondents. All of these play a role in supporting or hindering CLEL.	<ul style="list-style-type: none"> • CLEL is a shared attitude that self, human societies, and non-human nature are interconnected. • CLEL is a group of people sharing multiple values (altruistic, biospheric, egoistic) for the environment. • CLEL is a shared valuation of the natural and built environments in the region. • CLEL involves a community norm of desiring and working toward improved environmental quality.
Behavior / action	CLEL isn't just knowledge or beliefs; taking action based on these other CLEL components is a necessary part of this literacy. These actions may be oriented towards policy (civic engagement) or focused on a community problem outside of the policy sphere. The ultimate aim of CLEL is collective action, which is of a different scale than individual behaviors--though some survey respondents reminded us that collective action still involves individuals.	<ul style="list-style-type: none"> • CLEL is taking action in your community on environmental issues. • CLEL is taking the form of collective action towards a common environmental problem. • CLEL is concerning about community's individual and collective action toward the environmental issues community faced. • CLEL is action oriented; with a focus on collective (community) action, rather than individual action.

Table 2.2 (continued).

Connection	CLEL is driven by connection--both peoples' connection with each other and peoples' connection with the environment around them. When discussing this relational concept, some respondents brought up that connecting across generations (intergenerational learning) may be especially powerful in facilitating CLEL.	<ul style="list-style-type: none"> • CLEL is relationship building. • CLEL is discussing environmental issues with family, friends, neighbors (those in your community). • CLEL is an interactive "art" that requires we engage with those around us. • CLEL is intergenerational. • CLEL is a shared capacity to leverage connections and social networks.
Interdisciplinary	CLEL bridges disciplines and subject areas, intertwining environmental issues with social issues, political challenges, economic hardships, and more. This can be seen in formal interdisciplinary work (i.e., learning about environmental topics in social studies classrooms or math courses), in discussion of environmental issues, and more.	<ul style="list-style-type: none"> • CLEL is intersectionality (social, economic, environmental, political, cultural). • CLEL is multifaceted. • CLEL requires that environmental learning is incorporated across grades and subjects in formal schooling. • CLEL involves having EL topics covered in more than just K-12 settings. • CLEL is understanding systems -- bridging environmental and social -- so people can think about what constitutes a good solution and how to make it happen.
A continuous, iterative process	CLEL is more of a process than an endpoint, shifting and adapting as the community and community needs evolve. Flexibility is key in allowing for this adaptation over time.	<ul style="list-style-type: none"> • CLEL is dynamic, changing as changes in knowledge occur. • CLEL is made up of decisions or components that can be revised by the community as needed over time. • CLEL is a process. • CLEL requires periodic reinforcement even (especially) for long-time community members. • CLEL is flexible enough to wrestle with novel issues.

CLEL measurement considerations. The 34 participants generated 203 ideas on what to consider when measuring CLEL (about 6 responses per scholar). Eight themes arose from this question, many of which centered around understanding different aspects of “community.” The themes were as follows: *inclusivity, indicators, researcher purpose / motivation, understanding community bounds, understanding community components, understanding community connections, and understanding community processes*. See Table 2.3 for definitions and examples of each of these themes.

Table 2.3. Themes related to CLEL measurement considerations arising from Delphi Survey #1.

<u>Theme</u>	<u>Description</u>	<u>Examples (Direct Quotes from Participants)</u>
Inclusivity	CLEL measurement strategies need to be inclusive of varied values, life experiences, ways of knowing, and stakeholder perspectives. Because of the pluralistic nature of communities, this may require a certain level of acknowledging and embracing difference and disagreement. It may also help to engage the community members themselves in the measurement process.	<ul style="list-style-type: none"> • When measuring CLEL, traditional knowledge systems should also be taken into consideration. • When measuring CLEL, we need to consider how to value the contributions of underrepresented people and others who have been unheard and/or ignored when it comes to environmental issues. • When measuring CLEL, we need to consider power structures within the community. • When measuring CLEL, we need to consider whether/how the community can collaboratively be involved in the measurement.
Indicators	Measuring CLEL requires researchers to be clear about how they are defining and operationalizing indicators of CLEL (the components defined in the first section of this survey). For example, researchers should be clear about how they are defining knowledge--is it distributed unevenly across the community, or does everyone need to have the same level of knowledge? Is it enough to have knowledge, or are other attitudes, motivations, or values necessary? Is the researcher measuring CLEL as a continuous process or as an endpoint that a community reaches once they get to a certain level of these indicators or a certain goal is achieved?	<ul style="list-style-type: none"> • When measuring CLEL, definitions must be clear. • When measuring CLEL, we need to consider that CLEL should not require all individuals within a community to have the same level of understanding and environmental literacy, rather the community as a whole needs to have a sufficient level of environmental literacy, and needs to know how to leverage this literacy. • When measuring CLEL, we need to consider how to measure process/engagement with an issue not just knowledge about the environmental issue. • When measuring CLEL, we need to consider if CLEL is tied to success of efforts to collectively act or if the effort itself indicates CLEL.

Table 2.3 (continued).

Researcher purpose / motivation	Because a researcher's motivation for measuring CLEL impacts how they go about doing so, it is important to reflect upon this motivation and how it may impact the measurement processes and/or results. Is the purpose to be able to compare across communities? To help a community reach a certain collective impact goal? To understand the starting point of a community's literacy so that you can measure change? Something else?	<ul style="list-style-type: none"> • When measuring CLEL, we need to consider our motivation/purpose/goal for measuring CLEL in the first place. • When measuring CLEL, we need to consider why you want to measure CLEL. • When measuring CLEL, we need to consider how (or if) you are comparing communities. • When measuring CLEL, we need to consider "literacy for what purpose?"
Understanding community bounds	To measure community-level environmental literacy, we need to be clear about how we are defining the community in which we are working. Survey respondents talked about how communities can be bounded in many ways--by geography, by identity, by association, etc. Several people also emphasized that a community can change over time, as can its bounds, calling for flexibility on the researchers' part.	<ul style="list-style-type: none"> • When measuring CLEL, we need to consider where we draw boundaries around a community - is it an identity group or a neighborhood or a school or something else? • When measuring CLEL, we need to consider how transitional or fixed the community boundaries are. • When measuring CLEL, we need to be explicit and flexible about what we mean by "community". • When measuring CLEL, we need a dynamic definition of community.
Understanding community components	Measuring CLEL requires understanding the makeup of the community. Study participants discussed three broad types of community components: people, institutions, and the physical environment. A researcher should familiarize themselves with these different elements of the community to more effectively measure CLEL.	<ul style="list-style-type: none"> • When measuring CLEL, we need to consider demographic data - age, sex, education, occupation, income. • When measuring CLEL, we need to consider what social, political, and economic institutions exist within a community that can either bolster or undermine community learning. • When measuring CLEL, we need to consider the unique geographic and bioregional factors that make up the physical attributes of the community.

Table 2.3 (continued).

Understanding community connections	Given that this type of literacy is driven by connection, understanding the nature of social connections within the community of interest is important to effectively measuring CLEL.	<ul style="list-style-type: none"> • When measuring CLEL, we need to consider social connections, social capital, social cohesion, and social networks. • When measuring CLEL, we need to consider social context - nature of local neighborhood / city / country. • When measuring CLEL, we need to consider identification of key 'nodes' in a community's environmental knowledge network.
Understanding community processes	Community processes, both civic and otherwise, impact how a community builds CLEL. It is therefore important to understand these processes to better understand the context in which CLEL is created (or limited).	<ul style="list-style-type: none"> • When measuring CLEL, we need to consider process knowledge --- knowledge of how this community manages environmental decision-making and understanding of how decision-making ought to be managed. • When measuring CLEL, we need to consider the ability of individuals to influence community decision making. • When measuring CLEL, we need to consider how local governments talk about environmental problems.
Understanding community needs	Finally, it is key to understand what a community wants as well as what might prevent them from achieving these goals. Measurement strategies can then be tailored accordingly.	<ul style="list-style-type: none"> • When measuring CLEL, we need to consider shared and distinct goals of community members. • When measuring CLEL, we need to consider obstacles to literacy (at community & individual levels). • When measuring CLEL, we need to consider community needs.

Round 2

Expert panelists

Out of the 34 scholars that participated in Survey #1, 28 participated in Survey #2 (18% attrition rate). The demographic breakdown of participants remained very similar across Surveys #1 and #2, with high numbers of women, white folks, people working in the United States, and individuals holding doctoral degrees. See Table 2.1 to see the small changes in participant characteristics between the first two rounds of this Delphi study.

Findings

CLEL conceptualization. For each of the eight conceptualization themes, study participants answered the following two questions: “How much do you agree that this theme fits into your conceptualization of CLEL?” (hereafter Conceptualization Question A: Fit) and “How important is this theme as part of a complete conceptualization of CLEL?” (hereafter Conceptualization Question B: Importance).

Numerical consensus was reached for both Conceptualization Question A: Fit and Conceptualization Question B: Importance, with participants broadly agreeing that 1) each theme fit into their conceptualization of CLEL and 2) each theme was an important part of a complete conceptualization of CLEL. All calculated standard deviations fell below the 1.5 threshold for consensus based on that measure, and over half of the participants assigned a high agreement value or high importance value to the themes, serving as a secondary indicator of consensus (Table 2.4).

Despite all themes meeting the requirements of consensus, there was still variation in average fit, average importance, and standard deviations of both across the eight themes. Two

themes—*connection* and *a continuous iterative process*—had mean values above 2 and standard deviations of under 1 across both Conceptualization Questions A: Fit and B: Importance. This indicates high levels of stated fit and importance of these themes, with little disagreement between individual respondents on these topics. The category of *attitudes / feelings* was the lone theme with a mean of less than 2 and a standard deviation of greater than 1 across both questions, indicating less strong agreement on this theme’s fit and importance within a potential CLEL conceptualization framework. The remaining themes fell somewhere between these two extremes.

Additionally, study participants provided extensive open-ended feedback on the themes, providing qualitative data on the components of the theme names and written descriptions with which they agreed or disagreed as well as what they felt might be missing from these theme names and descriptions. A summary of participant feedback on each theme can be found in Table 2.5. All themes received actionable constructive criticism that drove proposed modifications to the theme name, description, or both—modifications that were presented back to the study participants in Survey #3. Feedback also resulted in one theme being suggested for deletion.

Table 2.4. Agreement levels on CLEL conceptualization themes, as found in Delphi Survey #2.

<i>Theme</i>	<u>Conceptualization Question A: Fit</u> How much do you agree that this theme fits into your conceptualization of CLEL?			<u>Conceptualization Question B: Importance</u> How important is this theme as part of a complete conceptualization of CLEL?		
	<i>Mean</i>	<i>Standard deviation</i>	<i>% “agree” or “strongly agree”</i>	<i>Mean</i>	<i>Standard deviation</i>	<i>% “very important” or “extremely important”</i>
A continuous, iterative process	2.39	0.79	89%	2.33	0.83	85%
Knowledge / skills	2.38	0.90	90%	2.11	1.07	75%
Connection	2.35	0.85	85%	2.43	0.84	86%
A focus on environmental issues	2.31	1.04	83%	2.39	0.88	89%
Mindfulness around power	2.21	0.98	76%	1.96	1.20	64%
Interdisciplinary	2.21	1.10	82%	2.14	1.11	75%
Attitudes / feelings	1.96	1.20	71%	1.89	1.07	68%
Behavior / action	1.89	1.48	70%	2.14	1.04	79%

Table 2.5. Survey #1’s original CLEL conceptualization themes with feedback from Survey #2, alongside modified themes proposed in Survey #3

<u>Original theme from Survey #1</u>	<u>Summarized theme feedback from Survey #2</u>	<u>Modified theme proposed in Survey #3</u>
<p>A focus on environmental issues CLEL holds environmental issues as its core subject matter.</p>	<ul style="list-style-type: none"> • Social and environmental challenges are inextricably intertwined, and by focusing this theme just on “environmental” issues, we miss the opportunity to emphasize this interconnectedness. Additionally, this framing implies focuses on the environment being the problem (rather than the humans who are driving environmental change being the problem). <i>Our suggested solution: Change “environmental” to “socio-ecological” in the theme title, and add additional text to the theme description to emphasize this point</i> • The use of the word “issue” or “problem” in this theme suggests that CLEL might not be able to exist related to socio-ecological assets – only to negatively-framed concerns. Different phrasing might allow for more positive framing. <i>Our suggested solution: Change “issues” to “topics” in the theme title</i> • These socio-ecological topics must be relevant to the community in order to be a focus of CLEL. The current definition does not include local relevance. <i>Our suggested solution: Add “relevant to the community” to the theme title, and add additional text to the theme description to emphasize this point</i> 	<p>A focus on socio-ecological topics relevant to the community CLEL recognizes that social and environmental systems are inextricably linked and that the socio-ecological challenges and opportunities that arise from them must therefore be addressed jointly. CLEL focuses on the specific socio-ecological topics that are relevant to the community of focus.</p>

Table 2.5 (continued).

<p>Connection CLEL is driven by connection—both peoples' connection with each other and peoples' connection with the environment around them. When discussing this relational concept, some respondents brought up that connecting across generations (intergenerational learning) may be especially powerful in facilitating CLEL.</p>	<p>There was broad agreement on this theme. The limited feedback can be summarized as follows:</p> <ul style="list-style-type: none"> • Several key words emerged in the open-ended feedback that were missing from the original theme description. These words included relationships, networks, and social capital. <i>Our suggested solution: Keep the theme largely the same, with the addition of another sentence highlighting these key concepts</i> • Some felt that connection may be an outcome of CLEL rather than a component. <i>Our suggested solution: Highlight that CLEL can strengthen connections as well as be driven by connection</i> 	<p>Connection CLEL is driven by connection—both peoples' connection with each other and peoples' connection with the environment around them. Social networks, social capital, and relationships are key drivers of CLEL, and the process of CLEL can also strengthen these connections.</p>
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Table 2.5 (continued).

<p>Knowledge / skills CLEL requires a degree of knowledge, awareness, understanding, and/or wisdom. It also requires to critically analyze and act on that knowledge. Knowledge and skills involved in CLEL can be distributed throughout the community; in other words, not everyone needs to have the same degree or type of knowledge and skills. Some of the skills required for CLEL that were brought up in Survey 1 included systems thinking skills and communication skills.</p>	<ul style="list-style-type: none"> • A key attribute of the knowledge and skills specific to CLEL is their collective, distributed nature. Not all members of the community need to have the same exact type or degree of knowledge, so long as the necessary knowledge and skills are found somewhere within the community. <i>Our suggested solution: Add “collectively-held” to the theme name and emphasize the collective nature more heavily in the theme description</i> • Knowledge and skills aren’t sufficient without other qualities, like efficacy and agency, that lead to action. <i>Our suggested solution: Ensure that future themes emphasize these additional pieces</i> 	<p>Collectively-held knowledge and skills CLEL requires a degree of knowledge and skills to be present in the community. These knowledges and skills need not necessarily be present in or shared amongst all members of the community. Instead, they can be distributed throughout the community. In other words, not everyone needs to have the same degree or type of knowledge and skills, so long as the knowledge and skills can be found somewhere within the community. Areas of focus include but are not limited to systems thinking, communication skills, and knowledge of how the community impacts and is impacted by the local environment.</p>
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Table 2.5 (continued).

<p>Mindfulness around power Because of its scale, CLEL inherently affects and is affected by power dynamics. CLEL must be inclusive of diverse voices and identities within the community, embracing multiple perspectives including Indigenous ways of knowing. CLEL must be justice-oriented and decolonized, and intentional effort and coordination is required to make it so.</p>	<ul style="list-style-type: none"> • While the description of this theme is on the right track, the theme name itself isn't worded well. <ul style="list-style-type: none"> ○ "Power" can mean a lot of different things. As the description is written, this theme feels more like it centers on diversity, equity, and inclusion than power. ○ "Mindfulness" isn't strong enough. Diverse perspectives need to be given the power to impact decision-making related to community issues. <p><i>Our suggested solution: Rename the theme "Inclusion of the community's diverse perspectives"</i></p> • Environmental and social justice are central to CLEL. <i>Our suggested solution: Start the theme description with "CLEL is justice-oriented" to emphasize this importance.</i> • There are many ways of thinking that should be given voice when making decisions about socio-ecological topics—too many perspectives to list each individually by name! However, calling out Indigenous ways of knowing, decolonial approaches, and various other knowledges stemming from diverse lived experiences might be worthwhile. <i>Our suggested solution: Acknowledge that the perspectives listed in the theme description are not exhaustive, but name a few key perspectives that are often overlooked when justice is not being centered</i> 	<p>Inclusion of the community's diverse perspectives CLEL is justice-oriented. It requires the community to embrace diverse voices and identities within the community and equitably give voice to these perspectives when making decisions on socio-ecological topics relevant to the community. Doing this requires a knowledge of, and willingness to navigate and at times subvert and dismantle, systems of power in the community. Perspectives to keep in mind are as far too numerous to list out in full, but they may include Indigenous ways of knowing, decolonial approaches, and other knowledges sparked by individuals' unique lived experiences.</p>
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Table 2.5 (continued).

<p>Behavior / action</p> <p>CLEL isn't just knowledge or beliefs; taking action based on these other CLEL components is a necessary part of this literacy. These actions may be oriented towards policy (civic engagement) or focused on a community problem outside of the policy sphere. The ultimate aim of CLEL is collective action, which is of a different scale than individual behaviors--though some survey respondents reminded us that collective action still involves individuals.</p>	<ul style="list-style-type: none"> • There was divergent feedback on this theme, with some people feeling that collective action was a component of CLEL and others feeling it was an outcome of CLEL. These comments generally fell into one of the following categories: <ul style="list-style-type: none"> ◦ A focus on collective action to solve collective challenges is a key component of CLEL--and this "collective" aspect is what differentiates CLEL from standard definitions of environmental literacy at the individual level. ◦ Action could be considered the outcome of CLEL rather than one of its components. Literacy can exist as a collective capacity without it being activated. <p><i>Our suggested solution: Reword this theme to say that CLEL is aimed at collective action, allowing for flexibility of interpretation based on community context</i></p> • Some participants felt that decision-making may be an important idea to center here rather than (or in addition to) action. Perhaps a community with high levels of CLEL may decide, after careful deliberation, that the appropriate "action" to take on a community challenge is to take no action. <p><i>Our suggested solution: Include this idea of inaction as a potential "action" decision within the theme description</i></p>	<p>Aimed at collective action</p> <p>CLEL's ultimate end goal is to take effective collective action on socio-ecological topics that the community identifies as important. The action itself could be considered to be either a component of CLEL or its outcome; regardless, the orientation of CLEL towards collective action remains the same.</p> <p>It is important to note, too, that aiming the process of CLEL at collective action may not necessarily result in collective action in the end. Perhaps a community with high levels of CLEL may decide, after careful deliberation, that the appropriate "action" to take on a local socio-ecological topic is to take no action.</p>
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Table 2.5 (continued).

<p>Attitudes / feelings CLEEL involves the affective in addition to the more concrete knowledge and skills previously mentioned. In this theme, words like values, norms, motivations, intentions, dispositions, ethics, trust, responsibility, and respect came up frequently amongst survey respondents. All of these play a role in supporting or hindering CLEEL.</p>	<p>There was divergent feedback on this theme. The majority of comments shared one or more of the following sentiments:</p> <ul style="list-style-type: none"> • A degree of shared attitudes and feelings within the community is crucial to transform collective knowledge and skills into collective action. • Specifying that a community must have shared values is antithetical to the idea of respecting a diversity of values and perspectives. It's important that people end up with a shared common goal, but the way they get there—valuing economics, valuing nature's intrinsic beauty, valuing human health, valuing environmental justice, etc.—does not have to be shared. • Maybe “attitudes / feelings” isn’t the right word to describe this. Consider focusing instead on affect, efficacy, norms, and/or agency. <p><i>Our suggested solution: Rename this theme “A common goal” and re-write the theme description to focus on collectively-held efficacy and agency rather than shared value</i></p>	<p>Commitment to a shared goal Members of the community must be collectively committed to addressing a shared goal related to one or more local socio-ecological topics. Though this does not require all community members to share the same set of values, it does require the community to possess a level of collectively-held efficacy and agency related to creating change.</p>
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Table 2.5 (continued).

<p>A continuous, iterative process CLEL is more of a process than an endpoint, shifting and adapting as the community and community needs evolve. Flexibility is key in allowing for this adaptation over time.</p>	<p>Respondents overwhelmingly agreed that CLEL is dynamic and, accordingly, must leave room for flexibility and adaptability in definition and measurement. However, there was some pushback against the idea that CLEL was a process. Respondents suggested that CLEL itself is a capacity—one that is built up by a continuous, iterative process as the original theme suggests, but not a process itself. <i>Our suggested solution: Rename this theme to be “A dynamic capacity” to describe CLEL itself, and ensure that the idea of CLEL being built continuously and iteratively is reflected elsewhere in the themes</i></p>	<p>A dynamic capacity CLEL isn’t static. Instead, it is a dynamic capacity due to the ever-changing nature of a given community, its environment, and the connections between and within these elements.</p>
<p>Interdisciplinary CLEL bridges disciplines and subject areas, intertwining environmental issues with social issues, political challenges, economic hardships, and more. This can be seen in formal interdisciplinary work (i.e., learning about environmental topics in social studies classrooms or math courses), in discussion of environmental issues, and more.</p>	<p>Although there was fairly good numerical agreement on this theme, feedback from this theme and other themes suggested that this may not be a stand-alone theme. Instead, it seems to already be covered within other themes (A focus on socio-ecological topics relevant to the community, Connection, etc.). Additionally, we received some feedback that this wording is very “formal education” heavy, implying (likely incorrectly) that CLEL is centered in schools and universities. <i>Our suggested solution: Remove this theme and highlight the interdisciplinary nature of CLEL throughout the other themes</i></p>	<p>[REMOVED]</p>

CLEL measurement considerations. For each measurement consideration theme, we asked participants the following two questions: “How much do you agree that this theme is important to consider when measuring CLEL?” (hereafter Measurement Question A: Fit) and “How important is this theme as part of a complete list of considerations to take into account when measuring CLEL” (hereafter Measurement Question B: Importance). Each of the eight measurement consideration themes met the criteria for consensus in terms of the theme’s standalone importance and in terms of its importance as a part of a complete list of measurement considerations for CLEL. In other words, across both Measurement Question A: Fit and Measurement Question B: Importance, all themes had a standard deviation of less than 1.5, and over half of the respondents assigned the themes a high importance value of either 2 or 3 (Table 2.6).

Half of the themes—*understanding community connections, inclusivity, understanding community processes, and indicators*—had means of greater than 2 and standard deviations of less than 1 for both Measurement Questions A: Fit and B: Importance, corresponding to especially high average importance values and strong agreement across survey respondents. *Researcher purpose / motivation* was the only measurement consideration theme to have an average importance of below 2 for either of the two questions, indicating that it may be seen as comparatively less important than the other considerations.

Like the CLEL conceptualization themes, the CLEL measurement consideration themes received considerable free-response feedback from the expert participants. These comments fueled suggested edits to the themes in Survey #3, largely adding specificity to the theme descriptions with limited edits to theme names. One theme was also proposed for removal. See Table 2.7 for a record of the original theme name and description derived from Survey #1 data, a

summary of feedback on that original theme received in Survey #2, and the proposed modified theme presented in Survey #3.

Table 2.6. Agreement levels on CLEL measurement consideration themes, as found in Delphi Survey #2.

<i>Theme</i>	<u>Measurement Question A: Fit</u> How much do you agree that this theme is important to consider when measuring CLEL?			<u>Measurement Question B: Importance</u> How important is this theme as part of a complete list of considerations to take into account when measuring CLEL?		
	<i>Mean</i>	<i>Standard deviation</i>	<i>% “agree” or “strongly agree”</i>	<i>Mean</i>	<i>Standard deviation</i>	<i>% “very important” or “extremely important”</i>
Inclusivity	2.61	0.63	93%	2.50	0.75	93%
Understanding community connections	2.57	0.57	96%	2.43	0.74	86%
Indicators	2.39	0.74	93%	2.25	0.80	79%
Understanding community processes	2.32	0.77	82%	2.14	0.93	79%
Understanding community needs	2.29	0.90	79%	2.14	1.21	79%
Understanding community bounds	2.14	1.04	79%	2.11	1.07	71%
Researcher purpose / motivation	2.07	0.87	74%	1.82	1.28	71%
Understanding community components	2.04	1.08	77%	2.14	0.97	79%

Table 2.7. Survey #1’s CLEL measurement consideration themes with feedback from Survey #2, with modified themes proposed in Survey #3.

<u>Original theme from Survey #1</u>	<u>Summarized feedback from Survey #2</u>	<u>Modified theme proposed in Survey #3</u>
<p>Inclusivity CLEL measurement strategies need to be inclusive of varied values, life experiences, ways of knowing, and stakeholder perspectives. Because of the pluralistic nature of communities, this may require a certain level of acknowledging and embracing difference and disagreement. It may also help to engage the community members themselves in the measurement process.</p>	<p>This theme had a very high level of agreement amongst respondents. Several respondents brought up the idea of how power needs to be discussed alongside inclusivity—not just power dynamics within the community, but also power structures that act upon the community from the outside. <i>Our suggested solution: Emphasize power dynamics within the theme description</i></p>	<p>Inclusivity CLEL measurement strategies need to be inclusive of varied values, life experiences, ways of knowing, and stakeholder perspectives. Because all communities are impacted by inequitable power structures acting within and/or upon them, CLEL measurement efforts must counteract these power structures in order to lift up less privileged perspectives. Additionally, the pluralistic nature of communities necessitates that communities and researchers expect and embrace a level of difference and disagreement. Engaging community members in measurement is an effective strategy for bringing a variety of local knowledges into the process and mitigating potential power differentials between researchers and community members.</p>

Table 2.7 (continued).

<p>Indicators Measuring CLEL requires researchers to be clear about how they are defining and operationalizing indicators of CLEL (the components defined in the first section of this survey). For example, researchers should be clear about how they are defining knowledge--is it distributed unevenly across the community, or does everyone need to have the same level of knowledge? Is it enough to have knowledge, or are other attitudes, motivations, or values necessary? Is the researcher measuring CLEL as a continuous process or as an endpoint that a community reaches once they get to a certain level of these indicators or a certain goal is achieved?</p>	<ul style="list-style-type: none"> • This theme should explicitly give space for qualitative indicators in addition to quantitative ones, perhaps mentioning emergent states. <i>Our suggested solution: Specify this in an additional sentence within the theme description</i> • Definitions should be co-created by researchers and community members. <i>Our suggested solution: Specify this in an additional sentence within the theme description</i> • Social norms around environmental concern might be important in addition to distributed knowledge. <i>Our suggested solution: Add “community norms” to the theme description</i> • Communities must be able to leverage distributed knowledge in order for it to be useful. <i>Our suggested solution: Add “and leveraged collectively” to the theme description</i> 	<p>Indicators Measuring CLEL requires clarity in the definitions and operationalizations of the indicators of CLEL. For example, there must be clarity in how knowledge is defined--can it be distributed unevenly across the community and leveraged collectively, or does everyone need to have some baseline level of knowledge? Is it enough to have knowledge, or are other attitudes, motivations, or community norms necessary? Is CLEL being measured as a continuous process or as an endpoint that a community reaches once they get to a certain level of these indicators or collective action is undertaken? These questions should be answered and definitions reached collaboratively between researchers and community members. It is also important to note that the idea of an indicator here is defined broadly, giving room for qualitative indicators (e.g., emergent states investigated through interviews) in addition to quantitative indicators (e.g., knowledge of local socio-ecological topics measured via a close-ended survey).</p>
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Table 2.7 (continued).

<p>Researcher purpose / motivation Because a researcher's motivation for measuring CLEL impacts how they go about doing so, it is important to reflect upon this motivation and how it may impact the measurement processes and/or results. Is the purpose to be able to compare across communities? To help a community reach a certain collective impact goal? To understand the starting point of a community's literacy so that you can measure change? Something else?</p>	<p>Despite there being low numerical agreement on this theme, there weren't too many overwhelming disagreements brought up in the comments or suggestions for overhauling this theme. The main points of commentary were as follows:</p> <ul style="list-style-type: none"> • Researcher positionality relative to the community is important here, too. <i>Our suggested solution: Add positionality to the theme name and description</i> • This is all important to consider before starting in on the research, as well as to return to periodically throughout the research. <i>Our suggested solution: Add this to the theme description</i> • Community should be at the center of any effort to measure CLEL; in the words of one respondent, "a community's literacy is for them. It serves their purposes and meets their definitions." <i>Our suggested solution: Add an additional sentence in the theme description to emphasize this</i> • The use of first-person pronouns in this description should be rethought. <i>Our suggested solution: Change to third person pronouns to match the other theme descriptions</i> 	<p>Researcher purpose and positionality Because a researcher's positionality and motivation for measuring CLEL impacts how they carry out and interpret the research, it is important for them to acknowledge and reflect upon this both before starting the research and periodically throughout the research process. Ultimately, CLEL belongs to the community, and the researcher should ensure that their own research priorities or evaluation efforts do not impede the goals of serving the community's needs and answering the community's questions.</p>
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Table 2.7 (continued).

<p>Understanding community bounds</p> <p>To measure community-level environmental literacy, we need to be clear about how we are defining the community in which we are working. Survey respondents talked about how communities can be bounded in many ways--by geography, by identity, by association, etc. Several people also emphasized that a community can change over time, as can its bounds, calling for flexibility on the researchers' part.</p>	<p>Respondent comments indicated agreement that defining community boundaries is important for measurement purposes. The overarching comments included the following:</p> <ul style="list-style-type: none"> • The community itself should be involved in its own self-definition--the researcher should not be the one defining the community. <i>Our suggested solution: Add a sentence specifying this within the theme description</i> • The boundaries need to be defined before starting in on the evaluation effort, and the researcher should regularly revisit this definition to ensure that they are still measuring within these bounds--or to note that the community bounds have shifted. <i>Our suggested solution: Add a sentence specifying this within the theme description</i> 	<p>Understanding community bounds</p> <p>To measure community-level environmental literacy, the community needs to be clearly defined and bounded. The community itself should have the lead voice in this process; in other words, the boundaries of the community should reflect the community's understanding of itself.</p> <p>Communities can be bounded in many ways--by geography, by identity, by association, and more. A community and its membership can also shift over time, which requires flexibility and regular revisiting of the community definition on the researchers' part.</p>
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Table 2.7 (continued).

<p>Understanding community components Measuring CLEL requires understanding the makeup of the community. Study participants discussed three broad types of community components: people, institutions, and the physical environment. A researcher should familiarize themselves with these different elements of the community to more effectively measure CLEL.</p>	<ul style="list-style-type: none"> • This feels like a foundational preparatory step rather than something to first be considered during measurement—though considering it during measurement is important, too, given that community components are as dynamic as the communities themselves. <i>Our suggested solution: Add two sentences specifying this within the theme description</i> • Repeatedly referring to “researchers” and “community members” separately feels antithetical to the collaborative, participatory approach this research should ideally take. <i>Our suggested solution: Remove this dichotomous language and use “CLEL measurers” to be inclusive of both researchers and community members</i> • The phrase “people, institutions, and the physical environment” does not cover other important community elements, nor are all of these present in all communities. <ul style="list-style-type: none"> ○ Community norms, power structures, and history (particularly past injustices) are all key to understanding the current dynamics of the community. ○ Not all communities will have all of these components. Online communities, for example, will not have a shared physical environment. <p><i>Our suggested solution: Add these additional community components to the theme description, clarify that the list is not exhaustive, and specify that not all communities must contain all components</i></p>	<p>Understanding community components Effectively measuring CLEL requires understanding the makeup of the community. Key parts of the community include its tangible components—such as people, institutions, and the physical environment—as well as more abstract concepts—like community norms, power structures, and history (including past injustices). While all of these listed components will not necessarily be present in all communities, CLEL measurers should spend time before engaging in the evaluation process identifying and familiarizing themselves with the components that are relevant to their specific community. Given the dynamic nature of a community and the elements that comprise it, these components should also be revisited throughout the measurement effort.</p>
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Table 2.7 (continued).

<p>Understanding community connections</p> <p>Given that this type of literacy is driven by connection, understanding the nature of social connections within the community of interest is important to effectively measuring CLEL.</p>	<p>While this theme is generally good, more specificity might be helpful.</p> <ul style="list-style-type: none"> ○ Naming some tools could be useful. ○ Specifying that these connections are dynamic is important. ○ It could be helpful to discuss how understanding a lack of connection—perhaps due to historic injustices—can help with understanding how CLEL is formed and how strongly. <p><i>Our suggested solution: Keep the title and initial sentence of the theme description, but also add additional specificity as suggested above</i></p>	<p>Understanding community connections</p> <p>Given that CLEL is driven by connection, understanding the nature of social connections within the community of interest is important to effectively measuring this type of literacy. Some forms of connection to investigate include social cohesion, the distribution of social capital, and the structure of social networks, including which “nodes” might have power as connectors or gatekeepers of knowledge or action. It is also important to understand which community components might be disconnected from each other and why; this becomes all the more important if connecting those components might afford more opportunities for effective collective action. Tools such as social network analysis and measurement of diffusion of innovation can be helpful in understanding these complex, dynamic connections.</p>
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Table 2.7 (continued).

<p>Understanding community processes Community processes, both civic and otherwise, impact how a community builds CLEL. It is therefore important to understand these processes to better understand the context in which CLEL is created (or limited).</p>	<p>This theme is a bit nebulous as-is.</p> <ul style="list-style-type: none"> ○ Specify that political processes are part of this theme. ○ Acknowledge that many communities may totally lack any process for ground-level involvement in decision-making. <p><i>Our suggested solution: Add to the theme description to clarify the above points</i></p>	<p>Understanding community processes Community processes, both civic and otherwise, impact how or whether a community builds CLEL. It is therefore important to understand these processes to better understand the context in which CLEL is created (or limited). Examples of community processes include the political processes that allow for community involvement in decision-making and, equally importantly, those that do not allow for community involvement either through intentional exclusion or through a lack of established inclusionary processes.</p>
<p>Understanding community needs Finally, it is key to understand what a community wants as well as what might prevent them from achieving these goals. Measurement strategies can then be tailored accordingly.</p>	<p>Many respondents felt that this theme did not necessarily make sense as a stand-alone theme, as other themes seemed to cover this topic already. For example, the “inclusivity” theme and other theme descriptions already suggest CLEL measurement as a collaborative, participatory process, meaning that community needs would by definition be expressed and prioritized through the process. Likewise, understanding barriers or obstacles to CLEL could fall under the other “understanding community” themes.</p> <p><i>Our suggested solution: Remove this theme and ensure that it is covered in other theme descriptions</i></p>	<p>[REMOVED]</p>

Round 3

Expert panelists

Out of the 28 scholars that participated in Survey #2, 25 participated in Survey #3 (11% attrition rate). Demographics were again similar to those described for Survey #1 and Survey #2, with minor changes shown in Table 2.1. Areas of expertise also remained similar to those previously reported (Figure 2.2).

Findings

CLEL conceptualization. Survey #3 asked Delphi participants to answer the three questions below about the modified themes presented to them:

- Conceptualization Question A: Fit – How much do you agree that this modified theme fits into your conceptualization of CLEL?
- Conceptualization Question B: Importance – How important is this modified theme as part of a complete conceptualization of CLEL?
- Conceptualization Question C: Improvement – How much do you agree that the modified theme is an improvement upon the original theme?

Conceptualization Questions A: Fit and B: Importance paralleled those asked in Survey #2, with Conceptualization Question C: Improvement looking to directly compare the original themes presented in Survey #2 with the modified themes presented in Survey #3.

Across all themes, over half of respondents either “agreed” (2) or “strongly agreed” (3) with Conceptualization Question A: Fit, indicating consensus based on that particular measure. For this question, all themes except for one also met the other standard for consensus of a standard deviation lower than 1.5. The theme stating that CLEL is *aimed at collective action*

(derived from the original theme of *behavior / action*) had a standard deviation of 1.56, falling short of consensus by the standard deviation measure. This provides mixed evidence on whether there was expert agreement around this edited theme.

Looking at Conceptualization Question B: Importance, all modified themes met both criteria for consensus without exception, indicating broad agreement that all themes were considered to be an important part of a complete conceptualization of CLEL.

With regards to Conceptualization Question C: Improvement, all themes met the metric for consensus based on greater than 50% of respondents agreeing or strongly agreeing that the modified theme was an improvement on the original theme. However, one theme failed to meet the standard deviation threshold for consensus: *commitment to a shared goal*, generated from the original theme of *attitudes / feelings*, which had a standard deviation of 1.53. Again, the fact that this theme met one but not both measures of consensus gives us less certainty about whether true consensus was reached within the group of study participants.

Looking across Conceptualization Questions A: Fit, B: Importance, and C: Improvement (Table 2.8), three conceptualization themes consistently received notably high average ratings (above 2) and especially low standard deviations (below 1): *a focus on socio-ecological issues relevant to the community, connection, and collectively-held knowledge and skills*. The highly-rated importance of these themes alongside high levels of participant agreement indicate the centrality of these themes to conceptualizing CLEL.

See Table 2.8 for detailed quantitative measures of consensus.

Table 2.8. Agreement levels on modified CLEL conceptualization themes, as found in Delphi Survey #3.

<u>Theme</u>		<u>Conceptualization Question A: Fit</u> How much do you agree that this modified theme fits into your conceptualization of CLEL?			<u>Conceptualization Question B: Importance</u> How important is this modified theme as part of a complete conceptualization of CLEL?			<u>Conceptualization Question C: Improvement</u> How much do you agree that the modified theme is an improvement on the original theme?		
<i>Original theme</i>	<i>Modified theme</i>	<i>Mean</i>	<i>Standard deviation</i>	<i>% “agree” or “strongly agree”</i>	<i>Mean</i>	<i>Standard deviation</i>	<i>% “very important” or “extremely important”</i>	<i>Mean</i>	<i>Standard deviation</i>	<i>% “agree” or “strongly agree”</i>
A focus on environmental issues	A focus on socio-ecological topics relevant to the community	2.56	0.77	92%	2.64	0.49	100%	2.48	0.87	92%
Knowledge / skills	Collectively-held knowledge and skills	2.48	0.59	96%	2.32	0.95	88%	2.36	0.70	88%
Connection	Connection	2.44	0.71	88%	2.60	0.58	96%	2.36	0.70	88%
Mindfulness around power	Inclusion of the community’s diverse perspectives	2.24	1.05	80%	2.32	0.95	84%	2.12	1.17	76%
Attitudes / feelings	Commitment to a shared goal	1.96	1.27	76%	2.12	1.17	76%	2.00	1.53	84%

Table 2.8 (continued).

A continuous, iterative process	A dynamic capacity	1.92	1.19	72%	1.84	1.21	72%	1.84	1.31	68%
Behavior / action	Aimed at collective action	1.76	1.56	80%	2.28	0.98	80%	1.88	1.39	76%
Interdisciplinary	[Removed]	N/A	N/A	N/A	N/A	N/A	N/A	1.68	1.25	60%

CLEL measurement considerations. Delphi panelists responded to the following three questions for each of the eight modified measurement consideration themes presented in Survey #3:

- Measurement Question A: Fit – How much do you agree that this modified theme is important to consider when measuring CLEL?
- Measurement Question B: Importance – How important is this modified theme as part of a complete list of considerations to take into account when measuring CLEL?
- Measurement Question C: Improvement – How much do you agree that the modified theme is an improvement on the original theme?

Similarly to the format for the conceptualization questions discussed previously, the first two questions (Measurement Question A: Fit and Measurement Question B: Importance) mirrored the questions asked in Survey #2. Measurement Question C: Improvement sought perspectives on whether the modified theme was stronger than the original theme.

Consensus, both in terms of a standard deviation of less than 1.5 and in terms of over half of participants assigning the themes high ratings, was reached on all measurement consideration themes across Measurement Questions A: Fit, B: Importance, and C: Improvement. This indicates that the expert panel largely agreed that each modified theme was an improvement upon the original theme, each modified theme was important to consider on its own when measuring CLEL, and each modified theme was important as part of a full list of considerations to keep in mind when measuring CLEL (Table 2.9).

Two themes—*understanding community components* and *understanding community processes*—stood out due to their especially high ratings and levels of consensus. These two themes received ratings of 2 or 3 with a standard deviation of below 1 across all questions in

Survey #3, highlighting these themes as particularly salient ideas to take into account when measuring CLEL.

See Table 2.9 for exact means, standard deviations, and percents of high ratings.

Table 2.9. Agreement levels on modified CLEL measurement consideration themes, as found in Delphi Survey #3.

<u>Theme</u>		<u>Measurement Question A: Fit</u> How much do you agree that this modified theme is important to consider when measuring CLEL?			<u>Measurement Question B: Importance</u> How important is this modified theme as part of a complete list of considerations to take into account when measuring CLEL?			<u>Measurement Question C: Improvement</u> How much do you agree that the modified theme is an improvement on the original theme?		
<i>Original theme</i>	<i>Modified theme</i>	<i>Mean</i>	<i>Standard deviation</i>	<i>% “agree” or “strongly agree”</i>	<i>Mean</i>	<i>Standard deviation</i>	<i>% “very important” or “extremely important”</i>	<i>Mean</i>	<i>Standard deviation</i>	<i>% “agree” or “strongly agree”</i>
Understanding community components	Understanding community components	2.60	0.50	100%	2.32	0.95	88%	2.48	0.59	96%
Inclusivity	Inclusivity	2.60	0.58	96%	2.32	1.11	88%	2.40	0.65	92%
Understanding community bounds	Understanding community bounds	2.32	0.75	92%	2.16	1.11	88%	2.16	1.37	80%
Understanding community connections	Understanding community connections	2.32	1.03	88%	2.40	0.96	88%	2.08	1.26	84%
Indicators	Indicators	2.32	0.85	96%	2.28	1.34	88%	1.88	1.30	84%

Table 2.9 (continued).

Understanding community processes	Understanding community processes	2.20	0.76	88%	2.28	0.98	92%	2.28	0.79	88%
Researcher purpose / motivation	Researcher purpose and positionality	2.08	0.91	80%	1.96	1.40	80%	2.12	0.93	80%
Understanding community needs	[Removed]	N/A	N/A	N/A	N/A	N/A	N/A	2.08	0.86	88%

Synthesized framework. Study participants overwhelmingly agreed that the CLEL summary framework, generated by combining all modified conceptualization and measurement themes into a single narrative statement, aligned with their conceptualization of CLEL. Participants gave an average agreement value of 2.40 on our scale of -3 to 3, with a standard deviation of 0.65; additionally, 92% of participants said that they either “agreed” or “strongly agreed” with the statement. This exceeds our requirements for consensus. The summary framework is as follows, with a graphical representation in Figure 2.3:

CLEL is the capacity of a community to work towards collective action related to socio-ecological challenges in their community. Key components of this capacity include collectively-held knowledge and skills related to local socio-ecological topics as well as collective commitment and ability to pursue a shared goal.

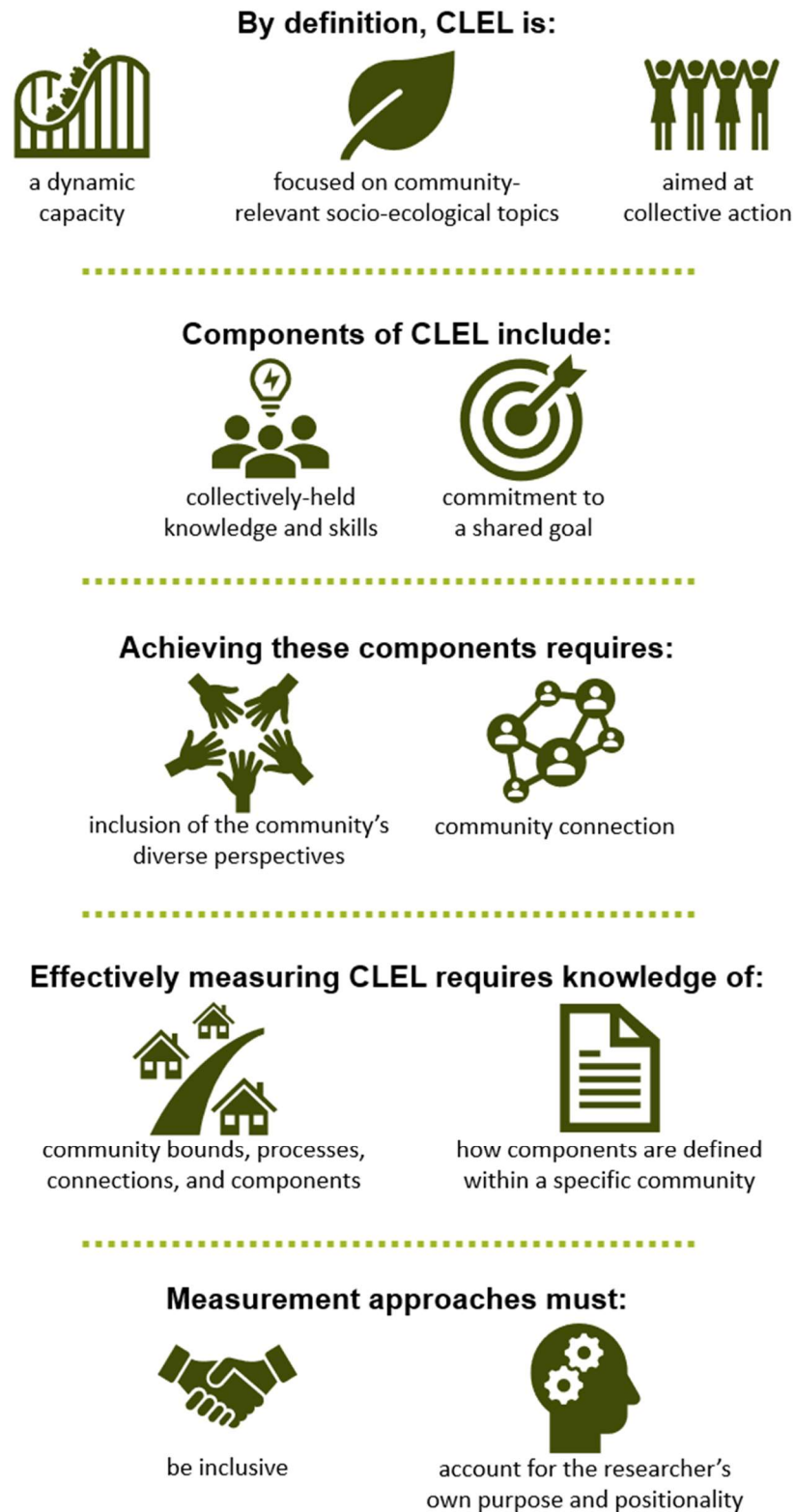
Achieving CLEL requires connection—both between community members and between the community and its environment—as well as intentional inclusion of the community’s diverse perspectives in decision-making. CLEL is dynamic due to the ever-changing nature of a given community, its environment, and the connections between and within these elements.

Efforts to measure CLEL must be inclusive of the community’s varied values and ways of knowing, actively engaging these different people and their perspectives in the measurement process. CLEL measurers, particularly researchers or evaluators who come from outside the community of focus, should examine their own goals and positionality before and during the measurement process to ensure that community needs and perspectives are always placed first.

Measuring CLEL requires a deep knowledge of the community of focus, including the following aspects of community: how it is bounded (e.g., by geography, by identity, by association); its major components both tangible (e.g., people, physical environment, institutions) and intangible (e.g., norms, power structures, history); the nature and structure of the social connections within it; and the processes that enable or prevent community involvement in decision-making.

Figure 2.3

Graphical summary of proposed CLEL framework.



Discussion

The CLEL conceptualization findings of this study align strongly with the two pieces of existing literature around environmental literacy beyond the individual level, emphasizing its goal of collective action, its dynamic tendencies, and its distributed nature. This is not particularly surprising, given the significant overlap in individuals and academic backgrounds involved in the creation of these different papers—see “Limitations and future research” for further discussion. Nevertheless, both Gibson et al. (2022) and Ardoin et al. (2022) frame the need for understanding collective or community-level environmental literacy as ultimately stemming from a need to understand and foster collective action, a framing with which our Delphi findings agree. All authors, including those of this paper, view CLEL as a necessary step towards collective environmental action, with the two linked together in a way similar to individual-level environmental literacy and individual-level action.

However, there is still a degree of disagreement on whether collective action is a *component* of CLEL or an *outcome* of CLEL. This debate is reflected in the relatively high standard deviation of the *aimed at collective action* theme; when respondents were asked in Survey #3 about the degree to which this theme aligned with their conceptualizations of CLEL, a standard deviation of 1.56 emerged—the highest standard deviation of any theme—indicating a lack of consensus. The open-ended feedback on this theme (Table 2.5) indicated that this divergence was likely due to the fact that some scholars viewed CLEL as describing the capacity of a community to take action (i.e., all of the steps leading up to action but not action itself) while others viewed CLEL as incomplete without action. This “component or outcome” discussion in the Delphi study mirrors that found in the individual-level environmental literacy research, with scholars presenting environmental literacy as a precursor to (Culen & Mony,

2003), pathway toward (Wheaton et al., 2018), or enveloping (Hollweg et al., 2011) individual-level engagement in environmental action. Within the CLEL literature, Gibson et al. (2022) acknowledge this tension in their paper but do not take a stance on whether CLEL is a precursor to or inclusive of collective action. In contrast, Ardoin et al. (2022) describe collective environmental literacy as “[collective] action along with its various supporting structures and resources,” proposing that action is a component of CLEL. Further scholarly discussion may lend additional clarity to this topic.

The experts in this Delphi process also underscored the dynamic nature of CLEL that follows the ever-changing characteristics of a given community and its environment—a nature that requires frequent reflection, adaptation, and iteration both in definition and in measurement. Existing literature agrees with Ardoin et al. (2022) proposing this dynamism as one of the four key aspects of collective environmental literacy and Gibson et al. (2022) pointing to it as a challenge in measuring CLEL. Within that general agreement, though, lies a nuanced debate over whether CLEL is a dynamic *process* or a dynamic *capacity*. The conceptualization theme related to this topic began as *a continuous iterative process*, arising from qualitative data gathered in Survey #1 and in alignment with past conceptualizations of environmental literacy as a process (Wheaton et al., 2018). However, when this theme was presented in Survey #2, some panelists felt that, although CLEL was generated through an iterative process, CLEL was not a process itself. Instead, they felt that it was a *capacity* for taking effective collective action, a capacity that waxes and wanes over time depending on collective knowledge, community connections, and other components of CLEL mentioned in other themes. When the theme name was proposed to be changed to *a dynamic capacity* in Survey #3, though, there were slightly lower levels of agreement on its importance as part of a complete conceptualization framework for CLEL

(mean=1.84 and $s=1.21$ for a *dynamic capacity*; mean=2.14 and $s=1.11$ for a *continuous iterative process*); there was, however, general agreement that the changed theme name and description was an improvement on the original (mean=1.84 and $s=1.31$). These mixed signals on whether CLEL is a capacity or a process indicate that it would be helpful to probe this idea further in the future, particularly as it might tie into the previous discussion of whether CLEL is a capacity for action or encompassing of action.

The collectively-held nature of skills and knowledge related to community socio-environmental challenges link to Ardoin et al. (2022)'s ideas of shared resources, speaking to the idea that CLEL is more than just the aggregate of community members' individual-level environmental literacies. Through both their original ideas in Survey #1 and their feedback in Survey #2, Delphi panelists pointed out that, although it is necessary to have a level of knowledge and skills present within a community to achieve CLEL, this knowledge and these skills need not exist to an equal degree in every community member. Instead, knowledge and skills can be sprinkled throughout the community unevenly, to be located and put into action by the community when needed. Ardoin et al. (2022) point to this idea through their concepts of shared resources (including knowledge, skills, and behaviors). Through sharing resources across the group rather than requiring every individual to build knowledge and skills in the same areas, communities can act more efficiently and accomplish more than individuals could alone. This also relates to Gibson et al. (2022)'s discussion of how shared knowledge, action strategies, and social capital may move CLEL from a latent state (a capacity) to an enabled state (collective action). The collectively-held nature of the various aspects of CLEL, then, is a generally agreed-upon characteristic that distinguishes CLEL from individual-level literacy. Beyond the limited CLEL literature, this idea of situated and distributed knowledge is also present in emerging

literature around community-level science literacy (NASEM, 2016; Roth & Calabrese Barton, 2004; Roth & Lee, 2002), adding additional credence to this Delphi finding.

In addition to providing additional perspectives on CLEL conceptualization, our Delphi process also generated, for the first time, a list of measurement considerations for CLEL that may guide future research efforts in this nascent area of study. While other literature has focused largely on conceptualization (Ardoin et al., 2022) and/or have posed limited questions on measurement (Gibson et al., 2022), this study outlines specific aspects—both of the researched community as well as the researchers themselves—that should be considered in CLEL measurement endeavors. Delphi participants emphasized the importance of deeply knowing the community of focus before and during CLEL measurement, establishing thorough knowledge of its boundaries (physical or associative), its processes (including civic processes), its connections (between people and each other, as well as between people and the environment), and its key components (demographics, norms, histories, etc.). These themes remained relatively constant throughout the Delphi process—far more than the conceptualization themes did—with just minor suggestions of edits to the theme descriptions rather than overhauls to the theme as a whole. The early and consistent consensus across these community understanding themes suggests that they may be a good starting point for measurement considerations of CLEL, though future research is of course needed to confirm or challenge this. They also add credence to the idea brought up by Gibson et al. (2022) that participatory research might be an appropriate approach when doing CLEL research, as members of the communities themselves bring the deepest knowledge of community possible. Additionally, Delphi participants underlined the need for researcher transparency in their own purpose for measuring CLEL, their positionality with regards to the research, and the indicators they are using to assess CLEL. This, too, hints at the potential

usefulness of a close researcher-community working relationship, with consistent open communication between the measurer of CLEL and the community being measured to ensure that the process is reciprocal and non-extractive. Researchers may consider looking to community-based participatory action research literature (Maiter et al., 2008; Bacon et al., 2013) and ethnographic scholarship (Nicols et al., 2017; Averill, 2006) for ideas on how to foster reciprocal, community-empowering relationships in their CLEL work, even if these methodological approaches are not those that they ultimately end up pursuing.

Zooming out to look at these findings holistically, the study also emphasizes the importance of inclusivity and connection, both in fostering and in accurately measuring community-level environmental literacy. While previous research has discussed the value of community collaboration involving diverse groups (synergy in Ardoin et al., 2022; representation of diverse perspectives in Gibson et al., 2022), this study places social justice and inclusivity directly at the center of CLEL. In their open-ended feedback in Survey #2, many Delphi participants underscored that CLEL, by definition, works to advance equity within a community, focusing on socio-ecological topics that interplay with social issues rather than on purely “environmental” issues that mainstream environmentalism has focused on in the past (Thomas, 2022). One Delphi respondent put it this way: “environmental issues without social justice does not constitute CLEL.” The conceptualization theme *inclusion of the community’s diverse perspectives* captures this sentiment within the first sentence of its description—“CLEL is justice-oriented”—and goes on to discuss the importance of giving power to historically marginalized perspectives in decision-making around community-relevant socio-ecological issues. This idea is also reflected in the measurement consideration theme of *inclusivity*, which highlights the need to amplify less privileged voices when determining how to assess CLEL to

avoid solely focusing on the most privileged perspectives and measurement techniques (in the United States, often ideas of Western science and quantitative measurement; Gough, 2002).

The importance of connection also emerged repeatedly in this study, suggesting that collective measurement strategies might need to be employed in order to properly grasp the degree of CLEL present within a community. Connections between individuals and their fellow community members as well as between community members and their local environments were seen as drivers of CLEL (conceptualization theme *connection*). This adds evidence to the theoretical (Ostrom & Ahn, 2007; Krasny, 2020) and empirical (Gibson Chapter 3) link between relationship-driven concepts, like social networks and social capital, and the advancement of collective action efforts. It also hints that collective measures that take these connections into account might be needed to assess CLEL (measurement consideration theme *understanding community connections*), in line with past suggestions of measuring collective outcomes with techniques like social network analysis (Gibson et al., 2022; Borgatti et al., 2018). Further exploration into creative methods of capturing connection could prove to be useful for future CLEL work.

Limitations and future research

The findings of this study are not without limitations, due in part to the nature of Delphi methodologies. A Delphi study, by nature, solely reflects the perspectives of its participant panelists. While we worked to invite a diversity of voices to our expert panel, participation in the study was fully voluntary and unpaid; study participation, then, could be seen as essentially adding to the underrecognized service to which scholars from historically underrepresented communities disproportionately contribute (Brissett, 2020; Wood et al., 2016; Baez, 2000). Not

surprisingly, then, our Delphi panel was relatively homogenous, with white scholars numerically dominating the group. Given that the environmental education field is far more racially diverse than our study's experts (Gupta et al., 2019), this could have contributed to a conceptualization of CLEL that does not match its own stated goals of centering diverse perspectives. We humbly welcome critique from scholars of Black, Indigenous, and other historically marginalized racial and ethnic identities so that our field can work toward a better, more inclusive understanding of CLEL. Gender diversity was also lacking on our panel. While our large numbers of women on the panel generally matches the fact that environmental education as a field has more women than men in senior leadership positions (Taylor, 2015), we had no participants beyond the dominant gender binary. This represents another weakness of the study, as these perspectives are welcomed and needed in the CLEL conversation. Finally, due to the authors' location in the United States and the majority of their networks centering around this country, there was limited expert representation beyond the US borders. Repeating a similar study in other countries and contexts might provide interesting comparative cases and spark additional fruitful discussion.

It is also important to note that the agreement between this study and the other two studies on beyond-individual environmental literacy may be due in part to many of the same voices being present in each of these efforts. The individuals involved in organizing and analyzing this Delphi study overlapped significantly with those who led the 2020 CLEL convening described in Gibson et al., 2022; all three authors of Ardoin et al., 2022, also participated in the 2020 CLEL convening and contributed to the Gibson et al., 2022, paper. This means an incredibly limited number of scholars are publishing on this topic at the moment, creating what could be an echo chamber of CLEL conceptualizations. Although this Delphi study brought in many new expert voices, their voices and perspectives were still analyzed through the

lens of the authors' past work. We encourage additional scholars to engage in scholarly writing about CLEL to ensure that our musings and those of our professional colleagues are not the only ones present in the literature.

Beyond the lack of diversity in the expert panel, the Delphi study was also inherently limited due to the small number of iterations of participant feedback involved in the methodology. While our established definition of consensus was largely reached by the end of Survey #3 across conceptualization and measurement consideration themes, there was still significant participant feedback on how to further hone the themes and their descriptions. Continuing with the iterative co-development process could have led to stronger consensus and insights into what CLEL is and how it may be assessed. Future work, perhaps combining Delphi processes with in-person discussion and debate (as in Gibson et al., 2022), could help further refine the ideas generated in this study. It is also possible that the lack of consensus within this Delphi study alludes to the idea that there may never be complete consensus on a CLEL framework due to the highly contextual, dynamic nature of communities and therefore of CLEL. Again, additional research would help probe this, perhaps resulting in the development of several different and equally valid conceptualizations of CLEL.

Conclusions and moving forward

In systematically bringing together perspectives from across the field of environmental education in iterative conversation, this study contributes to the ongoing discussion of environmental literacy beyond the individual level—moving the field one step closer to understanding how to foster collective action. The individual themes generated from this process provide guidance on the components of CLEL as well as what to keep in mind when assessing

CLEL, and the synthesis framework (Figure 7) brings these ideas together in a single narrative. These themes align with past theoretical research on this topic (Gibson et al., 2022; Ardoin et al., 2022) while also adding new ideas about the central role of justice and connection in CLEL conceptualizations. Moving forward, we enthusiastically invite discussion with and critique from other scholars within the field of environmental education as well as adjacent fields to help us all work toward a more nuanced view of CLEL. We also encourage empirical work in CLEL that might confirm or challenge the framework established here through pilot testing it in real-world contexts. Empirical, theoretical, or otherwise, we ultimately look forward to scholarly discussion of any sort on the topic of CLEL so that the environmental education field can continue moving forward in understanding how to foster collective action needed to address today's socio-ecological challenges.

Acknowledgements

The authors extend our deepest thanks to the scholars who served as expert panelists in this Delphi study, particularly the following 25 scholars who participated in all three stages of the study: Aimee Fraulo, Alex Kudryavtsev, Alison Bowers, Aparajita Rajwade, Billy Spitzer, Bora Simmons, Caitlin Reilly, Carrie McDougall, Charlotte Clark, Christopher Jadallah, Genie Bey, Ian Humphreys, Jean Goodwin, Jill K. McGowan, Ju Chou, Karen Kerr, Kathayoon Khalil, Lauren Watkins, Martha Monroe, Nils Peterson, Peta White, Roberta H. Hunter, Sarah Carrier, T'Noya Thompson, and Vince Meldrum.

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CHAPTER 3:

Pushing towards systemic change in the Capitalocene: Investigating the efficacy of existing behavior prediction models on private-sphere and collective pro-environmental actions in high school students

Introduction

In recent decades, the world has been hit with a barrage of global-scale environmental challenges spurred by capitalistic socioeconomic systems. Microplastics born of low-priced highly-harmful disposable plastic products permeate the ocean, impacting the health of global seafood stocks through chemical release and direct ingestion (Shim & Thomposon, 2015). Corporations release pollutants into water supplies, threatening vulnerable populations and creating environmental injustices in the United States and beyond (Butler et al., 2016). Growing international demand for Brazilian beef and the resulting expansion of cattle ranching land is responsible for 80% deforestation in the Brazilian Amazon, driving climate change and, in the process, increasing the frequency and severity of extreme weather events across the world (Skidmore et al., 2021; Kaimowitz et al., 2004; IPCC, 2018). These and other environmental issues—disproportionately perpetrated by the economic systems of the global north to the detriment of the global south (Akizu et al., 2017; Cotta, 2020)—extend beyond country borders, impacting communities all across our globalized world.

Environmental education holds promise as a strategy to help people tackle these challenges through fostering pro-environmental behavior. As a public good that from its establishment tasked itself with reaching people of “all age groups both inside and outside the formal school system” (hereafter referred to as “learners”; UNESCO, 1977), environmental education has a responsibility to support members of the public in building the skills and knowledge required to engage with and help address these pressing problems on their own terms and in ways they see fit. Programs that carry out environmental education often work toward this

goal through building environmental literacy—the knowledge, dispositions, and skills related to environmental topics—for the individuals they teach (Hollweg et al., 2011; Ardoin et al., 2018). Environmental literacy is considered to be a necessary precursor to the pro-environmental behaviors that these organizations wish to cultivate (Hollweg et al., 2011). For example, to help learners adopt behaviors that combat climate change, environmental educators might explain how carbon emissions can cause large-scale issues worldwide (knowledge), build up the individual's motivation to take action through identifying local impacts of climate change (dispositions), and discuss concrete action strategies to reduce personal carbon emissions (skills) (De Young, 1993). The educational intervention would then be considered successful if the learner leveraged their new knowledge, dispositions, and skills to engage in a new carbon-mitigating behavior, like adjusting their home's thermostat to decrease energy usage, upon returning home. In this way, environmental education seeks to spark pro-environmental behaviors through building environmental literacy.

Both in practice and in research efforts, environmental education tends to focus on these pro-environmental behaviors at the individual, private-sphere level—which may come short of the approach we need in the Capitalocene. For example, environmental education initiatives often concentrate on spurring small-scale actions among individuals, such as encouraging learners to take shorter showers to reduce household water consumption, and research studies in turn concentrate on what factors may contribute to the uptake of behaviors at this scale (Ballantyne & Packer, 2005). However, fostering and understanding drivers of pro-environmental behaviors at the individual, private-sphere level will not be enough to overcome the massive socio-ecological challenges of the Capitalocene. Let us take climate change as an example. While a person's efforts to reduce their carbon emissions can make a positive impact on climate change (Hens et

al., 2001; Zhou & Yang, 2016), individuals acting alone simply cannot surmount the economic, political, and social barriers to achieve the scale of action necessary to solve a global-scale phenomenon (Ide et al., 2020; Vachon & Menz, 2006). Researchers have found that just 90 companies are responsible for over 60% of the planet's carbon emissions (Heede, 2014). The political and financial influence required to alter the business models and pollution quantities of these powerful companies is far more than an individual acting alone possesses—and, unless individuals move beyond personal carbon reduction efforts into collective initiatives to curb these companies' emissions, a massive driver of climatic change will continue to remain unchecked.

Collective action provides a path forward to overcome these barriers and create meaningful environmental change. Collective action is defined as a group's "behavior toward a common goal based on a collective literacy, a collective competence (set of skills and experiences) and a collective need or goal" (Clark, 2016)—in other words, it involves many individuals coming together to work towards a shared goal. Though researchers have very recently begun to probe collective action and the community-level environmental literacy that is theorized to precede it (e.g., Gibson et al., 2022; Ardoin et al., 2022), little is currently known about what drives people to engage in collective environmental action and whether these drivers are the same as those of small-scale private-sphere environmental action.

This paper will investigate whether the field's existing models are effective at predicting an individual's engagement in collective pro-environmental behaviors in addition to the private-sphere actions they have historically been used to predict. Specifically, this paper focuses on predicting behavior amongst high school students, as young people will inherit the problems of the Capitalocene and are uniquely positioned to create change both now and into the future.

Recent youth-led movements (e.g., Sunrise Movement, Fridays for Future) demonstrate that young people are aware of how environmental crises are impacting and will continue to impact them. Understanding the mechanism for behavior change among this group may help the research community support their efforts. Further, though not yet of voting age themselves, youth can influence the adults in their lives through the process of intergenerational learning (Ballantyne et al., 2001; Ballantyne et al., 2006; Duvall & Zint, 2007). Not only are children effective at shifting entrenched beliefs in their parents (Lawson et al., 2019), but they can also impact the views of local elected officials with whom they interact (Hartley et al., 2021a; Hartley et al., 2021b). Thus, by understanding the drivers of large-scale behaviors in the youth who are positioned to support community-wide change, we can move one step closer to understanding what it takes to create large-scale environmental change in the Capitalocene.

Literature review

Categories of pro-environmental behavior

Whether at the private-sphere level or the collective level, pro-environmental behavior (PEB) is largely seen as the ultimate aim of environmental education efforts, a way for learners of all ages to make a positive impact on a planet in peril (UNESCO, 1977; Ardoin et al., 2020). Researchers often refer to PEB as a single, unidimensional concept, creating models that attempt to predict a person's engagement in PEBs ranging from support of public transportation to reduced meat consumption at home (Bamberg & Möser, 2007). However, studies show that PEBs are a multidimensional concept, with different behaviors falling into different categories (cite those studies). Stern (2000) theorized there to be three main types of PEBs—environmental activism, nonactivist behaviors in the public sphere, and private-sphere environmentalism—each

defined by the impact they have on the environment. Environmental activism, as its name implies, is characterized by active involvement in large-scale organizations, demonstrations, or social movements related to the environment (Stern, 2000). Nonactivist behaviors in the public sphere involve general support for pro-environmental choices and policies within a community (e.g., a person expressing their excitement about a new curbside composting program to their neighbor), and private-sphere environmentalism aligns well with individual-level environmental behaviors like turning off lights when they are not in use or picking up litter found on the ground (Stern, 2000). Larson et al. (2015) iterated upon Stern's categorizations of PEBs by examining how people in rural New York viewed PEBs. This study generated four types of PEBs: conservation lifestyle behaviors (similar to Stern's private-sphere environmentalism), social environmentalism (similar to nonactivist behaviors in the public sphere), environmental citizenship (similar to environmental activism), and land stewardship (improving one's privately-owned lands for wildlife conservation) (Larson et al., 2015). Because improvement to private lands is only possible for those who own land, this land stewardship category is not as broadly applicable as the other three categories and is not further considered in this paper.

More recently, scholars have added to these conceptualizations of public-sphere pro-environmental behavior through exploring the idea of collective action—behaviors that multiple people undertake together in an effort to move toward a shared goal (Clark, 2016), in this case a goal related to the environment. Collective action, as a group endeavor, stands in contrast to private-sphere actions that involve only a single person. In her action scale framework for collaborative actions, Tayne (2022) divides collective action into two main categories: those that push for system transformation (e.g., a group leading an effort to create new policies around energy efficiency requirements of appliances) and those that work toward behavior

transformation (e.g., a group working together to encourage other consumers to purchase ENERGY STAR® certified appliances; Brown et al., 2022). Both are collaborative efforts that seek to create change at a scale outside the individual, but their end goals differ, as do their potential levels of impact. Though changing consumer behavior at a large scale can certainly help move the needle on environmental issues, confronting the capitalist systems that spur today's global-scale socio-ecological challenges will require new systems to be put in place. Collective activist behaviors, then, could be more powerful than collective non-activist in this Capitalocene era, –making it important to differentiate the two from each other in addition to differentiating them from private-sphere behavior moving forward.

Based on the combined work of Stern (2000), Larson et al. (2015), and Tayne (2022), we focus on three types of behavior in this paper: *private-sphere behavior*, *collective activist behavior*, and *collective non-activist behavior*. (See Table 3.1 for examples of each of these types of behaviors alongside their analogues based on the work of the referenced scholars.) For the purposes of this study, we consider private-sphere actions to be those taken solely by one person without involving others. We define collective activist behaviors as actions that an individual participates in alongside others in a joint effort to push for system change (e.g., policy change). In contrast, collective non-activist behaviors are those that an individual participates in alongside others that do *not* seek to change systems; instead, collective non-activist behaviors typically work to change behaviors of other people. Because environmental education's current models of pro-environmental behavior prediction focus almost exclusively on private-sphere behaviors, more research is needed to understand the degree to which these models and their associated behavioral antecedents apply to collective behaviors. Filling this gap is essential to better understanding an individual's engagement in collective actions, particularly the collective

activist behaviors that will create the change that is necessary to confront the capitalist forces that spur the global-scale socio-ecological challenges the planet faces today.

Table 3.1. Categories of pro-environmental behaviors (PEBs).

<u>Definition</u>	<u>Example</u>	<u>Term</u>			
		<i>Stern, 2000</i>	<i>Larson et al., 2015</i>	<i>Tayne, 2022</i>	<i>This paper</i>
actions taken solely by one person, without involving others	A person chooses to buy a stainless steel drinking straw rather than single-use plastic straws.	Private-sphere environmentalism	Conservation lifestyle behaviors	Individual action	Private-sphere behaviors
actions that an individual participates in alongside others that do not push for system change (instead usually focusing on behavior change)	A person joins their neighborhood litter clean-up to remove plastic straws from their roadsides.	Nonactivist behaviors in the public sphere	Social environmentalism	Collaborative behavior transformation	Collective non-activist behaviors
actions an individual participates in alongside others in a joint effort to push for system change	A person joins a local nonprofit in speaking at a city council meeting, urging the council to support a single-use plastic straw ban.	Environmental activism	Environmental citizenship	Collaborative system transformation	Collective activist behaviors

Existing ways of predicting environmental behavior

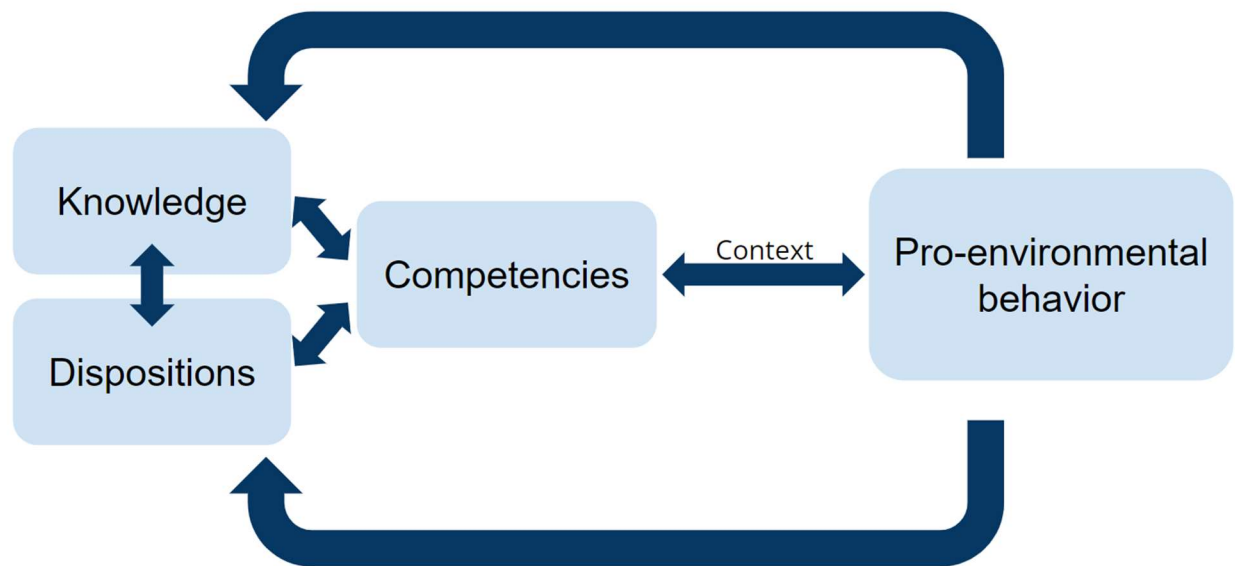
Environmental literacy framework

One method of conceptualizing the path to pro-environmental behavior involves the environmental literacy framework. The concept of environmental literacy was first detailed in the United Nations Educational, Scientific and Cultural Organization (UNESCO)'s Tbilisi Declaration, the result of the first global intergovernmental meeting on environmental education. This declaration describes environmental literacy as “the knowledge, values, attitudes, and practical skills to participate in a responsible and effective way in anticipating and solving environmental problems” (UNESCO, 1977). In 2011, Hollweg et al. iterated upon this definition to create a more formalized framework for environmental literacy; this is the conceptualization of environmental literacy commonly used by environmental education researchers today. This framework describes environmental literacy as a function of an individual's knowledge, dispositions, competencies, and behaviors related to the environment (Hollweg et al., 2011; see Figure 3.1). Knowledge (the information a person knows about environmental issues and ways to engage with them), dispositions (a person's attitudes towards and affective orientation to environmental issues and their role in addressing them), and competencies (the skills a person has to critically evaluate knowledge and possible action strategies) are built and changed over time, interacting with one another as they evolve. Competencies can then lead to environmentally responsible behavior, mitigated by the personal, social, and physical contexts in which the behaviors occur. Behaviors then feed back into knowledge, dispositions, and competencies, influencing future environmental choices. Environmental education programs often focus on boosting one or more of these elements of environmental literacy to make their impact. A systematic literature review of 119 peer-reviewed publications indicated that 68% of

environmental education programs focused on impacting environmental knowledge, 61% on dispositions, 26% on competencies, and 20% on behaviors (Ardoin et al., 2018). A majority of these published articles also showed evidence that these programs were working as intended, indicating positive impacts on the component or components of environmental literacy that the program sought to affect.

Figure 3.1

Theoretical framework of environmental literacy (Hollweg et al., 2011).



Although the Tbilisi Declaration stated that environmental education should work to “create new patterns of behavior of *individuals, groups, and society as a whole* towards the environment” [emphasis added] (UNESCO, 1977), the field’s current definition of environmental literacy focuses almost exclusively on the *individuals* part of this goal—individual-level environmental knowledge, dispositions, and competencies yielding individual-level, private-sphere environmental behavior (Hollweg et al., 2011). Indeed, while environmental

literacy evaluation instruments have been developed for ages ranging from elementary school students to adults (Erdogan, 2015; Goldman et al., 2013; McBeth & Volk, 2009; Szczytko et al., 2019; Shephard et al., 2014; Hunter & Jordan, 2019), these instruments all focus on individual-level environmental literacy in pursuit of private-sphere pro-environmental behaviors. In other words, the current model of environmental literacy was not created to measure collective environmental behaviors (Gibson et al., 2022). Additionally, because the model contains so many bi-directional impacts and reflexive loops, it can be difficult to use to predict behavior without some amount of modification. Because of these shortcomings, this study marries the environmental literacy framework with another framework: the theory of planned behavior.

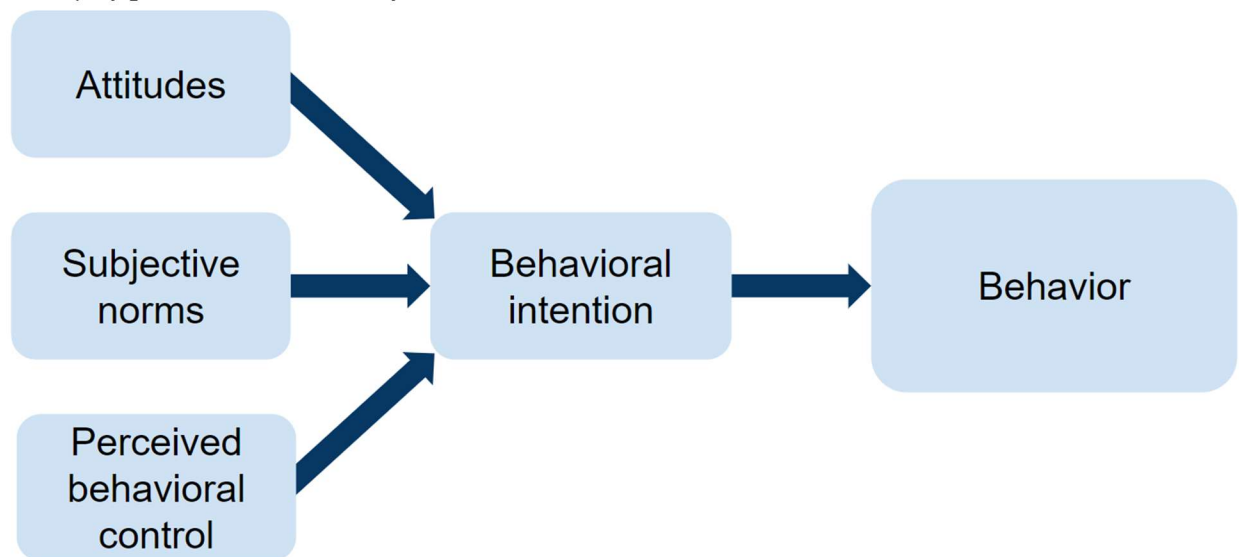
The theory of planned behavior

Used throughout many social science disciplines, the theory of planned behavior (TPB; Ajzen, 1991; Figure 3.2) shares several similarities with environmental literacy. Analogous to environmental literacy's dispositions, TPB proposes attitudes as an antecedent to behavioral intention (and, later, behavior itself); it defines attitudes as a person's evaluation of whether the action in question is worth engaging in, given the perceived costs and benefits (Ajzen, 1991; Stern, 2018, p. 41). Although Ajzen originally defined attitudes in this specific way, researchers have since interpreted this term much more liberally, using various affective-related proxies to stand in for attitudes in empirical studies (e.g., anticipated affect [Conner & Armitage, 2006; Ravis et al., 2009], hope [Szczytko et al., 2019; Stevenson et al., 2018b], concern [Stevenson et al., 2018b]). TPB also lists perceived behavioral control, or the extent to which a person feels it is possible for them to take an action if they wished to do so, as a factor influencing behavior. This could be seen as overlapping to some degree with environmental literacy's competencies, as both impact whether a person sees themselves as capable of engaging in a behavior. However,

TPB includes a new factor, subjective norms, not seen in the environmental literacy framework. Social context is mentioned as a potential mitigating factor in the environmental literacy model, but it is not presented as a main behavioral antecedent (Hollweg et al., 2011). Subjective norms describe a person's view of whether the people surrounding them, often referred to as significant others, approve or disapprove of the behavior at hand (Ajzen, 1991). Together, TPB posits that attitudes, perceived behavioral control, and subjective norms come together to form a person's intention to participate in a given behavior, which then leads to actual engagement in the behavior.

Figure 3.2

Theory of planned behavior (Ajzen, 1991).



A marriage of models

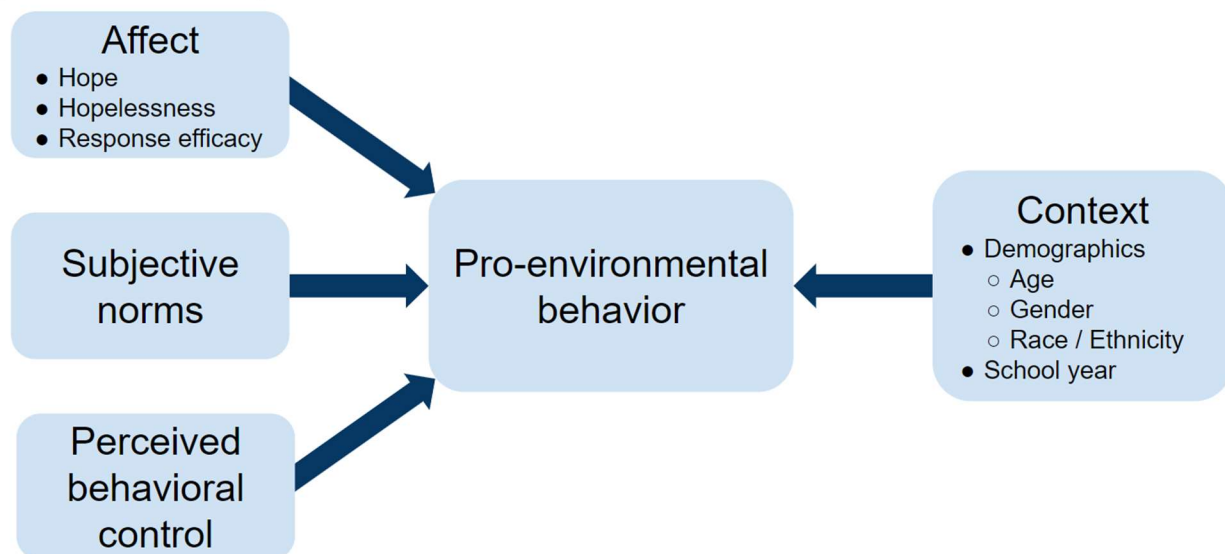
This paper brings together the environmental literacy framework and the theory of planned behavior to attempt to predict different categories of pro-environmental behaviors:

private-sphere behaviors, collective non-activist behaviors, and collective activist behaviors. Because research indicates that environmental knowledge—one of the four components of Hollweg’s environmental literacy framework—generally does not have a direct or strong impact on environmental behaviors (e.g., Krasny, 2020, p. 85; Busch et al., 2019; Stevenson et al., 2018b), knowledge was excluded from the model. Attitudes and dispositions were represented in the model through a combination of affective constructs, hereafter referred to simply as *affect*. Hope and hopelessness, affective traits which have repeatedly been shown to correlate with pro-environmental behavior (Ojala, 2012; Stevenson et al., 2018b; Stevenson & Peterson, 2016), were included in this affective category. Response efficacy, or the belief a person has that a given action will produce the intended effect, was also incorporated as a variable. This inclusion was due to multiple reasons, including because (1) efficacy measures are included in the environmental literacy framework under the category of dispositions (Hollweg et al., 2011); (2) the developer of TPB himself saw the exclusion of efficacy variables as a shortcoming of this model (Ajzen, 2002), and thus the inclusion of response efficacy could help contribute to a stronger model; (3) response efficacy has a demonstrated impact on intention to engage in pro-environmental behavior (Lam, 2006); and (4) response efficacy may be considered to be a part of hope and hopelessness, the other affective constructs represented in this marriage of models (Szczytko et al., 2019). Perceived behavioral control was also included in the model, as it both is a key component of TPB and should reflect a person’s valuation of their competencies related to environmental issues as specified by the environmental literacy framework. Given that norms have a demonstrated influence on many pro-environmental behaviors (e.g., Ham et al., 2015; Busch et al., 2019; Krasny, 2020, p. 160), subjective norms were retained as well. Finally, context was incorporated into the model through the inclusion of sociodemographic variables

and the school year in which the students took the surveys. The inclusion of sociodemographic variables is in line with the environmental literacy framework and other environmental education studies that demonstrate a link between environmental behaviors and sociodemographic factors like age, gender, and race (Brough et al., 2016; Wang et al., 2021; Ellis & Korzenny, 2012; Medina et al., 2019; Stevenson et al., 2013); each of these demographic factors were included as variables in this study. Additionally, because the school years in which this study was taking place were differentially impacted by the COVID-19 pandemic (see Sample Procedure in the Methods section below for details), school year was also included as a contextual variable. Finally, because environmental education is ultimately concerned with actual pro-environmental behavior rather than behavioral intention, behavioral intention was excluded from the model in favor of directly predicting behavior. See Figure 3.3 for the full model.

Figure 3.3

Combining the environmental literacy framework (Hollweg et al., 2011) with the theory of planned behavior (Ajzen, 1991).



Research questions

In the absence of established strategies for measuring collective pro-environmental behaviors, researchers might consider turning to the field's existing tools on monitoring other types of behaviors to see if these tools may also effectively measure collective behaviors, too. This paper tests whether the theory of planned behavior (Ajzen, 1991), a theory often used as a starting point for modeling private-sphere behaviors, can be used in conjunction with environmental literacy frameworks to predict an individual's engagement in collective pro-environmental behaviors (Figure 3.3). Based on the established multi-dimensionality of pro-environmental behaviors (Stern, 2000; Larson et al., 2015; Tayne, 2022), this paper will compare model accuracy in predicting three categories of environmental actions: private-sphere behaviors (actions taken solely by one person), collective non-activist behaviors (actions that involve multiple individuals and seek to change other peoples' behaviors), and collective activist behaviors (actions involving multiple individuals that are taken in an effort to change systems). Note that this paper focuses on modeling *individual-level engagement* in each of these types of behavior. In other words, even when looking at modeling collective behaviors that inherently involve multiple people, this study is interested in what might predict an *individual person's* engagement in these behaviors, using behavioral antecedents measured at the individual level. We do not delve into group-level attributes that might drive multiple people to choose to come together to take action on a shared goal—attributes like group interconnectedness or diffusion of ideas across social networks (Gibson et al., 2022)—which could not be modeled at the individual level. We leave this for future researchers to examine.

The research questions for this paper are as follows:

1. Are the factors that significantly predict pro-environmental behavior consistent across the three categories of behavior, in line with expectations of the theory of planned behavior and the environmental literacy framework?
2. Do these current behavior models have similar predictive power across the three different types of behavior?

By answering these questions, we hope to gain insight into whether we need to develop new tools specifically for assessing the collective behaviors that have the power to create large-scale change in the Capitalocene.

Methods

Sampling

Procedure

Study participants were drawn from high school environmental science classrooms throughout the state of North Carolina. Teachers were invited to opt their classroom into study participation via a recruitment email sent to North Carolina's Department of Public Instruction listserv, an email list to which all teachers in the state can opt in. Any interested teacher whose classroom met the basic eligibility requirements—namely, that it was an environmental science class (Earth & Environmental Science, AP Environmental Science, or IB Environmental Systems & Societies) composed solely of high school students (grades 9-12)—was invited to participate. Participating teachers distributed an online Qualtrics survey to their students within the first two months of the semester, and students had the option to opt in or out of inclusion in the study. Each student's parent or legal guardian was also asked for their consent to allow their child to participate in the research, as the vast majority of high school students are minors.

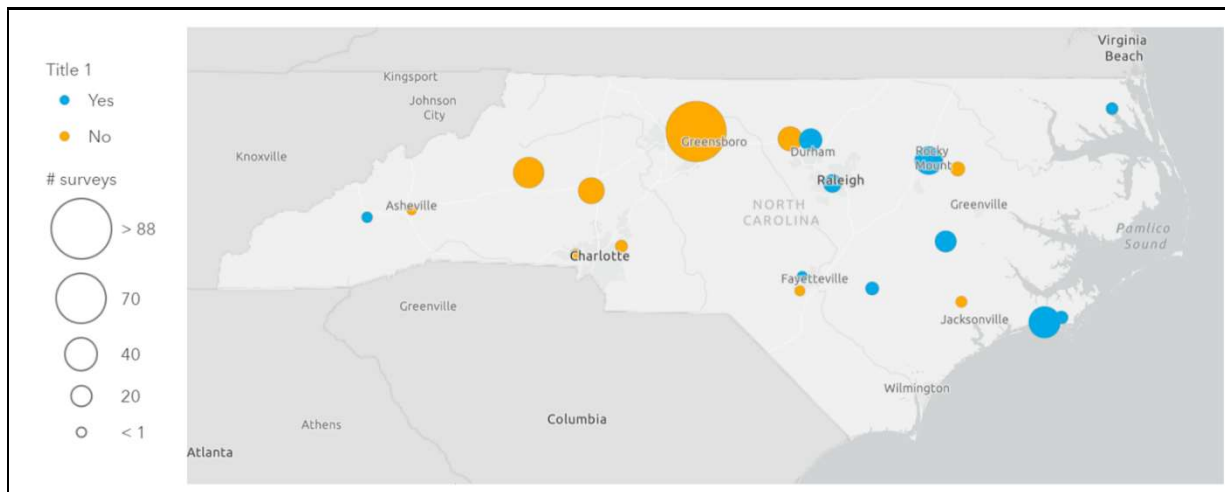
Four rounds of data collection took place over the course of two years: one in the fall of 2020, one in the spring of 2021, one in the fall of 2021, and one in the spring of 2022. Because students were on a semester schedule, each of these data collection points represented the beginning of a given course. It is worth noting that each of these semesters occurred during the COVID-19 pandemic, with many schools cycling between virtual, hybrid, and in-person teaching models throughout this period. The stress of the pandemic and digital burnout of virtual schooling almost certainly lowered the rate at which teachers opted into the study and students participated in the survey, and it very possibly shaped how students responded to the surveys themselves (see “Limitations” and “Discussion” for our interpretation).

Participants

Over the course of four semesters of data collection, a total of 24 teachers across 20 different schools distributed surveys in their environmental science classrooms. Participating schools spanned 18 of North Carolina's 100 counties. Twelve of the participating teachers (corresponding to 43.4% of the student respondents) were within Title 1 schools, meaning that their schools receive supplementary federal funding because at least 40% of the student body is considered low-income (No Child Left Behind Act, 2002). An average of approximately 60% of students at these Title 1 schools qualified for free or reduced lunch, another measure of socioeconomic status, compared to about 24% of students at the participating non-Title 1 schools. See Figure 3.4 below for a map of the participating classroom, shown by Title 1 status as well as by the number of student surveys from each classroom.

Figure 3.4

Map of participating classrooms.



From these 24 participating teachers' classrooms, a total of 362 students completed the survey, with approximately two-thirds of the surveys completed in the 2020-2021 school year (n=243) and one third in the 2021-2022 school year (n=119). Surveys were considered complete if they had all of the following: student assent, parent/guardian consent, at least 50% of the questions answered, and no clear signs of not taking the survey seriously (for example, writing in inappropriate free response answers or reporting a single Likert scale value across five or more constructs in a row). Out of an estimated 1345 students being taught by the 24 teachers participating in this study, 817 submitted a survey response (61% response rate). However, only 362 of those 817 surveys (44%) were able to be analyzed; the other 56% of surveys had to be removed from the dataset due to lack of parental permission (23%), lack of student consent (10%), survey completeness of less than half (19%), or an abundance of straightlined responses (5%). (See "Limitations" for possible explanations and implications of this lower-than-expected usable survey rate.) Students ranged in age from 14 to 19, with over 80% of the participants being ages 14-15. There were more girls in the study (49%) than boys (39%), with small numbers of students declining to respond (8%), identifying as non-binary (1%), or identifying in another way (3%). Based on a demographic question about race and ethnicity, over half of the students were white (59%), 11% were African-American, 10% were Hispanic, 3% were Asian or Pacific Islander, 1% were Native American, and 7% identified as multi-racial; 2% identified another way, and 8% declined to respond. See Table 3.2 for a full demographic breakdown and appendices for a breakdown of the number of students surveyed by each teacher.

Table 3.2. Demographics of participating students.

<u>Demographic</u>	<u>Number of Students</u>	<u>Percentage of Students</u>
Age		
14	129	35.64%
15	133	36.74%
16	57	15.75%
17	37	10.22%
18	5	1.38%
19	1	0.28%
Gender		
Girl / woman	177	48.90%
Boy / man	142	39.23%
Non-binary	5	1.38%
Other	10	2.76%
No response	28	7.73%
Race / ethnicity		
White, non-Hispanic	212	58.56%
African-American, non-Hispanic	41	11.33%
Hispanic	36	9.94%
Asian or Pacific Islander	10	2.76%
Multi-racial	2	0.55%
Other	25	6.91%
No response	8	2.21%
School year		
2020-2021	243	67.13%
2021-2022	119	32.87%

Survey tool

Constructs

Pro-environmental behaviors. Students were asked to self-report the frequency at which they engaged in eight different pro-environmental behaviors (PEBs), each of which fell into one of three categories of interest: private-sphere actions, collective non-activist actions, or collective activist actions. Private-sphere actions were defined as actions taken solely by one person without involving others, including picking up litter and avoiding flushing items down the

toilet besides toilet paper. Collective non-activist actions were defined as actions that an individual participates in alongside others that do not push for system change, instead usually attempting to create behavior change in other people; behaviors in this category included talking to others about ways that the community can work together to improve water quality, participating in community events like trash clean-ups, and organizing community events like trash clean-ups. Collective activist behaviors were defined as actions an individual participates in alongside others in a joint effort to push for system change, such as talking with school administrators about what rules the school can make to improve water quality around our school, writing to local officials in support of policies that support water quality in the community, and attending local government events to voice support of water quality policies in the community. Note that all behaviors centered around water quality in an effort to measure differences in engagement across types of PEBs (private-sphere, collective non-activist, or collective activist) rather than the topic of the PEB (e.g., recycling, water quality, reducing greenhouse gas emissions). Study participants were asked how frequently they participate in each behavior on a Likert-style scale of 1 (“Never”) to 7 (“Every chance I get”).

Behavioral antecedents. In line with the theory of planned behavior (Ajzen, 1991) and the environmental literacy framework (Hollweg et al., 2011), the survey asked students about their affective feelings towards PEBs; their perceived behavioral control over the eight PEBs of interest; and their perception of their parents’, friends’, and fellow community members’ level of care about the environment (subjective norms). All constructs of interest were tested for internal validity using Cronbach’s alpha, α , as a reliability coefficient (Gliem & Gliem, 2003). Constructs created from three or more items were considered internally reliable at $\alpha \geq 0.70$. Constructs comprised of two items were considered reliable at $\alpha \geq 0.40$ because of Cronbach

alpha's documented tendency to underestimate the reliability of two-item scales (Eisinga et al., 2013).

Affect. To represent student affect toward environmental actions, the survey used three different constructs. Two of these constructs originated from a modified version of Li & Monroe (2018)'s validated Climate Change Hope Scale, replacing the term "climate change" with "the environment" to match this study's broader environmental focus, in parallel with past studies' approaches (Szczytko et al., 2019). The scale was also divided into two constructs for analysis purposes: environmental hope ($\alpha=0.88$, 10 items) and environmental hopelessness ($\alpha=0.80$, 3 items). Though these two constructs might be assumed to be highly correlated, perhaps even to the point of collinearity, they are not so in reality ($r=-0.35$), and including the two as separate constructs in the model yields unexpected outcomes (see "Results"). The third construct included in the model to represent student affect was response efficacy, or the extent to which students felt that taking the eight different PEBs would be effective in improving water quality ($\alpha=0.92$, 8 items).

Perceived behavioral control. To measure perceived behavioral control over the PEBs of interest, the survey asked students to report on a 7-point Likert scale how strongly they agreed with the phrase "If I wanted to, I could...", followed by each PEB of interest ($\alpha=0.93$, 8 items).

Subjective norms. A series of 9 items gathered information about student perceptions of norms related to environmental concern and action. Students answered questions about norms set by three different groups—their parents, their friends, and other people in their community—to capture a range of possible significant others. Students reported on how strongly they agreed with the statement that the group 1) thinks that the student respondent should take care of the

environment, 2) usually takes care of the environment themselves, and 3) thinks that taking care of the environment is important ($\alpha=0.91$, 9 items).

Context. The survey asked students to voluntarily report their age (in years) as well as their gender (*boy/man, girl/woman, non-binary, or I identify another way* with a free response option). Out of those that selected the “I identify another way” option ($n=10$), most ($n=6$) wrote in free response answers that suggested that they were not taking the question seriously (e.g., attack helicopter, napkin dispenser, chihuahua). For this reason, and because of the incredibly limited number of participants who reported non-binary gender identities, gender was transformed into a binary “girl/woman” or “boy/man” variable for analysis purposes (see “Limitations”). Students were also asked to report their race (*White or Caucasian, non-Hispanic; Hispanic; African-American, non-Hispanic; Asian or Pacific Islander; other* with a free response option), with respondents having the option to select more than one race. Race was converted to a binary “white” or “person of color” variable, again because of limited response numbers in each of the sub-categories. The response date recorded on the survey provided information about the school year in which it was taken. For a full copy of the survey instrument, including item wording and reliability and validity statistics, see appendices.

Pilot testing

Before beginning the study, the survey was pilot tested with a small group of high school students ($n=10$) to test survey attrition and rate of response to specific questions. Follow-up cognitive testing was done with a subset of these students ($n=3$) on a voluntary basis to solicit additional information on which questions caused student confusion and why (Collins, 2003). Small wording adjustments were made to the survey accordingly to ensure that survey questions

were understandable with the youngest possible study participants (age 14) before being used in the main study.

Data analysis

To answer our first research question about which behavioral antecedents were significant predictors of each type of pro-environmental behavior, we used ordinary least squares regression to predict engagement in the three categories of behavior as a function of affect (environmental hope, environmental hopelessness, and response efficacy), perceived behavioral control, subjective norms, and context (demographics including age, gender, and race; and school year) (Burton, 2021) (see Figure 3.3). We then compared the resulting sets of variables that emerged as significant in each model.

When running the models, we excluded from our analysis all respondents who did not complete survey questions related to one or more of the behavioral antecedents relevant to the type of behavior being modeled ($n=56$ for private-sphere behaviors; $n=63$ for collective non-activist behaviors; $n=57$ for collective activist behaviors). We included classroom as a random effect within the model to account for possible differences in results as a result of the school, teachers, or other specific classroom-specific dynamics (Theobald, 2018). We transformed each of the three dependent variables—frequency of engaging in private-sphere behaviors, frequency of engaging in collective non-activist behaviors, and frequency of engaging in collective activist behaviors—using the Box-Cox transformation to better align with ordinary least squares regression assumptions of homoscedasticity of variance (Box & Cox, 1964; Osborne, 2010). While employing this transformation made our regressions more statistically sound, they also caused the beta coefficients in our generated models to become unintuitive to interpret (e.g., a negative beta indicating a positive correlation with the dependent variable because the dependent

variable had been raised to a negative exponent). Because of this complex interpretation and because our study was ultimately interested in variable significance (Research Question 1) and model fit (Research Question 2), we focused our attention on the p-values associated with the behavioral antecedents in each model and each model's prediction ability.

To answer our second research question about the comparative predictive power across the three models, we assessed model goodness of fit, comparing the percentage of variability in the data that the model was able to predict (R^2). A larger R^2 value was indicative of a model that did a better job at predicting action than models of lower R^2 values (Hagquist & Stenbeck, 1998; Taraday & Wieczorek-Taraday, 2018).

Results

Variable summaries

Students reported engaging in the different categories of pro-environmental behaviors at very different levels, with respondents taking private-sphere behaviors most frequently by far ($\bar{x}=5.30$, on a scale of 1 to 7), followed by collective non-activist behaviors being taken at less than half of that reported rate ($\bar{x}=2.60$) and then collective activist behaviors being taken even less often ($\bar{x}=1.95$). Private-sphere behaviors were seen by students as approximately as effective at improving environmental quality in the community as collective non-activist behaviors ($\bar{x}=5.45$ and $\bar{x}=5.40$, respectively), with collective activist behaviors seen as less impactful than either ($\bar{x}=4.87$). Students saw themselves as having high levels of behavioral control over private-sphere actions ($\bar{x}=6.14$), with collective non-activist actions ($\bar{x}=5.39$) and collective activist actions ($\bar{x}=5.05$) being perceived as less feasible for this group.

Survey respondents expressed relatively high levels of environmental hope ($\bar{x}=4.90$) and medium-low levels of environmental hopelessness ($\bar{x}=2.98$). They felt that their community held fairly strong subjective norms related to the environment ($\bar{x}=4.51$), meaning that the students saw their parents, friends, and other community members as wanting them to care for the environment.

A full summary of these model variables and their means, standard deviations, and reliability statistics can be found in Table 3.3.

Table 3.3. Summary statistics for model variables.

<u>Dependent variables</u>	<u>Mean</u>	<u>Standard deviation</u>	<u>Reliability</u>	
			Cronbach's α	# items in scale
Frequency of behavior	3.04	1.22	0.87	8
Private-sphere	5.30	1.25	0.49	2
Collective non-activist	2.60	1.53	0.83	3
Collective activist	1.95	1.54	0.95	3
<u>Independent variables</u>				
Affect				
Env. hope	4.90	1.01	0.88	10
Env. hopelessness	2.98	1.30	0.80	3
Response efficacy	5.25	1.26	0.92	8
Private-sphere	5.45	1.39	0.85	2
Collective non-activist	5.40	1.33	0.87	3
Collective activist	4.87	1.56	0.91	3
Subjective norms	4.51	1.20	0.91	9
Behavioral control	5.47	1.39	0.93	8
Private-sphere	6.14	1.26	0.87	2
Collective non-activist	5.39	1.58	0.91	3
Collective activist	5.05	1.76	0.93	3

Note: All variables are measured on a self-reported Likert scale ranging from 1 (low) to 7 (high).

Modeling engagement in private-sphere PEBs

The model predicting individual PEBs explained nearly 40% of the observed variance in self-reported student engagement in this category of behavior ($R^2=0.388$). Two categories of affect, environmental hope and response efficacy, contributed significantly to the model

($p < 0.001$), both indicating positive relationships with individual action. Subjective norms ($p < 0.001$) and perceived behavioral control ($p < 0.01$) were also significant predictors of increased action in the model. The affective behavioral antecedent of environmental hopelessness ($p = 0.982$) was not significant in this model, nor were the socio-demographic variables of age ($p = 0.679$), gender ($p = 0.590$), or race ($p = 0.990$). Engagement with private-sphere PEBs also did not vary significantly based on school year, according to this model ($p = 0.761$). Classroom had no significant influence on the model when included as a random effect. See Table 3.4 for more details.

Modeling engagement in collective non-activist PEBs

The generated model for collective non-activist PEBs, with an R^2 of 0.172, explained less than half of the variance compared to the model for private-sphere PEBs. Similarly to the private-sphere PEB model, subjective norms ($p = 0.000$) was a positive predictor of student engagement in PEBs of this type. Additionally, environmental hopelessness ($p = 0.471$) and each of the socio-demographic variables ($p = 0.100$ for age, $p = 0.813$ for gender, $p = 0.053$ for race) were not significant variables. Yet unlike the model above, perceived behavioral control had no significant impact ($p = 0.793$) on the model. School year was a significant predictor ($p = 0.047$), with students in the 2021-2022 school year being more likely to engage in collective non-activist behaviors than those in the 2020-2021 school year. Again, the random effect of classroom was not predictive. See Table 3.4 for full results.

Modeling engagement in collective activist PEBs

The model for student engagement in collective activist PEBs was the least explanatory of the three generated models ($R^2 = 0.095$). Like the other two models, subjective norms emerged

as a positive predictor of engagement in collective activist behaviors ($p=0.007$), but in contrast to the other two models, environmental hopelessness positively predicted collective activist behaviors ($p=0.043$). Environmental hope ($p=0.583$), response efficacy ($p=0.064$), and behavioral control ($p=0.805$) were not statistically significant. Mirroring the results from the two models above, age ($p=0.094$), gender ($p=0.174$), and race ($p=0.103$) were not significant predictors of behavior. School year also was not significant ($p=0.438$). Classroom did not have a significant impact on the model, either, when included as a random effect. Again, see Table 3.4 for additional details.

Table 3.4. Modeling different types of pro-environmental behaviors related to water quality, with p-values of all model variables shown.

Model Variables	<u>Private-sphere behavior</u> ¹	<u>Collective non-activist behavior</u> ²	<u>Collective activist behavior</u> ³
Affect			
Env. hope	0.000***	0.051	0.583
Env. hopelessness	0.982	0.471	0.043*
Response efficacy	0.000***	0.670	0.064
Subjective norms	0.000***	0.000***	0.007**
Behavioral control	0.002**	0.793	0.805
Context			
Socio-demographics			
Age	0.679	0.100	0.096
Gender ⁴	0.590	0.813	0.174
Race / Ethnicity ⁵	0.990	0.053	0.103
School year ⁶	0.761	0.047*	0.438
Model Characteristics			
Sample size	306	299	305
Adjusted R ²	0.388	0.172	0.095
Rho for classroom as a random effect	0	0	0

Note: Dependent variables were transformed using Box-Cox method, which makes the coefficient interpretation non-intuitive. In line with our research questions, we report the p-values here, along with the R² values.

¹Defined as actions taken solely by one person, without involving others. Actions include picking up litter and avoiding flushing items down the toilet besides toilet paper.

²Defined as actions an individual participates in that involve at least one additional person but do not push for changes in rules, policies, or systems. Actions include talking to others about ways that the community can work together to improve water quality, participating in community events like trash clean-ups, and organizing community events like trash clean-ups.

³Defined as actions an individual participates in that are taken in an effort to change rules, policies, or systems. Actions include talking with school administrators about what rules the school can make to improve water quality around our school, writing to local officials in support

of policies that support water quality in the community, and attending local government events to voice support of water quality policies in the community.

⁴1=girl/woman, 0=boy/man

⁵1=person of color, 0=white

⁶1=2021-2022 school year, 0=2020-2021 school year

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

(-) beside one or more asterisks indicates that the statistically significant variable is negatively correlated with the dependent variable; absence of this symbol indicates a positive correlation.

Discussion

Interpreting the three models

Our results suggest that commonly used behavior models (such as environmental literacy and the theory of planned behavior) are effective at predicting private-sphere pro-environmental behaviors among youth, but that more research and theory-building is needed to understand drivers of collective behaviors. Though the models for each of the three types of behavior were generated using the exact same input variables, there are clear differences in terms of goodness of fit. The individual behavior model was strongest amongst the three, with the included variables explaining nearly 40% of the variance in students' engagement in individual-level PEBs. In contrast, the two models predicting collective actions—both non-activist and activist in nature—were not nearly as explanatory, explaining approximately 17% and 10% of the variability in their action types, respectively. The relative strength of the private-sphere model over the collective models is not surprising, given that both the theory of planned behavior and the environmental literacy framework that form the basis for all three models were developed with individual private-sphere behaviors in mind (Ajzen, 1991; Hollweg et al., 2011). However, it does indicate that a new model with different behavioral antecedents may help researchers better predict collective actions of various types.

The impact of affect on youth engagement in environmental action may shed light on what types of behavioral antecedents would be more successful in predicting collective PEBs among youth. It is not surprising that environmental hope came up as a significant affective influence on private-sphere behavior, given that past studies have found affect in general (Heimlich & Ardoin, 2008) and hope in particular (Ojala, 2012; Stevenson et al., 2018b) to be predictive of pro-environmental behavior. Less immediately intuitive, though, is hopelessness's

presence as a positive predictor of high school student engagement in collective activist behaviors. Recent literature around negative affective phenomena related to the environment may provide some clarity. Ojala (2008) found that young adults who had both hope and worry about the environment were more likely to recycle than those without this mix of positive and negative emotions. The presence of this worry might indicate taking environmental problems seriously rather than having naive optimism without any amount of concern for environmental issues that are, realistically, of a concerning magnitude. A subsequent study refined this idea, subdividing hope into two categories: constructive hope and denial-based hope (Ojala, 2012). While denial-based hope built on false optimism had a negative correlation with action, particularly for teenagers, constructive hope built on trust in others and biospheric values was positively related to pro-environmental behavior. In this constructive hope there is again an element of negative affect in recognizing environmental issues as serious problems. The hopelessness scale used to predict behavior in this study, too, emphasizes the the severity of today's environmental challenges, with prompts such as "environmental problems are so complex that we will not be able to solve them" and "environmental problems are beyond my control, so I won't even bother trying to solve them" (Li & Monroe, 2018). Because of this phrasing, students who score highly on this particular hopelessness scale might be those most worried about the threat of environmental problems. Those who demonstrate high levels of hopelessness in this survey, then, might have that action-driving concern that Ojala highlights, rather than mere ambivalence or hope based on denial of environmental issues' seriousness (Ojala, 2008; Ojala, 2012; Costarelli & Colloca, 2004; Snyder, 2002).

The impact of hopelessness on collective activist actions may be particularly important moving forward, as these types of system-influencing action can yield a stronger environmental

impact. Perhaps the higher level of worry that humanity may not be able to solve environmental problems drives young people to push for action at a scale larger than themselves—a scale of action that matches the scale of the problem. This would add an interesting corollary finding to the recent study linking eco-depression to greater engagement in collective climate action (Stanley et al., 2021). At the same time, though, too much negative affect can lead to eco-anxiety, environmental numbness, and low self-efficacy, all of which are linked to inaction (Stanley et al., 2021; Gifford, 2011; Stevenson & Peterson, 2016). A healthy balance of hope and realistic concern may be most beneficial to inspire action (Stevenson et al., 2018a; Stevenson et al., 2018b). Continued research on the link between negative affective phenomena—including newer concepts like eco-anxiety, eco-depression, and environmental trauma—should be pursued, especially given that these emotions will likely only increase in their behavior-shaping power in this era of existential global social-ecological challenges. This line of research may work to support environmental educators in striking a good balance of addressing environmental worry among youth while supporting outlets to create the systemic change that the Capitalocene requires.

The fact that response efficacy and perceived behavioral control emerge only as predictors of private-sphere action suggests that individual-focused factors may be less influential on the types of collective behaviors that will be most effective in our Capitalocene context. These two variables' presence in the private-sphere behavioral model was expected due to their presence in existing theories of behavior (Ajzen, 1991; Hollweg et al., 2011). Their absence in both collective models, though, begs for additional interrogation. Perhaps response efficacy and perceived behavioral control, both individually-measured factors, may not be as closely tied to group-oriented behavior choices as they are to choices about more independent

behavior. In other words, the students in this study may not see their individual belief in action effectiveness or their individual ability to take an action as particularly pertinent, if the actions being engaged in involve other people—the defining characteristic of collective actions. It is possible that, when considering motivators of taking action alongside others, group-oriented factors may be stronger influences on behavior. (See “Conclusions” for further discussion of possible new behavioral antecedents to investigate in future studies.)

Subjective norms’ role as a significant predictor across all three types of pro-environmental behaviors further suggests that it may be fruitful to investigate variables that reflect social relationships when attempting to improve collective behavior predictions. Again, because subjective norms are a component of common behavior prediction models, their significance within the private-sphere behavior model was anticipated. However, their predictive power in the collective behavior models is notable because of the otherwise-strong divergence between the behavioral antecedents of these different categories of pro-environmental action. This may be because norms, like collective behaviors, are inherently relational; neither can exist if an individual is not in community with others. While people do not have to consider their relationships with other people to report on response efficacy or perceived behavioral control over an environmental action—both factors that were not significant predictors of collective action—they do have to look outside themselves when reporting on how they feel their community wants them to act on environmental topics. The significance of subjective norms, alongside the relational nature it shares with collective behaviors, calls for additional attention to other relational concepts that might help us better predict collective behaviors.

Context’s limited contribution to the three models’ predictive capabilities indicates that the behavioral antecedents for each type of behavior should be relatively consistent across

different socio-demographic groups. Amongst the four contextual variables included in the three models—age, gender, race/ethnicity, and school year—only school year emerged as significant for collective non-activist actions. We found that students in our second school year of data collection, the 2021-2022 school year, were statistically more likely to engage in these types of behaviors than their counterparts who took the survey in the 2020-2021 school year. This is almost certainly a factor of the COVID-19 pandemic, which severely limited activities requiring in-person contact with other people during the 2020-2021 school year. Because collective non-activist behaviors—e.g., talking to others about ways that the community can work together to improve water quality, participating in community events like trash clean-ups, and organizing community events like trash clean-ups—tend to require in-person interaction, it makes sense that these behaviors would be the ones most impacted by this pandemic timing. Separately, we found none of the socio-demographic variables to be significant predictors of any type of behavior. Students across ages, genders, and races/ethnicities engaged in these actions at statistically similar rates. While we acknowledge that our measures of gender and race are reductive, as our limited sample size pushed us to collapse these traits into artificial binaries, our findings align with other studies that find no disparities in environmental engagement as a function of gender and race (Szczytko et al., 2020; Faber Taylor et al., 2022). This stands in contrast to the false narrative that the environmental education research field perpetuated for years, that people of color and people of other non-dominant identities are less concerned about environmental challenges because they must focus their energies on other more pressing challenges like social injustices and economic inequalities (e.g., Van Liere & Dunlap, 1980; Mohai, 1990; Sheppard, 1995). Instead, this data contributes one more point of evidence in favor of the fuller picture of environmental action: that environmental action, which includes not just mainstream

environmentalism but also behaviors related to environmental justice, are of interest to students across a diversity of ages, races, and genders (Taylor, 1992; Curnow & Helferty, 2018; Medina et al., 2019); and, in fact, those excluded from mainstream environmentalism have been leading calls for environmental change for decades (Thomas, 2022).

Limitations and future research

This study is not without limitations, several of which relate to the COVID-19 pandemic context in which this research took place. As outlined in the methods, we had a lower usable survey rate than anticipated. We expect that this lower engagement and higher survey fatigue was due in large part to the pandemic, as student and parent mental health struggles likely—and understandably—made an optional survey a comparatively low priority (Anderson et al., 2022; Jones et al., 2022; Moreland-Russell et al., 2022; Ben Brik et al., 2022; Gadermann et al., 2021). It is possible that the survey, then, underrepresents those who were most impacted by the pandemic and its associated stressors. The pandemic also almost certainly influenced the survey responses themselves. Some research indicates that COVID-19 concerns had a significant impact on the rate of engagement in pro-environmental behaviors as well as their behavioral antecedents (Mi et al., 2021; Zebardast & Radaei, 2022; Kim & Lee, 2022), potentially playing out in this study as lower reported rates of engagement in one or more of the three types of pro-environmental behavior. However, conflicting studies argue that the pandemic did not have measurable influence on environmental action (Urban & Braun Kohlová, 2022). Because the relationship between the pandemic and pro-environmental behaviors is complex and not yet fully understood, future research in a non-pandemic context is needed to confirm or contradict the findings of this study.

Additionally, this study's approach, both from a sampling perspective and from a methodological perspective, limits its generalizability to new contexts. This research surveyed a very specific group of individuals—North Carolina high school students, most of them ages 14-15, in environmental science classrooms—calling for study duplication in different contexts to better understand widespread applicability of the findings. Each of the participating students also received the invitation to take the survey from their environmental science teacher, which, due to social desirability bias, may spark concerns over artificially high self-reported environmental attitudes or behaviors; thankfully, though, past research has indicated that social desirability bias likely has only a weak impact on self-reported environmental attitudes and no significant impact on self-reported environmental behaviors (Milfont, 2009).

Separately, from a statistics standpoint, the use of ordinary least squares (OLS) regression in this study is imperfect. Even after the dependent variables underwent Box-Cox transformations, the residuals associated with the OLS model for both types of collective behaviors were slightly heteroskedastic—a quality which breaks one of the assumptions of OLS regression (Burton, 2021). We made a conscious decision to move forward with this type of regression, despite it being an imperfect match for our data, because our study sought to use existing common models of behavior prediction not just theoretically, but also statistically. In other words, because OLS regression is a commonly-used approach to creating models of behavior prediction, it was the approach we wanted to pair with the commonly-used theoretical models of the theory of planned behavior and the environmental literacy framework. The fact that OLS assumptions were not met in the two models of collective behavior provides additional evidence that the field needs better models, both in terms of behavioral antecedents and in terms of statistical approaches, to predict different forms of behavior.

Finally, because of the quantitative nature of this work, this study investigates *which* behavioral antecedents are associated with engagement in different types of pro-environmental behavior, but not *why* these associations exist. More in-depth qualitative research would be helpful in elucidating the reasons behind these drivers. For example, interviews or focus groups with high school students could clarify, in the students' own words, the apparent paradox of hope contributing to some types of behavior and hopelessness to others types.

Perhaps the biggest limitation of this study is that, due to its scope, it begs a huge question that it cannot answer: if the behavioral antecedents suggested by the theory of planned behavior and the environmental literacy framework are poor predictors of collective actions, what factors actually *do* predict these kinds of pro-environmental behaviors? Additional empirical studies investigating this question are crucial to better understanding drivers of collective behaviors.

Conclusions and next steps

In helping us pinpoint the shortcomings of our field's commonly-utilized models in predicting collective behavior in high school students, this study represents an incremental step towards better understanding the types of collective actions that will have the power to shape the environmental challenges of the Capitalocene. Our empirical approach to understanding collective environmental action complements existing theoretical literature on collective action on the environment (Ardoin et al., 2022; Gibson et al., 2022), and we support continuing this multi-pronged approach as the field of environmental education works toward uncovering new models for engagement in collective behaviors—perhaps models that incorporate more relational predictors of action. Researchers may find it fruitful to trawl the environmental education literature around socially-oriented behavioral antecedents that may better match these socially-

oriented behaviors. Such concepts include social capital (Ostrom & Ahn, 2007; Castiglione et al., 2008; Krasny et al., 2015; Krasny, 2020), trust (Raymond, 2006; Ardoin et al., 2017; Kolleck, 2019; Rayamajhee & Bohara, 2021), synergy (Ardoin et al., 2022), and social networks (Ardoin et al., 2017; Kolleck, 2019). Looking beyond the boundaries of environmental education literature could bring in new insights too. For example, political science and psychology can lend insight into what drives youth engagement in activist behaviors outside of the environmental context (Schulz, 2005; Peterson et al., 2011; Sloam, 2014), and future studies could test whether these drivers hold true for environmental activism. Theories of diffusion from disease ecology and community psychology may also help better understand how ideas behind engaging in collective environmental actions might “spread” between people (Winett et al., 1995; Everton & Pfaff, 2022; Gibson et al., 2022). We can also learn from science education, which is grappling with the parallel concept of community-level scientific literacy and how groups develop this distributed literacy (NASEM, 2016). Taking all of these ideas together—those from this study, those from the broader environmental education literature, and those from other fields—we can move forward towards a better understanding of the drivers of collective action, thereby moving forward towards more collective action for the betterment of the environment.

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CHAPTER 4: **Social capital as a predictor of collective environmental action in high school students**

Introduction

Our planet hosts no shortage of massive social-environmental challenges today. From anthropogenic carbon emissions set to raise global temperatures by 1.5 degrees Celsius (IPCC, 2018) to a worldwide biodiversity loss so great it may amount to a sixth mass extinction (Dirzo et al., 2014), global environmental changes threaten ecosystems and human societies worldwide. The impacts of these changes, disproportionately concentrated in less privileged segments of society, themselves spawn issues of equity and justice from the local to the international scale (Taylor, 2011; Taylor, 2014; Raupach et al., 2007). In short, environmental issues pose an existential threat to both humans and the natural non-human environment (Barnosky et al., 2012), underlining the pressing need to address these challenges.

Pushing for action on social-environmental issues often takes the form of encouraging people to engage in a range of pro-environmental behaviors that have differing scopes and impacts. Though pro-environmental behaviors are often treated as a unidimensional concept within research studies, one way they can be subdivided is into two main categories based on how many people are involved in the action: *private-sphere behaviors* and *collective actions* (Stern, 2000; Larson et al., 2015). Private-sphere behaviors involve only a single person and often create small-scale change (Stern, 2000; Gibson et al., in review); examples might include an individual using a reusable bag at a grocery store to avoid single-use plastic bags, taking shorter showers to conserve water, or choosing to ride the bus to lower their carbon emissions. In contrast, collective behaviors involve multiple people coming together to push toward a shared goal (Clark, 2016; Tayne, 2022; Gibson et al., in review). These collective actions can be further subdivided into *collective activist* and *collective non-activist* behaviors based on the type of

change they seek to drive (Stern, 2000; Gibson et al., in review). While collective activist behaviors push for system change, collective non-activist behaviors seek to create change through influencing the environmental behaviors of others (Tayne, 2022; Gibson et al., in review). Put into practice, a collective activist behavior working to reduce vehicle-related greenhouse gas emissions might take the shape of a group hosting a rally in front of the state capitol building to protest lax enforcement of emission standards for vehicles registered in that state. A collective non-activist approach to the same issue could involve community educational initiatives to encourage consumers to voluntarily purchase hybrid or electric vehicles, or a campaign pushing for people to take existing public transportation rather than driving their own cars.

Though both private-sphere and collective pro-environmental behaviors can help make progress towards mitigating global environmental issues and their repercussions, organized and collective action represents a more appropriate approach to tackling today's large-scale challenges. This is in no small part because the powerful entities behind today's challenges are themselves organized and large in scale, with a great deal of economic, political, and social power behind them (Ide et al., 2020; Vachon & Menz, 2006). Looking at food production as an example, studies indicate that ever-increasing international meat demand is driving the majority of forest loss in the Amazon rainforests of Brazil (Skidmore et al., 2021; Kaimowitz et al., 2004). While a single person choosing to eat fewer steaks would technically lower demand for this meat, that person's choice alone would not have a significant impact on deforestation of that scale. Likewise, knowing that just four companies control 85% of the United States' beef supply (Chemnitz & Becheva, 2021), individuals working independently would struggle to match the economic and political influence these companies bring to decision-making arenas—making the

companies far more likely to successfully lobby for policies that favor them. In sum, acting on environmental issues at an independent, individual level—in other words, taking private-sphere actions—is on its own insufficient to create the change that today’s global issues require. Instead, collective action is required to create the scale of change necessary to overcome these powerful forces. For example, collective activist behavior could empower thousands of small-scale cattle ranchers to work together to fight against policies that prioritize “Big Ag” over family farms, or collective non-activist behavior could drive a nonprofit group to create a campaign that encourages responsible meat consumption across the country. These types of action have more power to create large-scale change.

Cultivating these impactful behaviors requires an understanding of the drivers of collective action—an understanding we currently lack. Historically, researchers interested in studying pro-environmental behavior have focused on predicting behavior at an individual level, resulting in models (e.g., Ajzen, 1991; Hollweg et al., 2011) that have been developed with private-sphere behavior in mind (Gibson et al., in review). Not surprisingly, these existing models underperform when attempting to predict behaviors that differ from those of the private-sphere—namely, collective behavior of both activist and non-activist natures (Gibson et al., in review). Gibson and colleagues (in review) found that a combination of the theory of planned behavior and the environmental literacy framework, both frequently used in social sciences to explain pro-environmental behavior, was able to explain nearly 40% of the variance in private-sphere behaviors of high school students but just 17% of the variance in their collective non-activist behaviors and a mere 9.5% of the variance in their collective activist behaviors (Gibson et al., in review). Though the tested behavioral antecedents of affect (hope, hopelessness, and response efficacy), subjective norms, perceived behavioral control, and sociodemographic

context predicted private-sphere behaviors relatively well, they insufficiently explained collective environmental behaviors. New models involving new behavioral antecedents are needed to more accurately model collective behavior and, in doing so, understand the ingredients that come together to foster its uptake.

Behavioral antecedents that take relationships into account may be useful additions to models to better predict collective behaviors that, by nature, involve interpersonal interactions. Scholars have begun to delve into this idea from a theoretical perspective, positing that relational variables may be main drivers of group action (Barth et al., 2021; Ardoin et al., 2022). Using empirical analysis, Gibson et al. (in review) found that, out of all of the behavioral antecedents traditionally included in the theory of planned behavior and the environmental literacy framework, only subjective norms were significantly predictive of both types of collective action. In that study, the subjective norms construct was also the only variable that spoke to community relationships and pressures rather than just individual-level thoughts and feelings (as was the case for hope, hopelessness, response efficacy, perceived behavioral control, and individual sociodemographic factors). Exploring additional relationship-based variables, then, may be fruitful in improving models of collective action. Literature around social capital provides additional support for this idea. Krasny et al. (2015) argue in the environmental education literature that fostering social capital in the young people of a community could create the proper conditions for collective action on community environmental issues to thrive. Krasny defines the concept as a combination of trust, social connections, and shared social norms within a community (Krasny, 2020; Figure 4.1). Trust, in this definition, can take the shape of broad trust in other people or trust toward a subset of known individuals, with the breadth or narrowness of this scope aligning with the posed research question. Social connections describe

the interactions a person has with others; this could be measured in terms of quantity (i.e., number of people) or depth (i.e., closeness to people). Finally, social norms describe the unwritten or informal rules of a community, or the forces that push people to behave in a certain way deemed “normal” by the community (Stern, 2018, pp. 28-30).

Broader literature also comments on social capital’s link to collective action, with economists Ostrom and Ahn (2007) conceptualizing the construct as “an attribute of individuals and of their relationships that enhance their ability to solve collective-action problems.” They theorize that there are three elements of social capital: trustworthiness, networks, and formal and informal rules or institutions. Trustworthiness and networks in this model closely parallel the trust and social connections of Krasny’s (2020) model. While the Ostrom and Ahn’s rules or institutions share similarities with Krasny’s social norms, they go a step farther; while social norms encompass only informal rules about behavior in a community, this model includes both informal and *formal* rules and institutions. This means that concepts such as laws, policies, and pre-existing systems are a part of this measure. Taken together, the three aspects of Ostrom and Ahn’s conceptualization of social capital—trustworthiness, networks, and institutions—come together to form trust, which then (alongside contextual factors) can spur collective action (Figure 4.2). However, despite these theoretical links between social capital and collective action, empirical studies confirming or contradicting these models in the context of pro-environmental behavior do not yet exist—a gap that needs to be filled if we are to know how to encourage collective environmental action.

Figure 4.1

Krasny's (2020) conceptualization of social capital and its link to collective action.

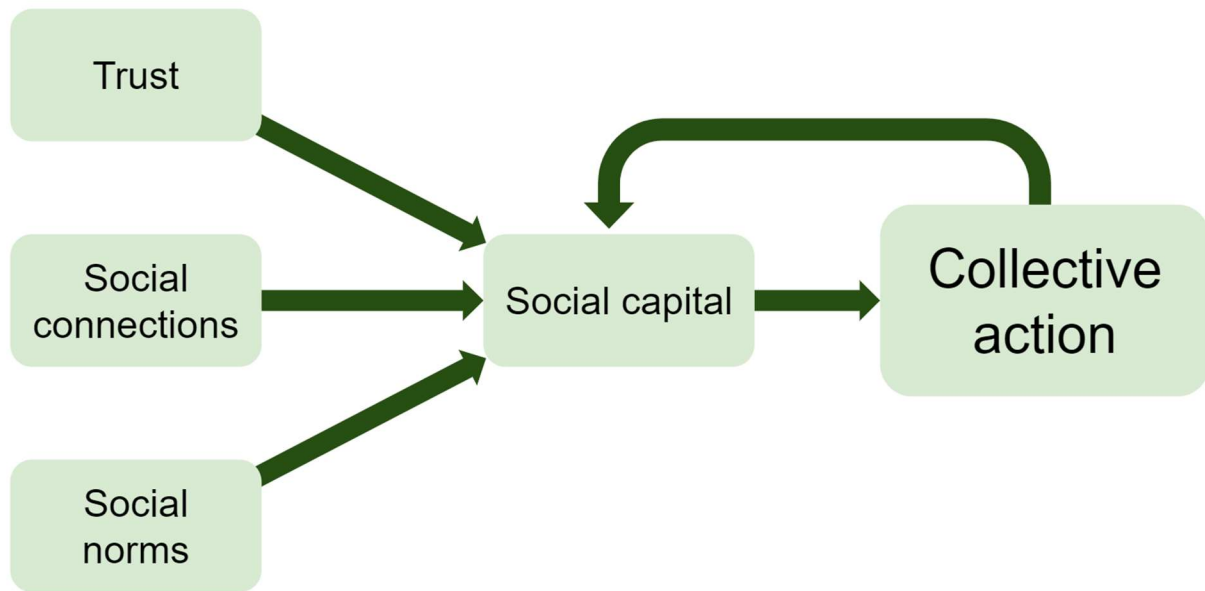
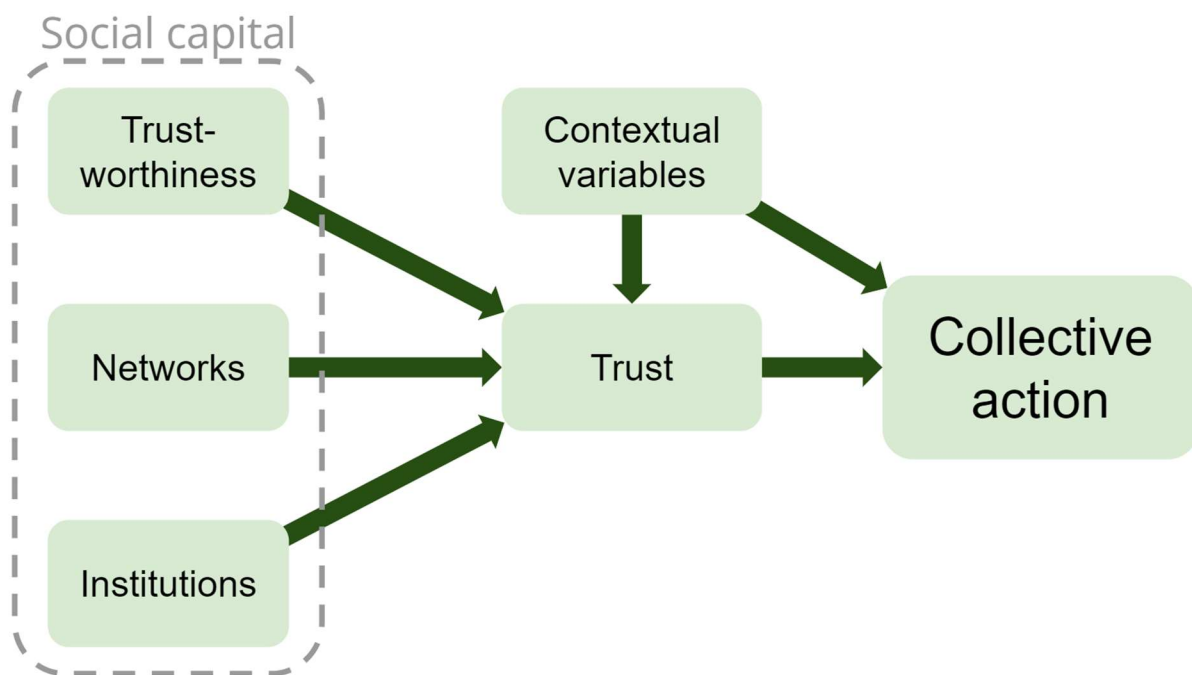


Figure 4.2

Ostrom & Ahn's (2007) conceptualization of social capital and its link to collective action.



This paper empirically investigates whether incorporating the concept of social capital in models of collective action can improve upon traditional behavior prediction models. This directly builds on the work and the dataset of Gibson et al. (in review), which found that oft-used models of the theory of planned behavior and the environmental literacy framework were useful predictors of private-sphere pro-environmental behavior but poor predictors of collective environmental action. Like Gibson et al., this study focuses on modeling and understanding the environmental behaviors of high school students, as young people have demonstrated an ever-increasing interest in taking collective environmental action and can influence the beliefs and actions of adults around them. More and more young people are rising up to lead large-scale movements for environmental change, from the indigenous youth advocates sparked the historic Dakota Access Pipeline protests at Standing Rock and other environmental justice movements (Elbein, 2017; Dellavilla, 2018; Estes & Dhillon, 2019; Neas et al., 2022) to the students who organized climate strikes in cities worldwide (Han & Ahn, 2020; Martiskainen et al., 2020; Neas et al., 2022). These strong efforts from young people call for strong support from adults—support that can only be given if we better understand what factors can help young people engage in the sort of action they seek to take. Additionally, intergenerational learning research suggests that youth education and action related to the environment can transfer to the adults with whom they interact (Ballantyne et al., 2001; Ballantyne et al., 2005; Duvall & Zint, 2007), from their parents (Lawson et al., 2019) to their local elected officials (Hartley et al., 2021a; Hartley et al., 2021b). Youth, therefore, could very well be the stones that instigate ripples of collective action in their communities, making understanding what drives them to take collective action particularly pertinent in the face of today’s global social-environmental challenges.

Research questions

After establishing that traditional models of pro-environmental behavior are poor predictors of collective action (Gibson et al., in review), this paper investigates the degree to which social capital variables might enhance or replace those models. Specifically, we modeled three different types of pro-environmental behavior—two types of collective action, collective activist behavior and collective non-activist behavior, as well as private-sphere behavior (Gibson et al., in review). Including private-sphere behaviors in this study allows us to compare the predictive power of models that were originally created with private-sphere behavior in mind (Ajzen, 1991; Hollweg et al., 2011; Gibson et al., in review) to our new models that attempt to predict collective action to a similar level of accuracy. Ultimately, though, this study is interested in better understanding drivers of collective environmental action in high school students as a unique contribution to the literature.

Each type of pro-environmental behavior was modeled in three distinct ways. One model, hereafter referred to as the “traditional model,” used a combination of commonly-used behavioral antecedents from the theory of planned behavior (Ajzen, 1991) and the environmental literacy framework (Hollweg et al., 2011), as seen in Gibson et al. (in review). The second model, which we call the “social capital model,” used behavioral antecedents related to social capital to model engagement in the different categories of environmental actions (Ostrom & Ahn, 2007; Krasny, 2020). The third model combined the two approaches, adding the traditional behavioral antecedents as well as components of social capital as variables in our models of behavior prediction, hereafter referred to as the “combination model.” We then compared model fit between and within each of the three types of pro-environmental behaviors, working toward the end goal of understanding which model is most appropriate to use for each type of behavior,

how well each behavior types's best model can actually predict the behavior, and which variables are significant predictors of the behavior. In short, our research questions are as follows:

1. Can traditional models of pro-environmental behavior be improved through incorporating social capital variables, either as the only behavioral antecedents or as additional antecedents within the model?
2. What variables are significant predictors of collective non-activist behavior? Of collective activist behavior?
3. How do our best models for collective behaviors compare in their predictive abilities, both to each other and to our best model of private-sphere action?

Answering these questions will take us one step closer to better models for collective action and, in the process, a better understanding of what we need to do to spur more action at this scale to address the planet's current environmental issues.

Methods

Study participants

Procedure

To recruit high school students to participate in this study, we worked in collaboration with high school environmental science teachers across the state of North Carolina during the 2020-2021 and 2021-2022 school years. Teachers were considered eligible if they taught any form of environmental science (Earth & Environmental Science, AP Environmental Science, IB Environmental Systems & Societies) to high school students (grades 9 to 12) during the semesters during which the study took place. Teachers were contacted about the study opportunity via the North Carolina Department of Public Instruction listserv, an email list that is open to all K-12 teachers statewide, and invited to opt their classrooms into the research by distributing the study's surveys to their students within the first two months of their semester-long environmental science course. Surveys were made available via an online Qualtrics link, and teachers received a small stipend for survey distribution. Because survey participation was completely voluntary and not linked to course requirements, students were asked whether they assented to participate in the research, and the students' parent(s) or guardian(s) were asked whether they consented for their child to participate. Both student assent and parent/guardian consent were required for study participation.

The study took place during the peak of the global COVID-19 pandemic, a context that undoubtedly shaped study participation rate as well as survey responses. Over four semesters of data collection, participating schools went through periods of in-person instruction, online learning, and hybrid schooling, adding stress and uncertainty to the lives of teachers, students,

and parents alike (Fardin, 2020). See “Limitations” for a full discussion of the potential impacts of the pandemic on survey response rate and study findings.

Participant attributes

Surveys were distributed by 24 high school environmental science teachers in 20 schools across 18 different North Carolina counties. Of the schools involved in the study, half (n=10) were Title 1 schools, defined as schools receiving additional funding from the federal government due to 40% or more of their student population belonging to low-income families (No Child Left Behind Act, 2002). The 24 participating teachers made surveys available to an estimated 1345 students, and 817 (61%) of those students engaged in the survey. Of those, though, only 362 (44%) were considered appropriate to include in analysis. Issues such as lack of parent permission (23%), survey completion rate of lower than 50% (19%), missing student assent (10%), or response straightlining across five or more consecutive constructs (5%) excluded the remaining surveys. (Please see “Limitations” for more on the implications of this response rate.) Of the 362 completed survey responses, 243 (67%) came from the 2020-2021 school year and 119 (33%) from the 2021-2022 school year.

Demographically, the vast majority of student participants were young high school students, with more than 80% reporting an age of either 14 or 15 years. Girls outnumbered boys in the study (49% and 39% of participants, respectively), with limited numbers of non-binary students (1%), students identifying in a different way (3%), or students who did not wish to report their gender (8%). Racially, most students identified as white (59%). 11% of students identified as African-American, 10% as Hispanic, 3% as Asian or Pacific Islander, 1% as Native American, and 7% as multi-racial. The remaining 10% either declined to respond (8%) or identified another way (2%). This breakdown closely matches that of the state of North Carolina

in all categories outside of African-American persons, with that race underrepresented by about half (11% in our survey and 22% in the state) (U.S. Census Bureau, 2021). For all demographic characteristics of survey respondents, see Table 4.1 below.

Table 4.1. Participant demographics.

<u>Characteristic</u>	<u>Number of Students</u>	<u>Percentage of Students</u>
Age		
14	129	36%
15	133	37%
16	57	16%
17	37	10%
18	5	1%
19	1	0%
Gender		
Girl / woman	177	49%
Boy / man	142	39%
Non-binary	5	1%
Other	10	3%
No response	28	8%
Race / ethnicity		
White, non-Hispanic	212	59%
African-American, non-Hispanic	41	11%
Hispanic	36	10%
Asian or Pacific Islander	10	3%
Multi-racial	2	1%
Other	25	7%
No response	8	2%
School year		
2020-2021	243	67%
2021-2022	119	33%

Survey

Constructs

Pro-environmental behaviors. To measure the frequency with which students partook in pro-environmental behavior, the survey tool asked participants about their level of engagement with eight specific pro-environmental behaviors, with students self-reporting their

engagement on a Likert scale ranging from 1 (“Never”) to 7 (“Every chance I get”). Each of the eight pro-environmental behaviors in the survey was categorized as either a private-sphere behavior, a collective non-activist behavior, or a collective activist behavior (with no actions cross-cutting multiple categories). The two private-sphere behaviors included in the survey were picking up litter and avoiding flushing items down the toilet besides toilet paper. To measure collective, non-activist behaviors, we asked students about how often they 1) talked to other people about ways that the community can work together to improve water quality, 2) participated in community events like trash clean-ups, and 3) organized community events like trash clean-ups. The three targeted actions to measure collective activist behaviors were talking with school administrators about what rules the school can make to improve water quality around our school, writing to local officials in support of policies that support water quality in the community, and attending local government events to voice support of water quality policies in the community. All eight of the pro-environmental behaviors included in the survey—two private-sphere, three collective non-activist, and three collective activist behaviors—related to the issue of water quality so as to focus on the type of pro-environmental behavior at hand without introducing unnecessary variability in the action’s environmental issue of focus. Frequency of engagement in the actions within each category were averaged to yield a composite value for each of the three types of behavior.

Traditional behavioral antecedents. In alignment with Gibson et al. (in review), our “traditional” variables were derived from a combination of the theory of planned behavior (Ajzen, 1991) and the environmental literacy framework (Hollweg et al., 2011), the former which is widely used in the social science literature and the latter which is commonly applied in environmental education research. Students were asked about their feelings towards the

environment and environmental behaviors (affect); their perception of environmental norms amongst their family, friends, and community as a whole (subjective norms); and the degree to which they felt they could engage in environmental behaviors of various types (perceived behavioral control). A short justification for the inclusion of each component of this traditional model is included below, with a more thorough explanation of reasoning available in the study on which this model was based (Gibson et al., in review).

We evaluated each included construct for internal validity via the reliability measure Cronbach's alpha (Gliem & Gliem, 2003), with an alpha of 0.70 or greater considered desirable. Two- or three-item constructs with alphas lower than this benchmark were examined for face validity on a case-by-case basis and were accepted as valid given unanimous agreement amongst the coauthor team; this is because alpha is known to underestimate the reliability of constructs comprised of a low number of items (Eisinga et al., 2013). Across all constructs, a composite value was generated through averaging all items within that construct.

Affect. Three constructs fell under the category of affect in this survey: hope, hopelessness, and response efficacy (Gibson et al., in review). Much literature exists around hope's correlation with environmental action (Ojala, 2012; Stevenson et al., 2018; Stevenson & Peterson, 2016), making inclusion of hope and hopelessness within this affective category a natural choice. Our survey's measures of hope and hopelessness were derived from Li & Monroe's (2018) Climate Change Hope Scale, a tool specifically designed and validated for high school students. Because our study did not focus on climate change specifically, we reframed the scale to center around the environment more generally, as past research has shown to be effective (Szczytko et al., 2019). We included hope and hopelessness as separate constructs ($\alpha=0.88$, 10 items; and $\alpha=0.80$, 3 items) because they separated out in a factor analysis and are less correlated

than might be expected ($r=-0.35$). Finally, the third affective dimension, response efficacy, was included both because it can be seen as a component of hope (Szczytko et al., 2019) and because research suggests it may be linked to intention toward pro-environmental action (Lam, 2006). Response efficacy was measured by asking students how effective they thought each of the eight behaviors of interest would be in improving community water quality on a Likert scale of 1 (“not at all effective”) to 7 (“extremely effective”) ($\alpha=0.92$, 8 items).

Subjective norms. Because of its centrality to the theory of planned behavior (Ajzen, 1991) and its identified influence on environmental action (Ham et al., 2015; Busch et al., 2019; Krasny, 2020, p. 160), subjective norms were incorporated into the traditional behavior prediction model. The survey asked students to report how much they felt that three different groups of significant others—friends, parents, and other people in the community—take care of the environment, think that taking care of the environment is important, and think that the student responding to the survey should take care of the environment ($\alpha=0.91$, 9 items).

Perceived behavioral control. Perceived behavioral control, or a student respondent’s view of the degree to which they could take an action if they wished to do so, was included due to its importance in the theory of planned behavior (Ajzen, 1991) and its reflection of the environmental literacy framework’s *competencies* element (Hollweg et al., 2011; Gibson et al., in review). Students were asked to rate their agreement with a statement starting with “If I wanted to, I could...” followed by each eight environmental behaviors of interest ($\alpha=0.93$, 8 items) on a Likert scale from 1 (“strongly disagree”) to 7 (“strongly agree”).

Social capital variables. Drawing on Ostrom & Ahn’s (2007) social capital definition and Krasny’s (2020) social capital model, we asked respondents how much they trusted their fellow community members (trust), how many people they discussed water quality with and how

often (social networks), and how much they felt young people were willing and able to create community change (perception of youth power in the community). As with the constructs included in the traditional model, Cronbach's alpha (α) was used to measure construct validity (Gliem & Gliem, 2003), with an initial benchmark of 0.70 and an examination of face validity for constructs that failed to meet this cutoff. Composite values were generated for each construct through averaging all items within that construct.

Trust toward community. Since both Ostrom & Ahn (2007) and Krasny (2020) centered trust as a main piece of their conceptualizations of social capital, we included trust toward community as one of the three components of social capital measured in this study. Students were asked how much they trusted different groups of people to help improve water quality in their community, on a scale of 1 ("not at all") to 5 ("a great deal"). Community was defined as inclusive of the following groups: family members, teachers, other adult community members, and other youth. A separate measure of trust was taken for each group and then averaged to create a composite community trust score ($\alpha=0.74$, 4 items). The survey also captured degrees of trust for figures like scientists and politicians, but a factor analysis showed these authority figures to be a distinct category from the four groups included in our community definition; trust for scientists and politicians was therefore omitted from the trust composite construct.

Social networks. Ostrom & Ahn's (2007) variable of *social connections* was combined with Krasny's (2020) nearly-identical component *networks* to create our variable, which we call *social networks*. Social networks were conceptualized in this study as a combination of two constructs: the number of social connections an individual has and the intensity of those connections. To measure the number of social connections that may be relevant to our research questions, we asked students to list the names of individuals they had talked to about water

quality in the past month. The number of unique names provided gave us the number of social connections; in social network analysis terms, this number is equivalent to the number of ties in that individual's ego-network, or that individual's degree (Borgatti et al., 2018; p. 33-34).

Intensity of social connection was measured by asking students how often in the last month they had discussed water quality with 1) their environmental science class, 2) their friends outside of class, and 3) their family, all on a scale of 1 ("never") to 5 (">5 times"). These three questions were averaged to create the discussion frequency or intensity of connection variable ($\alpha=0.54$, 3 items).

Perception of youth power in the community. This construct—adapted from the policy control dimension of the socio-political control scale for youth which was developed for and validated with high school students (Peterson et al., 2011)—represents a measure of *formal and informal rules or institutions* of Ostrom & Ahn (2007) (which, by definition, also encompasses the informal rules or *social norms* of Krasny [2020]). The items in the scale speak to the student respondent's perception of the degree to which they and other youth might be interested in and capable of engaging with the community (social norms around community participation) as well as the amount of support they feel they have from the community to do so (institutional support for youth participation). Together, these factors combine to form the students' perceptions of youth power in their community—how much social norms and/or more formalized institutions support their engagement in community efforts ($\alpha=0.91$, 9 items). The survey measured student agreement with a variety of statements related to the construct, with values ranging from 1 ("strongly disagree") to 7 ("strongly agree").

Contextual variables. Given the inclusion of context in the models on which our traditional (Ajzen, 1991) and social capital (Ostrom & Ahn, 2007) models were built, contextual variables were incorporated as behavioral antecedents in this research effort.

Sociodemographics. Although context could take almost an infinite number of forms, we selectively included the sociodemographic variables of age, gender, and race given their demonstrated relationship with environmental behavior (Brough et al., 2016; Wang et al., 2021; Ellis & Korzenny, 2012; Medina et al., 2019; Stevenson et al., 2013). Age was recorded as a whole number, in years. Students self-reported their gender by either checking a pre-existing box (*boy/man*, *girl/woman*, or *non-binary*) or by writing in their own answer to allow for flexibility of expression. Most of the students who wrote in their own answer (6 of the 10 respondents) seemed not to do so genuinely, writing in phrases like “its none of your bee’s wax” and “dog/chihuahua”. Because of this and the very low number of non-binary participants, gender was collapsed into a binary (*boy/man* and *girl/woman*). (Refer to “Limitations” for a discussion of the implications of this choice.) Similarly, although our original race/ethnicity question offered a variety of response options (*White or Caucasian, non-Hispanic; Hispanic; African-American, non-Hispanic; Asian or Pacific Islander; other* with a free response option), with the ability to select multiple races, we later converted this category to a binary variable of “white” or “person of color,” as we lacked the statistical power to analyze all race/ethnicities separately.

School year. We included school year as an additional contextual variable given the differential impacts of COVID-19 during the two school years during which this study was conducted. School year was recorded as either 2020-2021 or 2021-2022, based on the recorded response date of the survey.

Pilot testing

Prior to distributing the student survey to the 24 participating teachers and their classrooms, we pilot tested the survey tool. We asked 10 high school students to complete the full survey as a measure of survey attrition, and we conducted voluntary cognitive interviews with 3 of these students to talk through confusing elements of the survey, with particular attention to which words might be difficult for our youngest 14-year-old survey respondents to understand (Collins, 2003). Minor adjustments to survey question and response wording were made to the final iteration of the survey based on this student feedback.

See appendices for the full survey tool as well as more details on item-level reliability scores.

Analysis

To begin addressing any of this study's research questions, we created 9 regression models. For each type of pro-environmental behavior—private-sphere, collective non-activist, collective activist—we created one “traditional model” that used traditional variables and contextual factors, one “social capital model” that employed social capital variables and contextual factors, and one “combination model” that incorporated traditional variables, social capital variables, and contextual variables (Figure 4.3).

We employed feasible generalized least squares (FGLS) regression in the creation of each of our 9 generated models. This type of regression was selected because it is more robust to heteroskedasticity than ordinary least squares (OLS) regression (Cameron & Trivedi, 2005); given the heteroskedasticity in the collective action models (see Gibson et al., in review), choosing to use FGLS rather than OLS represents an important step toward this study's overall goal of creating more accurate models for collective action. In our model creation, we assumed a

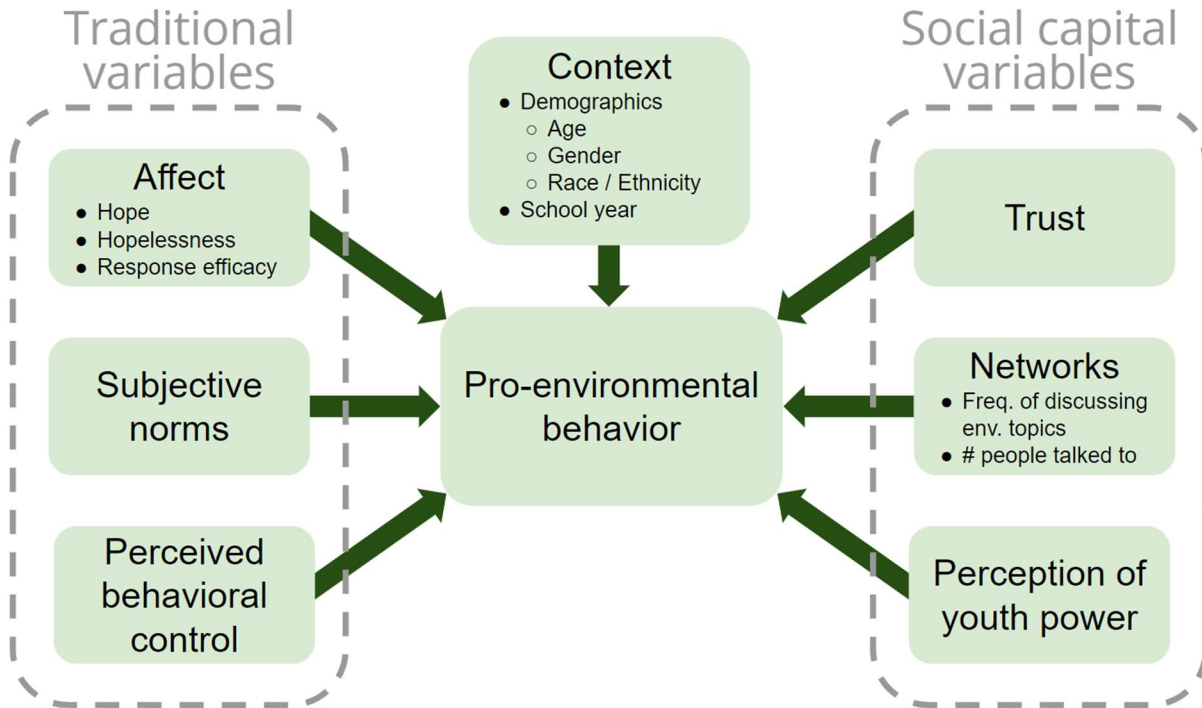
heteroskedastic but uncorrelated error structure and no autocorrelation of errors, using an iterated GLS estimator with a tolerance of 0.002. We also utilized a Box-Cox transformation on the dependent variable, pro-environmental behavior, to further correct for heteroskedasticity (Box & Cox, 1964). Because the Box-Cox transformation can result in unintuitive beta coefficients (for example, inverting a variable and therefore flipping the sign of beta relative to if the variable were non-transformed), we chose not to report beta values and instead to focus exclusively on our stated research questions (identifying significant predictor variables and comparing model fit).

To see if social capital variables might improve upon traditional behavior prediction models (Research Question 1), we compared several measures of model goodness of fit across the three models generated within a specific behavioral category (e.g., collective activist behavior). We first used R^2 , with higher R^2 values indicating that more variance is explained and the model is therefore considered stronger (Hagquist & Stenbeck, 1998; Taraday & Wieczorek-Taraday, 2018). We also calculated AIC (Akaike, 1987) and BIC (Schwarz, 1978) scores for the models, both of which measure model goodness of fit by balancing error variance with number of parameters in hopes of preventing overfitting through the inclusion of too many independent variables. Lower AIC and BIC scores indicated better model fit, with BIC being more sensitive to overfitting. We also answered Research Question 3 using these metrics, but comparing across behavior types rather than within them.

To address Research Question 2, we identified the variables that were statistically significant ($p > 0.05$) within the best model of collective non-activist behavior and the best model of collective activist behavior.

Figure 4.3

Modeling pro-environmental behavior using various combinations of traditional variables (Ajzen, 1991; Hollweg et al., 2011; Gibson et al., in review), social capital variables (Ostrom & Ahn, 2007; Krasny, 2020), and context.



Traditional model:

Traditional variables + Context → Pro-environmental behavior

Social capital model:

Social capital variables + Context → Pro-environmental behavior

Combination model:

Traditional variables + Social capital variables + Context → Pro-environmental behavior

Results

Variable summaries

Students participated in private-sphere behavior much more frequently than they did collective non-activist or collective activist behaviors (\bar{x} =5.30, 2.60, and 1.95, respectively; see Table 4.2). In the same vein, they viewed private-sphere behaviors as more effective and within their behavioral control than collective non-activist behaviors, followed by collective activist behaviors as the least effective and least within their control (see Table 4.2). Separately from these behaviors, students reported high levels of environmental hope (\bar{x} =4.90) and medium-to-low levels of hopelessness (\bar{x} =2.98). They perceived their community as wanting them to care for the environment (subjective norms \bar{x} =4.51) but only moderately trusted those same community members to take action to improve local water quality (\bar{x} =2.74). Students said that they talked about water quality to their friends and family a little over once a month and connected with about 2 people in those conversations. Finally, the survey respondents said that they felt that youth had moderate to high levels of power within their community (\bar{x} =4.42). See Table 4.2 for a full breakdown of variable means, standard deviations, and reliability statistics.

Table 4.2. Summary of model variables.

	<u>Mean</u>	<u>Min</u>	<u>Max</u>	<u>SD</u>	<u>Reliability</u>	
<u>Dependent variables</u>					α	# items
Frequency of behavior	3.04	1	7	1.22	0.87	8
Private-sphere	5.30	1	7	1.25	0.49	2
Collective non-activist	2.60	1	7	1.53	0.83	3
Collective activist	1.95	1	7	1.54	0.95	3
<u>Independent variables</u>						
Affect						
Env. hope	4.90	1	7	1.01	0.88	10
Env. hopelessness	2.98	1	7	1.30	0.80	3
Response efficacy	5.25	1	7	1.26	0.92	8
Private-sphere	5.45	1	7	1.39	0.85	2
Collective non-activist	5.40	1	7	1.33	0.87	3
Collective activist	4.87	1	7	1.56	0.91	3
Subjective norms	4.51	1	7	1.20	0.91	9
Behavioral control	5.47	1	7	1.39	0.93	8
Private-sphere	6.14	1	7	1.26	0.87	2
Collective non-activist	5.39	1	7	1.58	0.91	3
Collective activist	5.05	1	7	1.76	0.93	3
Trust toward community	2.74	1	5	0.98	0.74	4
Social networks						
Discussion frequency	2.24	1	5	0.77	0.54	3
# people talked to	1.97	1	10	2.09	N/A	1
Perception of youth power	4.42	1	7	1.23	0.91	9

Predicting collective non-activist behavior

The three different models for collective non-activist varied noticeably in their predictive power. The traditional model predicted just 17% of the variance in behavioral engagement, whereas the social capital model predicted 26% and the combination model predicted 27.8%. Although the combination model had the highest R^2 , the social capital model had the lowest AIC and BIC scores, giving mixed signals on which model is the strongest in this behavioral category. The social capital model yielded significant variables of perceived power of youth in the community ($p<0.001$), trust toward the community ($p<0.05$), and frequency of discussing environmental issues ($p<0.01$). All had a positive association with engaging in collective non-activist behaviors. The combination model shared two of those same variables—youth power ($p<0.001$) and discussion frequency ($p<0.001$)—as well as two additional variables of subjective norms ($p<0.01$) and number of people talked to about environmental issues in the last month ($p<0.05$). Again, an increase in each of these variables was associated with an increase in this type of pro-environmental behavior. See Table 4.3 for full details.

Predicting collective activist behavior

Like collective non-activist behavior, collective activist behavior was better predicted by the two models that incorporated social capital: the social capital model ($R^2=0.160$) and the combination model ($R^2=0.165$). These models had nearly twice the predictive power of the traditional model ($R^2=0.087$). Because the combination model had both the highest R^2 value and the lowest AIC and BIC scores, it was considered the strongest of the three models. It contained a whopping eight significant variables—twice as many as the best collective non-activist behavior models. Within the set of traditional variables, hopelessness ($p<0.05$) and subjective norms

($p < 0.01$) emerged as significant positive predictors. All four of the social capital variables were also significant. Youth power, community trust, and discussion frequency all had p-values lower than 0.05, and the number of people talked to had a p-value of less than 0.01. Additionally, two contextual variables had a significant relationship with collective activist behavior. Race and ethnicity was positively correlated with behavior ($p < 0.05$), meaning that students of color engaged in collective activist behaviors significantly more than white students. The significance of school year ($p < 0.05$) and its negative association indicated that students engaged in civic behavior more frequently in the 2020-2021 school year than the 2021-2022 school year. Table 4.3 shows additional information.

Predicting private-sphere behavior

Though this study is first and foremost concerned with collective behavior, we also modeled private-sphere behavior as a basis of comparison for the collective models. The strongest model of private-sphere behavior was the combination model ($R^2 = 0.393$), explaining nearly 40% of the variance in behavior and having the lowest AIC and BIC scores, followed very closely by the traditional model ($R^2 = 0.386$) and then the social capital model ($R^2 = 0.205$). The strongest model, the combination model, revealed four significant predictors, all with a positive relationship with behavioral engagement: hope ($p < 0.01$), response efficacy ($p < 0.001$), subjective norms ($p < 0.01$), and perceived behavioral control ($p < 0.001$). Again, see Table 4.3.

Table 4.3. Modeling various types of pro-environmental behaviors using the traditional model (“trad mod”), the social capital model (“SC mod”), and a combination of the two (“comb mod”).

	Private-sphere¹			Collective non-activist²			Collective activist³		
	<i>Trad mod.</i>	<i>SC mod.</i>	<i>Comb mod.</i>	<i>Trad mod.</i>	<i>SC mod.</i>	<i>Comb mod.</i>	<i>Trad mod.</i>	<i>SC mod.</i>	<i>Comb mod.</i>
Model Variables									
Traditional vars									
Affect									
Hope	***		**	*					
Hopelessness							*		*
Resp. eff.	***		***						
Subj. norms	***		**	***		**	***		**
Beh. control	**		***						
Social capital vars									
Comm. trust		*			*			*	*
Social networks									
Disc. freq.					**	***		*	*
# ppl talked to						*		**	**
Youth power		***			***	***		***	*
Contextual vars									
Demographics									
Age							*(-)	*(-)	
Gender ⁴								***(-)	
Race/Eth ⁵				*			*		*
School year ⁶				*				**(-)	*(-)

Table 4.3 (continued).

Model Attributes									
Sample size	306	301	289	299	300	283	305	301	289
R ²	0.386	0.205	0.393	0.170	0.260	0.278	0.087	0.160	0.165
AIC	2483	2496	2340	-812	-861	-813	265	251	229
BIC	2591	2604	2461	-705	-753	-693	373	358	350

Note: Dependent variables were transformed using Box-Cox method, which makes the coefficient interpretation non-intuitive. In line with our research questions, we report the p-values and coefficient valence (- denotes negative valence). We also list R², AIC, and BIC values as a measure of model fit.

¹Defined as actions taken solely by one person, without involving others. Actions include picking up litter and avoiding flushing items down the toilet besides toilet paper.

²Defined as actions an individual participates in that involve at least one additional person but do not push for changes in rules, policies, or systems. Actions include talking to others about ways that the community can work together to improve water quality, participating in community events like trash clean-ups, and organizing community events like trash clean-ups.

³Defined as actions an individual participates in that are taken in an effort to change rules, policies, or systems. Actions include talking with school administrators about what rules the school can make to improve water quality around our school, writing to local officials in support of policies that support water quality in the community, and attending local government events to voice support of water quality policies in the community.

⁴1=girl/woman, 0=boy/man

⁵1=person of color, 0=white

⁶1=2021-2022 school year, 0=2020-2021 school year

*p<0.05

**p<0.01

***p<0.001

Discussion

Overall, our models suggest that the drivers of private-sphere behavior are qualitatively different from the drivers of collective behavior, requiring us to create new models that more accurately portray what goes into fostering collective action. These findings are consistent with calls for more theoretical and empirical work to understand collective environmental action (Ardoin et al., 2013; Gibson et al., in review; Ostrom, 2010). Past efforts to create models for community-level environmental literacy (Gibson et al., 2022; Ardoin et al., 2022) and community-level environmental action (Aguilar et al., 2018) have pointed to the insufficiency of existing collective literacy and action frameworks in the realm of environmental action. This study represents a step towards better frameworks. The abilities of the social capital model and the combination model to predict both types of collective behavior were nearly double that of the traditional models, offering some of the first empirical support for the development of new models of PEB when considering collective versus private sphere behaviors. In contrast, we find that the addition of social capital variables fails to improve our models of private-sphere behaviors, providing further evidence that the factors that predict collective action are fundamentally different from those that predict private-sphere action. Though the combination models did offer slightly more predictive power, the only variable from traditional models that was significantly predictive was social norms, which, like social capital, centers around community relationships. This again underlines the need to bring non-traditional, relationship-based behavioral antecedents into our models of collective action (Gibson et al., 2022; Ardoin et al., 2022).

Encouragingly, all included social capital variables appear to be helpful in understanding collective behaviors among high school students. As there was so little difference in model fit

between the social capital and traditional models, and in significant variables between activist and non-activist collective behaviors, we first discuss them here together. After exploring commonalities across models, we then turn to nuances between the models that offer opportunity for more research.

Common predictors of collective action

Trust

Young people need to feel like they can trust other community members before engaging in collective environmental action. The significance of community trust predicting collective behaviors aligns with several other studies' findings on generalized trusts' link to collective action (Sønderskov, 2008; Duit, 2011) in addition to aligning with the theoretical models on which this study was built (Ostrom & Ahn, 2007; Krasny, 2020). More intentional inclusion of youth voice in deliberative processes and participatory governance approaches could be a promising step towards building trust in community members and in authority figures (Stern & Hellquist, 2017), as could immersive time spent with peers and community members (Ardoin et al., 2017). However, due to the complex and multifaceted nature of the concept of trust (Stern & Hellquist, 2017; Robbins, 2016), we caution that more research is needed to fully understand the relationship between trust and collective action. See "Limitations and Future Research" for more details.

Social networks

The significance of both social network variables—the frequency with which students talked to others about water quality and the number of unique people that were a part of those conversations—underlines the importance of community connection on collective action around

environmental topics. This link between social networks and collective behavior is already noted in the conceptual literature (Chapter 1; Gibson et al., 2021; Ardoin et al., 2022) as well as in the empirical literature (Wakefield et al., 2006), but it has not yet been extensively studied in a youth-specific context. However, there has been significant research into the link between social connections and individual pro-environmental behavior in youth; research demonstrates that young people who discuss environmental topics with their friends, family, and teachers tend to show more concern for the environment (Stevenson et al., 2019; Lawson et al., 2019) and engage in more pro-environmental behaviors (Valdez et al., 2018). Facilitating connections and discussions between young people and other community members, then, may empower youth to engage in more individual as well as collective behaviors. Environmental discussions can impact those on the other side of the conversations, too. Because young people have a measurable influence on the environmental beliefs and concerns of the adults with which they interact (Lawson et al., 2019; Hartley et al., 2021a; Hartley et al., 2021b), youth-initiated community conversations about the environment may also drive changes in local adults and policymakers, snowballing into even more impactful collective action.

Perception of Youth Power

The positive link between a student's perception of their power within their own community and that student's engagement in collective behaviors emphasizes that young people need to be taken seriously and supported in their efforts to engage in large-scale change, if they are to continue pursuing such change. Adults can serve in this legitimizing role through power-sharing (Zeldin et al., 2013; Richards-Schuster & Timmermans, 2017; Zeldin et al., 2017). Support from formalized institutions like local governments (Hartley et al., 2021a; Hartley et al., 2021b) also has a role to play in building the "formal and informal rules and institutions"

(Ostrom & Ahn, 2007) component of social capital necessary to empower students to be effective agents of systemic change. For instance, state and local governments can establish youth advisory councils which, when run in non-extractive and non-tokenizing ways, give young people a direct platform through which they can share their ideas and concerns with policymakers (NC Department of Administration, 2022). Finally, there is evidence building that the social norms discussed by Krasny (2020) and encompassed in the “informal rules” portion of Ostrom’s definition are incredibly important in understanding youth engagement in collective activism. A study investigating what drove young people in Germany to participate in the Fridays for Future movement, a global school strike initiative, found that the strongest predictor of an individual’s engagement in activism is their perception of their friends’ engagement in activism (Wallis & Loy, 2021). Observing peer engagement in collective environmental action can build social norms, or “unwritten codes of conduct,” that encourage young people to conform by also pursuing similar action (Chung & Rimal, 2016). Additional qualitative research on significant life experiences of youth advocates confirms that friends, peers, and other gatherings of like-minded young people also drive leadership in collective behaviors related to the environment (Arnold et al., 2009). Through bolstered social norms around youth participation in activism and through increased adult and institutional support of that activism, young people can build the perceived power they need to take action to change socio-environmental systems for the better.

Subjective norms

As discussed previously, subjective norms are the only traditional variable to speak to students’ perceptions of other community members, making them more directly relevant to collective behaviors than the other individually-measured traditional variables. While the social

norms described above relate to what young people observe their peers doing and the pressures to conform accordingly, subjective norms describe how students perceive other community members as wanting them to act (Ajzen, 1991). Because subjective norms relate to student perceptions of community members, this variable is also linked to other aspects of social capital like the level to which students trust community members to care about the environment ($r=0.35$). Subjective norms are also moderately- to highly-correlated to youth perception of their power in the community, which encompasses social norms around youth environmental action ($r=0.58$). The close relationship between subjective norms and social norms is not particularly surprising, and practically, it suggests that bolstering norms of either of these types may help inspire collective activist behavior amongst young people.

Nuances between types of collective action

While the aforementioned behavioral antecedents were significant across both activist and non-activist forms of collective action, some variables only reached significance in one of the two categories, calling for additional investigation into their potential role in predicting collective behavior. All significant predictors of collective non-activist behavior were also significant predictors of collective activist behaviors, though the converse was not true. The following constructs predicted engagement in collective activist behaviors—either in the social capital model, the combination model, or both—but not in collective non-activist behaviors.

Hopelessness

Hopelessness' potential positive relationship with collective activist behavior, as highlighted by the combination model, may reflect the delicate balance of concern and hope students need to simultaneously hold in order to take large-scale action. Although more

hopelessness being associated with more collective activism may be counterintuitive at first, we can turn to one of the most well-known instigators of youth collective activism to begin to anecdotally understand how this might be the case. Greta Thunberg, Swedish climate activist, said the following at the 2019 World Economic Forum when she was 16 years old: “I often hear adults say: ‘We need to give the next generation hope.’ But I don’t want your hope. I want you to panic. I want you to feel the fear I do. Every day. And want you to act. I want you to behave like our house is on fire. Because it is” (Workman, 2019). Thunberg emphasizes the fear she feels daily as a result of the climate crisis, a level of fear that might translate into a high hopelessness score on this study’s questionnaire. The survey questions related to hopelessness questions asked students to reflect on the degree to which they agree with statements like “environmental problems are beyond my control, so I won’t even bother trying to solve them” and “environmental problems are so complex that we will not be able to solve them”—statements that focus on the large-scale, existential nature of the socio-environmental issues we face today (Li & Monroe, 2018). Students who understand the true severity and scale of problems like climate change, then, might score higher on the hopelessness scale than those who are less concerned about climate change. Research indicates that environmental worry, when paired with a degree of environmental hope, makes young people more likely to engage in pro-environmental behaviors than if they did not have that combination of negative and positive affect (Ojala, 2008). Further research is needed to better disentangle this relationship between hopelessness and collective environmental activism so that we can foster youth collective action without venturing into the realms of eco-anxiety or eco-depression, which can have both negative mental health ramifications and can stymie pro-environmental action (Stanley et al., 2021; Gifford, 2011).

School Year

In both of our best models of collective activist behaviors, the contextual variable of school year emerged as significant, with the 2020-2021 school year associated with more of this action than the 2021-2022 school year; this may allude to the extremely unique context of 2020. The 2020-2021 school year took place during the height of the COVID-19 pandemic, pushing the majority of schooling and social activities online. While we may intuitively think that this would cause engagement in pro-environmental behaviors as a whole to decrease because of increased stress or focus on global health issues rather than environmental concerns, the research shows mixed results; some studies suggest possible increases in environmental behaviors or behavioral intentions, while others show no change at all (Mi et al., 2021; Zebardast & Radaei, 2022; Kim & Lee, 2022; Urban & Braun Kohlová, 2022). Our research indicates a possible decrease in youth engagement in collective non-activist behaviors from the 2020-2021 school year to the 2021-2022 school year (Gibson et al., in review), which we hypothesize to be due to decreased opportunities for the in-person interactions that are typically a part of non-activist collective actions. Perhaps, then, this study's finding of an increase in collective activist behaviors might reflect students seeking out ways to work with others to create change in a way that does not require in-person interaction; in other words, perhaps students are turning to collective activist behaviors when collective non-activist behaviors are not feasible. Alternatively or in addition to this replacement hypothesis, young people could have been more focused on creating systemic change through activism due to the social context of 2020 and 2021. These two years were massively historical, with not only the pandemic changing world dynamics but also the murder of George Floyd sparking a widespread reckoning with racism, the impeachment of then-President Trump, a hugely impactful presidential election in the United States, and an

insurrection at the nation's capitol. The calls for systemic change related to democracy and racial justice that these events spawned may have in turn spurred an increased awareness of or desire to push for systemic change related to environmental issues, too. Replication of this study during more "normal" years would help disentangle the relationship between school year and collective activist behaviors.

Race / Ethnicity

Within the socio-demographic variables, the combination model for collective activist behaviors found that students of color were significantly more likely to engage in collective activist behaviors than their white peers, carrying on these communities' long histories of leading collective environmental justice movements (Taylor, 2014). For decades, Western researchers contended that historically marginalized people (with research often focused on Black communities) had lower concern for environmental issues than did their white counterparts, often arguing that people of color had battle larger challenges like financial inequality and social inequality before they would have the time and capacity to concern themselves with environmental problems (Sheppard, 1995; Mohai, 1990; Van Liere & Dunlap, 1980). However, this perspective failed to understand that "environmental" issues are inextricably intertwined with social, economic, and racial injustices (Taylor, 2014). In the process, it failed to see the environmental justice movement—which was led by people of color and pushed for systemic change—as a part of mainstream environmentalism (Thomas, 2022). The fact that students of color continue engaging in collective efforts to push for system change, then, is perhaps just a continuation of this tradition of activism. Additionally, differences in cultural influences between many white families and many families of color may contribute to this behavior difference, too. Dominant cultures within Europe and the United States are considered to be predominantly

individualistic in nature, valuing personal freedoms and impacts over those of the larger society, whereas many countries in East Asia, Africa, and Latin America lie closer to the collectivism end of the spectrum, valuing “we” over “me” (Green et al., 2005). Perhaps students growing up in families with these more collectivist roots—often students of color—have a higher tendency to engage in collective actions (Singelis et al., 1995; Gaines et al., 1997). However, most of the research on this topic is decades old, so further studies are necessary to properly understand this connection in our current context.

Age

Within the social capital model but not the combination model of collective activist behavior, age was significantly and negatively correlated with behavior, perhaps because students become more jaded over time. Studies that have attempted to disentangle the relationship between age and pro-environmental action have yielded conflicting results (Wiernik et al., 2013), leaving this finding difficult to interpret. One possible explanation for younger students being more likely to engage in collective activist behavior is that the students earlier in their lives might be less jaded towards systems of power. A 2021 study of 10,000 young people found that, of those who talked to other people about climate change, approximately half felt they were dismissed (Hickman, 2021). This might result in less of an inclination to talk to people in power over time, if students expect to be turned away.

Gender

The social capital model of collective activism found that boys engaged in this type of behavior significantly more frequently than girls, likely because boys are more socialized to be comfortable challenging authority and therefore could be more likely to push for system change.

While research shows that assertiveness, risk-taking, intensity, and leadership ability are seen as strong positives in men, women are expected to be cooperative, patient, and polite (Prentice & Carranza, 2002). Even preschool-age children experience backlash if they do not align with these stereotypes (Sullivan et al., 2018), and girls who challenge authority even at age one are viewed negatively (Sullivan et al., 2022). These stereotypes and the repercussions that hit if the stereotypes are broken could have deterred the high school girls of this study from challenging existing systems and the powerful people who control them.

Comparing across models

Though the inclusion of social capital variables improved our models of both collective non-activist behavior and collective activist behavior, our best models of collective behavior still fall short of the predictive power of the traditional models for private-sphere behavior, calling for additional work on collective action models. Between the two types of collective action investigated in this study, the strongest model of collective non-activist behaviors was stronger than the collective activist model ($R^2=0.278$ and $R^2=0.165$, respectively), perhaps due in part to low rates of engagement in collective activist behaviors. Over half of surveyed students (57%) reported that they had engaged in no collective activist behaviors in the last month, and predicting what drives students to engage in behavior is difficult when there are few cases of actual behavioral engagement off of which to work. Additionally, collective activist behavior, as a concept, is very different from the private-sphere behaviors that steered the development of most pro-environmental behavior models. While private-sphere action and collective non-activist action both center around behavior change—either changing one’s own behavior in isolation or persuading others to change theirs—collective activist behaviors seek to shift systems. It is not

surprising, then, that collective non-activist behaviors can be better predicted by existing models than can collective activist behaviors due to shared similarities with private-sphere behavior.

Limitations and future research

Like all research, this study has limitations both in terms of its context (namely, the COVID-19 pandemic) and in terms of its structure. The global pandemic added significant stress to student and parent lives (Anderson et al., 2022; Moreland-Russell et al., 2022), undoubtedly lowering the rate at which students consented to and completed the survey as well as the rate at which parents filled out the consent forms that allowed us to use their child's survey response. Families experiencing more stress were hypothetically less likely to participate in the survey, potentially leading to underrepresentation of historically marginalized groups most impacted by the pandemic (Kantamneni, 2020; Clark et al., 2020). Student responses to survey questions may have been impacted, too, though research is mixed on how the pandemic shaped pro-environmental behaviors (Mi et al., 2021; Zebardast & Radaei, 2022; Kim & Lee, 2022; Urban & Braun Kohlová, 2022). Study replication during a non-pandemic time would help clarify whether these results hold true outside of this very specific context. Replication with a larger number of students would also be helpful, as this study's limited sample size pushed us to collapse race/ethnicity and gender into false binaries rather than analyzing each identified race/ethnicity or gender independently. Doing so in the future could add nuance to our findings.

The fact that social capital, as one of the study's central concepts, has myriad conceptualizations outside of those that formed the basis of our survey opens up the door for future research using different social capital measures. Though the components of Ostrom & Ahn's (2007) definition of social capital aligned well with Krasny's (2020), the literature is

littered with alternative conceptualizations. Paldam & Svendsen (2000) defined social capital as “density of trust” in the community, and Paldam posited that it could be measured through looking at the rate of engagement in voluntary organizations within a community of focus (Paldam, 2000). Duit (2011) also agreed that membership in voluntary organizations was a key part of social capital but added that the quality of these and other institutions within the community was just as important. Other researchers proposed various combinations of trust, norms, associational activity, values, attitudes, and network density as together forming social capital (Bjørnskov, 2006; Adriani, 2015; Grootaert & van Bastelaer, 2002; Bjørnskov & Svendsen, 2003; Rayamajhee & Bohara, 2021). With so many differing perspectives on social capital, we chose to focus on those we saw most frequently used in environmental contexts (Ostrom & Ahn, 2007; Krasny, 2020). However, adopting any one of these other models of social capital may yield different results; additional research could shed light onto what these results may look like.

Even within our selected conceptualization of social capital, there is room for alternate interpretations and operationalizations of the key variables that feed into social capital, again presenting opportunities for new lines of research inquiry. Both Ostrom & Ahn (2007) and Krasny (2020) defined trust as a component of social capital, but trust itself can have many components and subcategories (Robbins, 2016). Our study focused on community trust—trust of family members, teachers, other adults, and fellow youth—but it may be fruitful to incorporate “special trust” of authorities (Paldam, 2005) into future work to understand how trust in people of power may relate to collective behavior choices. Existing research indicates that a degree of skepticism towards authority figures may actually correlate to more engagement in behaviors that align with our definition of collective activism (Smith et al., 2013). Contrastingly, de Vries

et al. (2019) highlight that a combination of both institutional trust and interpersonal trust is necessary to facilitate collective action amongst adults. Still other studies indicate that trust may not actually have a meaningful impact on behavior outside of specific organizational settings (Duit, 2011)—an idea that relates to the group membership concepts emerging in some of the alternative definitions of social capital mentioned above (Sønderskov, 2008). Finally, even if we were to fully disentangle the meaning and component parts of social capital, it is possible that other frameworks beyond social capital would better explain youth engagement in collective behavior (e.g., social identity approaches in social psychology; Barth et al., 2021). Exploring these ideas within and outside of the concept of social capital would move this work forward and bring us to a stronger understanding of what drives students to participate in group behaviors for the betterment of their environments.

Conclusions and moving forward

Through providing evidence that the concept of social capital can help us better predict high school student engagement in collective pro-environmental behaviors, this study brings us a step closer to understanding how we might foster this type of highly-impactful action in young people. Rather than focusing on empowering individuals in isolation, we should work to build trust, relationships, and youth voice within communities. These are the factors that had a significant relationship with collective action. However, our work here is just beginning; the models this study generated for collective action are still far weaker than those that the field has established for private-sphere behaviors. Future research could qualitatively investigate what variables might be missing in the models presented here through focus groups or interviews with high school students themselves. Furthermore, because this study focused on measuring one

individual survey-taker's engagement in collective action, we do not yet know what might drive an entire community collective action effort; such an effort may need to be measured through alternative approaches like social network analysis, participatory action research, or other methods (Gibson et al., 2021; Chapter 1; Ardoin et al., 2022). This will help us move, community-by-community, toward the large-scale system change we need to address today's biggest socio-environmental challenges.

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CHAPTER 5:

The power of connection: How we can move from individual environmental action to collective action

This piece was originally written as a way to succinctly summarize my research for a lay audience as part of a Three-Minute Thesis competition within North Carolina State University's College of Natural Resources 2022 Graduate Student Symposium. It will also be posted as a blog on my personal website to make my dissertation findings more accessible.

“Take shorter showers! Recycle! Turn off your lights!” We’ve been hearing about the power of individual environmental actions for years—and as a tree-hugging, Prius-driving vegetarian myself, I certainly do my best to live by them. However, today's most pressing environmental challenges—climate change, plastic pollution, sea level rise—are so enormous that they can’t be solved on the individual level alone. People must work together, becoming greater than the sum of their parts, to affect issues on this scale.

That’s where collective action comes in. Collective action happens when multiple people come together to push for change—rallying for new environmentally friendly policies, for example, or attending community litter cleanups. And it can be especially powerful when spurred by young people, who, research shows, have a strong influence on the adults in their lives and who will soon become adults themselves.

Unfortunately, we don’t really know what drives young people to take collective action for the environment, which makes it hard to know how to encourage more of this action.

My dissertation research worked to address this. I looked at whether we can predict a young person’s engagement in collective environmental actions the same way we’ve historically predicted engagement in individual actions.

Let’s break that down a little more: We social scientists often try to predict behavior with three factors: a person’s attitudes, what the people around them think (norms), and how easy they think the behavior is to take (behavioral control).

From the fall of 2020 to the spring of 2022, I surveyed hundreds of North Carolina high school students about the types of environmental actions they take—both individual and collective—as well as different factors that might drive these behaviors.

What I found is that, while our “usual suspects” of attitudes, norms, and behavioral control are pretty good at predicting individual environmental behavior, they’re pretty bad at predicting collective behaviors. In other words, our usual way of predicting behavior just doesn’t work at the collective scale.

Instead, collective behaviors are better predicted by things like how many people the student talks to about environmental issues, how much power they feel they have in their community, and how much they trust other members of their community. I also found that students who were less hopeful about their personal ability to make a difference for the environment were more likely to join in collective efforts—perhaps seeing themselves as insufficient alone, but powerful together.

Looking at these drivers—connectedness, trust, power—it’s clear that efforts to foster collective action for the environment need to look different than efforts to foster individual action. To move towards collective action, we need to start intentionally bringing people together in conversation and collaboration. Then, we can truly work towards solutions that are powerful enough to meet the pressing needs of our planet today.

Figure 5.1

Summary of the drivers of different types of environmental action in high school students

What drives students to take different types of environmental action?



APPENDICES

Appendix A: Delphi Survey #1

Environmental problems we face today require collective action — communities coming together to address large-scale problems. However, we tend to measure environmental literacy at the individual level. Understanding and encouraging collective action may require a shift in focus from individual to community-level environmental literacy. How is environmental literacy created, shared, and distributed by communities to create community-scale change? We think these are important questions, but the concept of community-level environmental literacy has yet to be formally defined or measured.

The purpose of this study is to learn more about how environmental education researchers think about the concept of community-level environmental literacy (CLEL) — both how it is defined and how it might be measured. This will allow us to start a broader conversation on the topic, and perhaps move closer to consensus on a shared definition.

This research study will use a Delphi process, consisting of three iterative surveys:

- Survey 1 will involve open-ended brainstorming, inviting participants to offer their thoughts on the core components of CLEL in their own words. Participants can choose to complete this as either an online survey or as a quick phone interview.
- Survey 2 will present the common themes from Survey 1 and ask participants to give feedback on those themes and their importance to CLEL.
- Survey 3 will present a potential framework for CLEL based on Survey 2 and will ask for participant feedback on this framework. *We will also conduct a social network analysis in Survey 3; this involves listing all participant names within the survey so that we can ask each participant who else they have discussed CLEL with.*

We estimate that each survey will take between 10-20 minutes to complete. Each survey will be available for two weeks for completion at your convenience.

As a thank-you for contributing, we are happy to print the names of those who participated in all three survey iterations in the acknowledgements section of any publications resulting from this study. (We are also happy to keep participation confidential, if preferred.) We also plan to hold a webinar presenting the results of the study to keep everyone in the loop about what we find.

If you wish to be a part of this study, please read through the consent form [here](#) and tell us whether you agree to participate in the research.

- Yes, I agree to be in this research study.
- No, I do not agree to be in this research study.

The goal of this survey, Survey 1, is to gather ideas on what the key characteristics of community-level environmental literacy (CLEL) might be. We also would like to hear your thoughts on what should be considered when trying to measure CLEL.

We ask for your name and email address so that we can follow up with you directly with invitations to take the next two surveys. We will also use participant names to conduct a social network analysis as part of the final survey. Once the last survey is completed, we will ask all participants whether they would like their names acknowledged in publications about this study or whether they would prefer for their participation to remain confidential. At that point, all participants who so desire will have their names and emails permanently removed from our records to remove any link between them and the research.

What is your name?

What is your email address?

How would you define community-level environmental literacy (CLEL) in your own words?

In your opinion, what constitutes community-level environmental literacy (CLEL)?
How can we define it? What are its constituent components or constructs? What makes community-level environmental literacy different from individual-level environmental literacy? List as many characteristics as you would like, using a different text box for each one of your responses.

CLEL is... _____

CLEL is... _____

CLEL is... _____

CLEL is... _____

CLEL is... _____

CLEL is... _____

CLEL is... _____

CLEL is... _____

CLEL is... _____

CLEL is... _____

CLEL is... _____

CLEL is... _____

CLEL is... _____

CLEL is... _____

CLEL is... _____

In your opinion, what needs to be considered when trying to measure CLEL?

Here, we aren't really looking for specific measurement tools or scales you'd recommend using, like surveys or interviews. Rather, we'd love to know what sort of things you think we should keep in mind when measuring CLEL or any challenges you think might come up specific to CLEL.

When measuring CLEL, we need to consider...

When measuring CLEL, we need to consider...

When measuring CLEL, we need to consider...

When measuring CLEL, we need to consider...

When measuring CLEL, we need to consider...

When measuring CLEL, we need to consider...

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When measuring CLEL, we need to consider...

When measuring CLEL, we need to consider...

When measuring CLEL, we need to consider...

When measuring CLEL, we need to consider...

When measuring CLEL, we need to consider...

How would you describe your field of expertise?

How long have you been working in this field (in years)?

In what country are you located?

▼ United States ... Zimbabwe

In what state are you located?

▼ Alabama ... Wyoming

What is your gender identity?

- ☐ Man
- ☐ Woman
- ☐ Non-binary
- ☐ I identify another way _____
- ☐ Prefer not to say

What is your race or ethnicity? Select all that apply.

- ☐ African-American
- ☐ Asian or Pacific Islander
- ☐ Hispanic
- ☐ Native American
- ☐ White or Caucasian
- ☐ I identify another way _____
- ☐ Prefer not to answer

Is there anyone else you would recommend we contact to take this survey? Please provide their name and affiliation.

Appendix B: Delphi Survey #2

Thank you so much for completing Survey 1 of our study on **community-level environmental literacy (CLEL)** earlier this semester! We really appreciated hearing your thoughts on how CLEL can be defined and what should be considered when attempting to measure it.

After receiving survey submissions from environmental education experts across the world, our research team used qualitative coding to identify emergent themes across participant responses. **In this survey, Survey 2, we present these themes back to you to hear whether you feel they paint an accurate picture of CLEL.**

In the following survey pages, we will present the themes that emerged from Survey 1. We will ask you to give us feedback on each theme, sharing (1) whether you agree that the theme is a part of your conceptualization of CLEL and (2) whether you feel anything is incorrect or missing in our description of the theme.

We will then use everyone's feedback from this survey to create a modified list of themes and theme descriptions, presenting these out to you in our third and final survey, Survey 3, for final reactions.

Thank you in advance for your time and feedback! We appreciate you!

Before we get started, please provide us with your name and email address so that we can follow up with you directly with an invitation to take the final survey.

Name _____
Email _____

In this first section, we will ask for your feedback on the themes that emerged from the prompt: In your opinion, what constitutes community-level environmental literacy (CLEL)?

Each of the following pages will present one theme, describing how we defined the theme and providing quotes from participant responses that were coded as belonging to that theme. We will then ask for your feedback on the theme and whether it aligns with your conceptualization of CLEL.

Please note that these themes are listed in no particular order. Because this first stage of the Delphi study was intentionally generative, we wanted to present all contributions as equally worthy of consideration. We therefore also did not include the frequency at which each theme showed up in participant responses to avoid privileging certain themes over others.

To give you an overall sense of what you will be seeing, we have a full list of the themes below:

- A focus on environmental issues
- Mindfulness around power
- Knowledge / skills
- Attitudes / feelings
- Behavior / action
- Connection
- Interdisciplinary
- A continuous, iterative process

We will now move on to addressing each theme individually.

Theme 1: A focus on environmental issues

CLEL holds environmental issues as its core subject matter.

Examples of participant responses falling under this theme:

- CLEL is based on the *environmental issues* pertinent to the boundaries of the community.
- CLEL is essential to *sustainable resource management* in a growing population.
- CLEL is a community norm of desiring and working toward *improved environmental quality*.

How much do you agree with the following statement?

"Theme 1: A focus on environmental issues" fits into my conceptualization of CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below to elaborate on how well this theme does or does not fit into your conceptualization of CLEL.

Do you feel that anything is incorrect or missing in the above description of "Theme 1: A focus on environmental issues"? If so, please use the space below to elaborate.

Theme 2: Mindfulness around power

Because of its scale, CLEL inherently affects and is affected by power dynamics. CLEL must be inclusive of diverse voices and identities within the community, embracing multiple perspectives including Indigenous ways of knowing. CLEL must be justice-oriented and decolonized, and intentional effort and coordination is required to make it so.

Examples of participant responses falling under this theme:

- CLEL is reflective of diverse, equitable, and inclusive ideas and beliefs.
- CLEL is respect and acknowledgment of Indigenous knowings.
- CLEL considers the assets and strengths of different cultures, races, sexual orientations, gender identities, social groups, religious traditions, classes, ages, abilities, language groups, and religious traditions in bringing about change that addresses environmental quality and long-term sustainability

How much do you agree with the following statement?

"Theme 2: Mindfulness around power" fits into my conceptualization of CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below to elaborate on how well this theme does or does not fit into your conceptualization of CLEL.

Do you feel that anything is incorrect or missing in the above description of "Theme 2: Mindfulness around power"? If so, please use the space below to elaborate.

Theme 3: Knowledge / skills

CLEL requires a degree of knowledge, awareness, understanding, and/or wisdom. It also requires to critically analyze and act on that knowledge. Knowledge and skills involved in CLEL can be distributed throughout the community; in other words, not everyone needs to have the same degree or type of knowledge and skills. Some of the skills required for CLEL that were brought up in Survey 1 included systems thinking skills and communication skills.

Examples of participant responses falling under this theme:

- CLEL is a reflection of knowledge, skills and abilities that are organized for collective benefit.
- CLEL is collective knowing.
- CLEL is knowledge of ecosystems impacted by the community members.
- CLEL is positive development of skills and attributes to include a joint identification of issues and analysis and evaluation of these in a critical way, as part of a group.

How much do you agree with the following statement?

"Theme 3: Knowledge / skills" fits into my conceptualization of CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below to elaborate on how well this theme does or does not fit into your conceptualization of CLEL.

Do you feel that anything is incorrect or missing in the above description of "Theme 3: Knowledge / skills"? If so, please use the space below to elaborate.

Theme 4: Attitudes / feelings

CLEL involves the affective in addition to the more concrete knowledge and skills previously mentioned. In this theme, words like *values*, *norms*, *motivations*, *intentions*, *dispositions*, *ethics*, *trust*, *responsibility*, and *respect* came up frequently amongst survey respondents. All of these play a role in supporting or hindering CLEL.

Examples of participant responses falling under this theme:

- CLEL is a shared attitude that self, human societies, and non-human nature are interconnected. CLEL is a group of people sharing multiple values (altruistic, biospheric, egoistic) for the environment.
- CLEL is a shared valuation of the natural and built environments in the region.
- CLEL is a sense of efficacy around environmental issues.
- CLEL involves a community norm of desiring and working toward improved environmental quality.

How much do you agree with the following statement?

"Theme 4: Attitudes / feelings" fits into my conceptualization of CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below to elaborate on how well this theme does or does not fit into your conceptualization of CLEL.

Do you feel that anything is incorrect or missing in the above description of "Theme 4: Attitudes / feelings"? If so, please use the space below to elaborate.

Theme 5: Behavior / action

CLEL isn't just knowledge or beliefs; taking action based on these other CLEL components is a necessary part of this literacy. These actions may be oriented towards policy (civic engagement) or focused on a community problem outside of the policy sphere. The ultimate aim of CLEL is collective action, which is of a different scale than individual behaviors--though some survey respondents reminded us that collective action still involves individuals.

Examples of participant responses falling under this theme:

- CLEL is taking action in your community on environmental issues.
- CLEL is taking the form of collective action towards a common environmental problem.
- CLEL is concerning about community's individual and collective action toward the environmental issues community faced.
- CLEL is action oriented; with a focus on collective (community) action, rather than individual action.

How much do you agree with the following statement?

"Theme 5: Behavior / action" fits into my conceptualization of CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below to elaborate on how well this theme does or does not fit into your conceptualization of CLEL.

Do you feel that anything is incorrect or missing in the above description of "Theme 5: Behavior / action"? If so, please use the space below to elaborate.

Theme 6: Connection

CLEL is driven by connection--both peoples' connection with each other and peoples' connection with the environment around them. When discussing this relational concept, some respondents brought up that connecting across generations (intergenerational learning) may be especially powerful in facilitating CLEL.

Examples of participant responses falling under this theme:

- CLEL is relationship building.
- CLEL is discussing environmental issues with family, friends, neighbors (those in your community).
- CLEL is an interactive "art" that requires we engage with those around us.
- CLEL is intergenerational.
- CLEL is a shared capacity to leverage connections and social networks.

How much do you agree with the following statement?

"Theme 6: Connection" fits into my conceptualization of CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below to elaborate on how well this theme does or does not fit into your conceptualization of CLEL.

Do you feel that anything is incorrect or missing in the above description of "Theme 6: Connection"? If so, please use the space below to elaborate.

Theme 7: Interdisciplinary

CLEL bridges disciplines and subject areas, intertwining environmental issues with social issues, political challenges, economic hardships, and more. This can be seen in formal interdisciplinary work (i.e., learning about environmental topics in social studies classrooms or math courses), in discussion of environmental issues, and more.

Examples of participant responses falling under this theme:

- CLEL is intersectionality (social, economic, environmental, political, cultural).
- CLEL is multifaceted.
- CLEL requires that environmental learning is incorporated across grades and subjects in formal schooling.
- CLEL involves having EL topics covered in more than just K-12 settings.
- CLEL is understanding systems -- bridging environmental and social -- so people can think about what constitutes a good solution and how to make it happen.

How much do you agree with the following statement?

"Theme 7: Interdisciplinary" fits into my conceptualization of CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below to elaborate on how well this theme does or does not fit into your conceptualization of CLEL.

Do you feel that anything is incorrect or missing in the above description of "Theme 7: Interdisciplinary"? If so, please use the space below to elaborate.

Theme 8: A continuous, iterative process

CLEL is more of a process than an endpoint, shifting and adapting as the community and community needs evolve. Flexibility is key in allowing for this adaptation over time.

Examples of participant responses falling under this theme:

- CLEL is dynamic, changing as changes in knowledge occur.
- CLEL is made up of decisions or components that can be revised by the community as needed over time.
- CLEL is a process.
- CLEL requires periodic reinforcement even (especially) for long-time community members.
- CLEL is flexible enough to wrestle with novel issues.

How much do you agree with the following statement?

"Theme 8: A continuous, iterative process" fits into my conceptualization of CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below to elaborate on how well this theme does or does not fit into your conceptualization of CLEL.

Do you feel that anything is incorrect or missing in the above description of "Theme 8: A continuous, iterative process"? If so, please use the space below to elaborate.

Now that you have reacted to these themes individually, let's consider them together.

How important are each of these themes as part of a complete conceptualization of community-level environmental literacy?

	1	2	3	4	5	6	7
A focus on environmental issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mindfulness around power	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Knowledge / skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Attitudes / feelings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Behavior / action	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Connection	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Interdisciplinary	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A continuous, iterative process	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Taking all of the themes above as our conceptualization of CLEL, do you feel that anything is missing? In other words, are there additional themes that we missed? Please describe below.

In this next section, we will ask for your feedback on the themes that emerged from the prompt:
In your opinion, what needs to be considered when trying to measure community-level environmental literacy (CLEL)?

In the same way as the preceding section, each of the following pages will present one theme, describing how we defined the theme and providing quotes from participant responses that were coded as belonging to that theme. We will then ask for your feedback on the theme and whether it aligns with your conceptualization of CLEL.

Please note that these themes are listed in no particular order. Because this first stage of the Delphi study was intentionally generative, we wanted to present all contributions as equally worthy of consideration. We therefore also did not include the frequency at which each theme showed up in participant responses to avoid privileging certain themes over others.

To give you an overall sense of what you will be seeing, we have a full list of the themes below:

- Inclusivity
- Indicators
- Researcher purpose / motivation
- Understanding community bounds
- Understanding community components
- Understanding community connections
- Understanding community processes
- Understanding community needs

We will now move on to addressing each theme individually.

Theme 1: Inclusivity

CLEL measurement strategies need to be inclusive of varied values, life experiences, ways of knowing, and stakeholder perspectives. Because of the pluralistic nature of communities, this may require a certain level of acknowledging and embracing difference and disagreement. It may also help to engage the community members themselves in the measurement process.

Examples of responses falling under this theme:

- When measuring CLEL, traditional knowledge systems should also be taken into consideration.
- When measuring CLEL, we need to consider who we see as important or powerful community members that need to be included (i.e. government, teachers, healthcare systems, labor unions, etc)
- When measuring CLEL, we need to consider how to value the contributions of underrepresented people and others who have been unheard and/or ignored when it comes to environmental issues.
- When measuring CLEL, we need to consider power structures within the the community.
- When measuring CLEL, we need to consider whether/how the community can collaboratively be involved in the measurement.

How much do you agree with the following statement?

When trying to measure CLEL, it is important to consider *inclusivity*.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below to elaborate on how well this theme does or does not fit into your conceptualization of CLEL.

Do you feel that anything is incorrect or missing in the above description of "Theme 1: Inclusivity"? If so, please use the space below to elaborate.

Theme 2: Indicators

Measuring CLEL requires researchers to be clear about how they are defining and operationalizing indicators of CLEL (the components defined in the first section of this survey). For example, researchers should be clear about how they are defining knowledge--is it distributed unevenly across the community, or does everyone need to have the same level of

knowledge? Is it enough to have knowledge, or are other attitudes, motivations, or values necessary? Is the researcher measuring CLEL as a continuous process or as an endpoint that a community reaches once they get to a certain level of these indicators or a certain goal is achieved?

Examples of responses falling under this theme:

- When measuring CLEL, definitions must be clear.
- When measuring CLEL, we need to consider that CLEL should not require all individuals within a community to have the same level of understanding and environmental literacy, rather the community as a whole needs to have a sufficient level of environmental literacy, and needs to know how to leverage this literacy.
- When measuring CLEL, we need to consider how to measure process/engagement with an issue not just knowledge about the environmental issue.
- When measuring CLEL, we need to consider if CLEL is tied to success of efforts to collectively act or if the effort itself indicates CLEL.

How much do you agree with the following statement?

When trying to measure CLEL, it is important to consider *the indicators you are using*.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below to elaborate on how well this theme does or does not fit into your conceptualization of CLEL.

Do you feel that anything is incorrect or missing in the above description of "Theme 2: Indicators"? If so, please use the space below to elaborate.

Theme 3: Researcher purpose / motivation

Because a researcher's motivation for measuring CLEL impacts how they go about doing so, it is important to reflect upon this motivation and how it may impact the measurement processes and/or results. Is the purpose to be able to compare across communities? To help a community reach a certain collective impact goal? To understand the starting point of a community's literacy so that you can measure change? Something else?

Examples of responses falling under this theme:

- When measuring CLEL, we need to consider our motivation/purpose/goal for measuring CLEL in the first place.
- When measuring CLEL, we need to consider why you want to measure CLEL.
- When measuring CLEL, we need to consider how (or if) you are comparing communities.
- When measuring CLEL, we need to consider "literacy for what purpose?".

How much do you agree with the following statement?

When trying to measure CLEL, it is important to consider *the researcher's purpose / motivation*.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below to elaborate on how well this theme does or does not fit into your conceptualization of CLEL.

Do you feel that anything is incorrect or missing in the above description of "Theme 3: Researcher purpose / motivation"? If so, please use the space below to elaborate.

Theme 4: Understanding community bounds

To measure *community*-level environmental literacy, we need to be clear about how we are defining the community in which we are working. Survey respondents talked about how communities can be bounded in many ways--by geography, by identity, by association, etc. Several people also emphasized that a community can change over time, as can its bounds, calling for flexibility on the researchers' part.

Examples of responses falling under this theme:

- When measuring CLEL, we need to consider where we draw boundaries around a community - is it an identity group or a neighborhood or a school or something else?
- When measuring CLEL, we need to consider how transitional or fixed the community boundaries are.
- When measuring CLEL, we need to be explicit and flexible about what we mean by "community".
- When measuring CLEL, we need a dynamic definition of community.

How much do you agree with the following statement?

When trying to measure CLEL, it is important to *understand community bounds*.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below to elaborate on how well this theme does or does not fit into your conceptualization of CLEL.

Do you feel that anything is incorrect or missing in the above description of "Theme 4: Understanding community bounds"? If so, please use the space below to elaborate.

Theme 5: Understanding community components

Measuring CLEL requires understanding the makeup of the community. Study participants discussed three broad types of community components: people, institutions, and the physical environment. A researcher should familiarize themselves with these different elements of the community to more effectively measure CLEL.

Examples of responses falling under this theme:

- When measuring CLEL, we need to consider demographic data - age, sex, education, occupation, income.
- When measuring CLEL, we need to consider community members' social identities, in particular their sense of *being* a member of a community.
- When measuring CLEL, we need to consider what social, political, and economic institutions exist within a community that can either bolster or undermine community learning.
- When measuring CLEL, we need to consider the presence of civic and social organizations in a community.
- When measuring CLEL, we need to consider the unique geographic and bioregional factors that make up the physical attributes of the community.

How much do you agree with the following statement?

When trying to measure CLEL, it is important to *understand community components*.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below to elaborate on how well this theme does or does not fit into your conceptualization of CLEL.

Do you feel that anything is incorrect or missing in the above description of "Theme 5: Understanding community components"? If so, please use the space below to elaborate.

Theme 6: Understanding community connections

Given that this type of literacy is driven by connection, understanding the nature of social connections within the community of interest is important to effectively measuring CLEL.

Examples of responses falling under this theme:

- When measuring CLEL, we need to consider social connections, social capital, social cohesion, and social networks.
- When measuring CLEL, we need to consider social context - nature of local neighborhood / city / country.
- When measuring CLEL, we need to consider identification of key 'nodes' in a community's environmental knowledge network.

How much do you agree with the following statement?

When trying to measure CLEL, it is important to *understand community connections*.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below to elaborate on how well this theme does or does not fit into your conceptualization of CLEL.

Do you feel that anything is incorrect or missing in the above description of "Theme 6: Understanding community connections"? If so, please use the space below to elaborate.

Theme 7: Understanding community processes

Community processes, both civic and otherwise, impact how a community builds CLEL. It is therefore important to understand these processes to better understand the context in which CLEL is created (or limited).

Examples of responses falling under this theme:

- When measuring CLEL, we need to consider process knowledge--knowledge of how this community manages environmental decision-making and understanding of how decision-making ought to be managed.
- When measuring CLEL, we need to consider the ability of individuals to influence community decision making.
- When measuring CLEL, we need to consider how local governments talk about environmental problems.

How much do you agree with the following statement?

When trying to measure CLEL, it is important to *understand community processes*.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below to elaborate on how well this theme does or does not fit into your conceptualization of CLEL.

Do you feel that anything is incorrect or missing in the above description of "Theme 7: Understanding community processes"? If so, please use the space below to elaborate.

Theme 8: Understanding community needs

Finally, it is key to understand what a community wants as well as what might prevent them from achieving these goals. Measurement strategies can then be tailored accordingly.

Examples of responses falling under this theme:

- When measuring CLEL, we need to consider shared and distinct goals of community members.
- When measuring CLEL, we need to consider obstacles to literacy (at community & individual levels).
- When measuring CLEL, we need to consider community needs.

How much do you agree with the following statement?

When trying to measure CLEL, it is important to *understand community needs*.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below to elaborate on how well this theme does or does not fit into your conceptualization of CLEL.

Do you feel that anything is incorrect or missing in the above description of "Theme 8: Understanding community needs"? If so, please use the space below to elaborate.

Now that you have reacted to these themes individually, let's consider them together.

How important are each of these themes as part of a complete list of considerations to take into account when measuring community-level environmental literacy?

	-3	-2	-1	0	1	2	3
Inclusivity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Indicators	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Researcher purpose / motivation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understanding community bounds	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understanding community components	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understanding community connections	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understanding community processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understanding community needs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Taking all of the themes above as our list of considerations for researchers to take into account when measuring CLEL, do you feel that anything is missing? In other words, are there additional themes that we missed? Please describe below.

Do you have any additional thoughts or comments that weren't captured in the survey questions?

Appendix C: Delphi Survey #3

Introduction

Thank you so much for completing Survey 2 of our study on **community-level environmental literacy (CLEL)**! We enjoyed reading your feedback on the themes that emerged from the first part of our study. We feel like we're one step closer to defining a list of components of CLEL as well as suggestions for measuring CLEL!

Since receiving all Survey 2 responses, our team has been calculating participant agreement on the themes and coding the open-ended feedback you all provided. **In this survey, Survey 3, we will propose modifications to the themes from Survey 2 and an integrated statement about CLEL for your feedback.**

In the following survey pages, we will share the agreement statistics and a summary of the feedback you provided on each theme. We will then present you with a new version of the theme based on your feedback and ask to what degree you support this new version.

This survey, Survey 3, represents the final survey of our Delphi study. As such, it will ask for less in the way of open-ended responses in an attempt to work toward a final list of themes and theme descriptions for this study. *(As much as I'd truly love to continue this iterative process with you all, I recognize that this was only scoped to be a three-survey commitment and want to be respectful of your time. If you'd like to keep this CLEL discussion going, though, please stay in touch!)*

Thank you, once again, for your time and feedback! We truly appreciate your contributions to the field's improved understanding of CLEL.

Before we get started, please provide us with your name and email address so that we can track study participation over time.

Name _____

Email _____

What constitutes CLEL?

In our last survey, we asked you for your feedback on the themes that emerged from the prompt: **In your opinion, what constitutes community-level environmental literacy (CLEL)?**

Each of the following pages will present one of these themes again and will detail

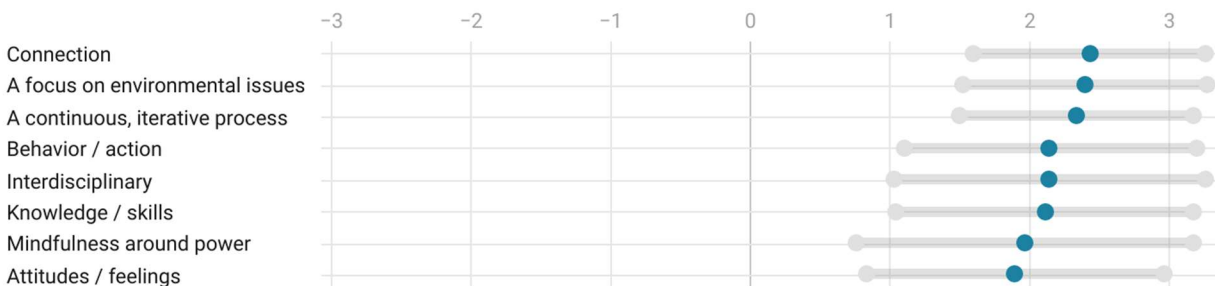
- (1) the degree to which participants agreed on the importance of that theme,
- (2) the main points of participant feedback we received related to that theme, and
- (3) a modified version of the theme that incorporates participant feedback.

We will then ask you to indicate whether you feel the modified theme is an improvement upon the original theme as well as your level of agreement with the modified theme.

To give you an overall sense of what you will be seeing in this first section, below is a graph that summarizes the level of importance that the study participants (including you!) ascribed to each of the CLEL conceptualization themes presented in Survey 2.

The scale ranges from strongly disagree (-3) to strongly agree (3). The mean reported importance is shown in teal, with one standard deviation above and below the mean shown in gray.

How important is this theme as part of a complete conceptualization of CLEL?



Created with Datawrapper

We will now focus on each conceptualization theme individually, starting with the theme that received the highest importance ranking and then moving to themes with progressively lower reported importance from there.

Connection

Original theme

In Survey 2 of this Delphi study, we showed you the following theme title and description that attempted to capture commonalities across responses to Survey 1.

Connection

CLEL is driven by connection--both peoples' connection with each other and peoples' connection with the environment around them. When discussing this relational concept, some respondents brought up that connecting across generations (intergenerational learning) may be especially powerful in facilitating CLEL.

Level of agreement

When asked "How important is this theme as part of a complete conceptualization of CLEL?" on a scale of not at all important (-3) to extremely important (3), the summary statistics were as follows:

Mean reported importance: **2.43**

Standard deviation: **0.84**

Summary of feedback

There was broad agreement on this theme, with little in the way of feedback. The limited feedback can be summarized as follows:

- Several key words emerged in the open-ended feedback that were missing from the original theme description. These words included relationships, networks, and social capital.
Our suggested solution: Keep the theme largely the same, with the addition of another sentence highlighting these key concepts
- Some felt that connection may be an outcome of CLEL rather than a component.
Our suggested solution: Highlight that CLEL can strengthen connections as well as be driven by connection

Modified theme

Based on this feedback, we modified the original theme title and/or description and propose the below language as a replacement:

Connection

CLEL is driven by connection--both peoples' connection with each other and peoples' connection with the environment around them. Social networks, social capital, and relationships are key drivers of CLEL, and the process of CLEL can also strengthen these connections.

How much do you agree with the following statement?

The modified theme is an improvement on the original theme.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How much do you agree with the following statement?
The modified theme fits into my conceptualization of CLEL.

Strongly
disagree
☐

Disagree
☐

Somewhat
disagree
☐

Neutral
☐

Somewhat
agree
☐

Agree
☐

Strongly
agree
☐

A focus on socio-ecological topics relevant to the community

Original theme

In Survey 2 of this Delphi study, we showed you the following theme title and description that attempted to capture commonalities across responses to Survey 1.

A focus on environmental issues

CLEL holds environmental issues as its core subject matter.

Level of agreement

When asked "How important is this theme as part of a complete conceptualization of CLEL?" on a scale of not at all important (-3) to extremely important (3), the summary statistics for this theme were as follows:

Mean reported importance: **2.39**

Standard deviation: **0.88**

Summary of feedback

When we asked for your open-ended feedback on this theme, the group offered up many insightful comments, including the following pieces of constructive criticism:

- Social and environmental challenges are inextricably intertwined, and by focusing this theme just on “environmental” issues, we miss the opportunity to emphasize this interconnectedness. Additionally, this framing implies focuses on the environment being the problem (rather than the humans who are driving environmental change being the problem).

Our suggested solution: Change “environmental” to “socio-ecological” in the theme title, and add additional text to the theme description to emphasize this point

- The use of the word “issue” or “problem” in this theme suggests that CLEL might not be able to exist related to socio-ecological assets – only to negatively-framed concerns. Different phrasing might allow for more positive framing.

Our suggested solution: Change “issues” to “topics” in the theme title

- These socio-ecological topics must be relevant to the community in order to be a focus of CLEL. The current definition does not include local relevance.

Our suggested solution: Add “relevant to the community” to the theme title, and add additional text to the theme description to emphasize this point

Modified theme

Based on this feedback, we modified the original theme title and/or description and propose the below language as a replacement:

A focus on socio-ecological topics relevant to the community

CLEL recognizes that social and environmental systems are inextricably linked and that the socio-ecological challenges and opportunities that arise from them must therefore be addressed jointly. CLEL focuses on the specific socio-ecological topics that are relevant to the community of focus.

How much do you agree with the following statement?
The modified theme is an improvement on the original theme.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How much do you agree with the following statement?
The modified theme fits into my conceptualization of CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

A dynamic capacity

Original theme

In Survey 2 of this Delphi study, we showed you the following theme title and description that attempted to capture commonalities across responses to Survey 1.

A continuous, iterative process

CLEL is more of a process than an endpoint, shifting and adapting as the community and community needs evolve. Flexibility is key in allowing for this adaptation over time.

Level of agreement

When asked "How important is this theme as part of a complete conceptualization of CLEL?" on a scale of not at all important (-3) to extremely important (3), the summary statistics were as follows:

Mean reported importance: **2.33**

Standard deviation: **0.83**

Summary of feedback

Respondents overwhelmingly agreed that CLEL is dynamic and, accordingly, must leave room for flexibility and adaptability in definition and measurement. However, there was some pushback against the idea that CLEL was a process. Respondents suggested that CLEL itself is a capacity—one that is built up by a continuous, iterative process as the original theme suggests, but not a process itself.

Our suggested solution: Rename this theme to be “A dynamic capacity” to describe CLEL itself, and ensure that the idea of CLEL being built continuously and iteratively is reflected elsewhere in the themes

Modified theme

Based on this feedback, we modified the original theme title and/or description and propose the below language as a replacement:

A dynamic capacity

CLEL isn't static. Instead, it is a dynamic capacity due to the ever-changing nature of a given community, its environment, and the connections between and within these elements.

How much do you agree with the following statement?

The modified theme is an improvement on the original theme.

Strongly
disagree

☐

Disagree

☐

Somewhat
disagree

☐

Neutral

☐

Somewhat
agree

☐

Agree

☐

Strongly
agree

☐

How much do you agree with the following statement?
The modified theme fits into my conceptualization of CLEL.

Strongly
disagree

☐

Disagree

☐

Somewhat
disagree

☐

Neutral

☐

Somewhat
agree

☐

Agree

☐

Strongly
agree

☐

Aimed at collective action

Original theme

In Survey 2 of this Delphi study, we showed you the following theme title and description that attempted to capture commonalities across responses to Survey 1.

Behavior / action

CLEL isn't just knowledge or beliefs; taking action based on these other CLEL components is a necessary part of this literacy. These actions may be oriented towards policy (civic engagement) or focused on a community problem outside of the policy sphere. The ultimate aim of CLEL is collective action, which is of a different scale than individual behaviors--though some survey respondents reminded us that collective action still involves individuals.

Level of agreement

When asked "How important is this theme as part of a complete conceptualization of CLEL?" on a scale of not at all important (-3) to extremely important (3), the summary statistics were as follows:

Mean reported importance: **2.14**

Standard deviation: **1.04**

Summary of feedback

When we asked for your open-ended feedback on this theme, the group offered up many insightful comments, including the following pieces of constructive criticism:

- There was divergent feedback on this theme, with some people feeling that collective action was a component of CLEL and others feeling it was an outcome of CLEL. These comments generally fell into one of the following categories:
 - A focus on collective action to solve collective challenges is a key component of CLEL—and this “collective” aspect is what differentiates CLEL from standard definitions of environmental literacy at the individual level.
 - Action could be considered the outcome of CLEL rather than one of its components. Literacy can exist as a collective capacity without it being activated.

Our suggested solution: Reword this theme to say that CLEL is aimed at collective action, allowing for flexibility of interpretation based on community context

- Some participants felt that decision-making may be an important idea to center here rather than (or in addition to) action. Perhaps a community with high levels of CLEL may decide, after careful deliberation, that the appropriate “action” to take on a community challenge is to take no action.

Our suggested solution: Include this idea of inaction as a potential “action” decision within the theme description

Modified theme

Based on this feedback, we modified the original theme title and/or description and propose the below language as a replacement:

Aimed at collective action

CLEL’s ultimate end goal is to take effective collective action on socio-ecological topics that the community identifies as important. The action itself could be considered to be

either a component of CLEL or its outcome; regardless, the orientation of CLEL towards collective action remains the same.

It is important to note, too, that aiming the process of CLEL at collective action may not necessarily result in collective action in the end. Perhaps a community with high levels of CLEL may decide, after careful deliberation, that the appropriate “action” to take on a local socio-ecological topic is to take no action.

How much do you agree with the following statement?

The modified theme is an improvement on the original theme.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How much do you agree with the following statement?

The modified theme fits into my conceptualization of CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Interdisciplinary [PROPOSED FOR REMOVAL]

Original theme

In Survey 2 of this Delphi study, we showed you the following theme title and description that attempted to capture commonalities across responses to Survey 1.

Interdisciplinary

CLEL bridges disciplines and subject areas, intertwining environmental issues with social issues, political challenges, economic hardships, and more. This can be seen in formal interdisciplinary work (i.e., learning about environmental topics in social studies classrooms or math courses), in discussion of environmental issues, and more.

Level of agreement

When asked "How important is this theme as part of a complete conceptualization of CLEL?" on a scale of not at all important (-3) to extremely important (3), the summary statistics were as follows:

Mean reported importance: **2.14**

Standard deviation: **1.11**

Summary of feedback

Although there was fairly good numerical agreement on this theme, feedback from this theme and other themes suggested that this may not be a stand-alone theme. Instead, it seems to already be covered within other themes (A focus on socio-ecological topics relevant to the community, Connection, etc.). Additionally, we received some feedback that this wording is very "formal education" heavy, implying (likely incorrectly) that CLEL is centered in schools and universities. *Our suggested solution: Remove this theme and highlight the interdisciplinary nature of CLEL throughout the other themes*

Modified theme

Based on this feedback, we propose removing this theme.

How much do you agree with the following statement?

The modified theme is an improvement on the original theme.

Strongly
disagree
☐

Disagree
☐

Somewhat
disagree
☐

Neutral
☐

Somewhat
agree
☐

Agree
☐

Strongly
agree
☐

Collectively-held knowledge and skills

Original theme

In Survey 2 of this Delphi study, we showed you the following theme title and description that attempted to capture commonalities across responses to Survey 1.

Knowledge / skills

CLEL requires a degree of knowledge, awareness, understanding, and/or wisdom. It also requires to critically analyze and act on that knowledge. Knowledge and skills involved in CLEL can be distributed throughout the community; in other words, not everyone needs to have the same degree or type of knowledge and skills. Some of the skills required for CLEL that were brought up in Survey 1 included systems thinking skills and communication skills.

Level of agreement

When asked "How important is this theme as part of a complete conceptualization of CLEL?" on a scale of not at all important (-3) to extremely important (3), the summary statistics were as follows:

Mean reported importance: **2.11**

Standard deviation: **1.07**

Summary of feedback

When we asked for your open-ended feedback on this theme, the group offered up many insightful comments, including the following pieces of constructive criticism:

- A key attribute of the knowledge and skills specific to CLEL is their collective, distributed nature. Not all members of the community need to have the same exact type or degree of knowledge, so long as the necessary knowledge and skills are found somewhere within the community.

Our suggested solution: Add "collectively-held" to the theme name and emphasize the collective nature more heavily in the theme description

- Knowledge and skills aren't sufficient without other qualities, like efficacy and agency, that lead to action.

Our suggested solution: Ensure that future themes emphasize these additional pieces

Modified theme

Based on this feedback, we modified the original theme title and/or description and propose the below language as a replacement:

Collectively-held knowledge and skills

CLEL requires a degree of knowledge and skills to be present in the community. These knowledges and skills need not necessarily be present in or shared amongst all members of the community. Instead, they can be distributed throughout the community. In other words, not everyone needs to have the same degree or type of knowledge and skills, so long as the knowledge and skills can be found somewhere within the community. Areas of focus include but are not limited to systems thinking, communication skills, and knowledge of how the community impacts and is impacted by the local environment.

How much do you agree with the following statement?
The modified theme is an improvement on the original theme.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How much do you agree with the following statement?
The modified theme fits into my conceptualization of CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Inclusion of the community's diverse perspectives

Original theme

In Survey 2 of this Delphi study, we showed you the following theme title and description that attempted to capture commonalities across responses to Survey 1.

Mindfulness around power

Because of its scale, CLEL inherently affects and is affected by power dynamics. CLEL must be inclusive of diverse voices and identities within the community, embracing multiple perspectives including Indigenous ways of knowing. CLEL must be justice-oriented and decolonized, and intentional effort and coordination is required to make it so.

Level of agreement

When asked "How important is this theme as part of a complete conceptualization of CLEL?" on a scale of not at all important (-3) to extremely important (3), the summary statistics were as follows:

Mean reported importance: **1.96**

Standard deviation: **1.20**

Summary of feedback

When we asked for your open-ended feedback on this theme, the group offered up many insightful comments, including the following pieces of constructive criticism:

- While the description of this theme is on the right track, the theme name itself isn't worded well.
 - "Power" can mean a lot of different things. As the description is currently written, this theme feels more like it centers on diversity, equity, and inclusion than on power.
 - "Mindfulness" isn't strong enough. Diverse perspectives need to be given the power to impact decision-making related to community environmental issues.

Our suggested solution: Rename the theme "Inclusion of the community's diverse perspectives"

- Environmental and social justice are central to CLEL.
Our suggested solution: Start the theme description with "CLEL is justice-oriented" to emphasize this importance.

- There are many ways of thinking that should be given voice when making decisions about socio-ecological topics—too many perspectives to list each individually by name! However, calling out Indigenous ways of knowing, decolonial approaches, and various other knowledges stemming from diverse lived experiences might be worthwhile.

Our suggested solution: Acknowledge that the perspectives listed in the theme description are not exhaustive, but name a few key perspectives that are often overlooked when justice is not being centered

Modified theme

Based on this feedback, we modified the original theme title and/or description and propose the below language as a replacement:

Inclusion of the community's diverse perspectives

CLEL is justice-oriented. It requires the community to embrace diverse voices and identities within the community and equitably give voice to these perspectives when making decisions on socio-ecological topics relevant to the community. Doing this requires a knowledge of, and willingness to navigate and at times subvert and dismantle, systems of power in the community.

Perspectives to keep in mind are as far too numerous to list out in full, but they may include Indigenous ways of knowing, decolonial approaches, and other knowledges sparked by individuals' unique lived experiences.

How much do you agree with the following statement?

The modified theme is an improvement on the original theme.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How much do you agree with the following statement?

The modified theme fits into my conceptualization of CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Commitment to a shared goal

Original theme

In Survey 2 of this Delphi study, we showed you the following theme title and description that attempted to capture commonalities across responses to Survey 1.

Attitudes / feelings

CLEL involves the affective in addition to the more concrete knowledge and skills previously mentioned. In this theme, words like values, norms, motivations, intentions, dispositions, ethics, trust, responsibility, and respect came up frequently amongst survey respondents. All of these play a role in supporting or hindering CLEL.

Level of agreement

When asked "How important is this theme as part of a complete conceptualization of CLEL?" on a scale of not at all important (-3) to extremely important (3), the summary statistics were as follows:

Mean reported importance: **1.89**

Standard deviation: **1.07**

Summary of feedback

There was divergent feedback on this theme. The majority of comments shared one or more of the following sentiments:

- A degree of shared attitudes and feelings within the community is crucial to transform collective knowledge and skills into collective action.
- Specifying that a community must have shared values is antithetical to the idea of respecting a diversity of values and perspectives. It's important that people end up with a shared common goal, but the way they get there—valuing economics, valuing nature's intrinsic beauty, valuing human health, valuing environmental justice, etc.—does not have to be shared.
- Maybe "attitudes / feelings" isn't the right word to describe this. Consider focusing instead on affect, efficacy, norms, and/or agency.

Our suggested solution: Rename this theme "A common goal" and re-write the theme description to focus on collectively-held efficacy and agency rather than shared value

Modified theme

Based on this feedback, we modified the original theme title and/or description and propose the below language as a replacement:

Commitment to a shared goal

Members of the community must be collectively committed to addressing a shared goal related to one or more local socio-ecological topics. Though this does not require all community members to share the same set of values, it does require the community to possess a level of collectively-held efficacy and agency related to creating change.

How much do you agree with the following statement?
The modified theme is an improvement on the original theme.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How much do you agree with the following statement?
The modified theme fits into my conceptualization of CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Now that you have reacted to these modified themes individually, let's consider them together.

How important are each of these themes as part of a complete conceptualization of community-level environmental literacy?

	-3	-2	-1	0	1	2	3
Connection	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A focus on socio-ecological topics relevant to the community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A dynamic capacity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aimed at collective action	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Collectively-held knowledge and skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inclusion of the community's diverse perspectives	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Commitment to a shared goal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Connection	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you have any overall feedback on this list of components?

What should be considered when measuring CLEL?

We will now focus on **measurement considerations**.

In our last survey, we asked you for your feedback on the themes that emerged from the prompt: **In your opinion, what needs to be considered when trying to measure community-level environmental literacy (CLEL)?**

Each of the following pages will present one of these themes again and will detail

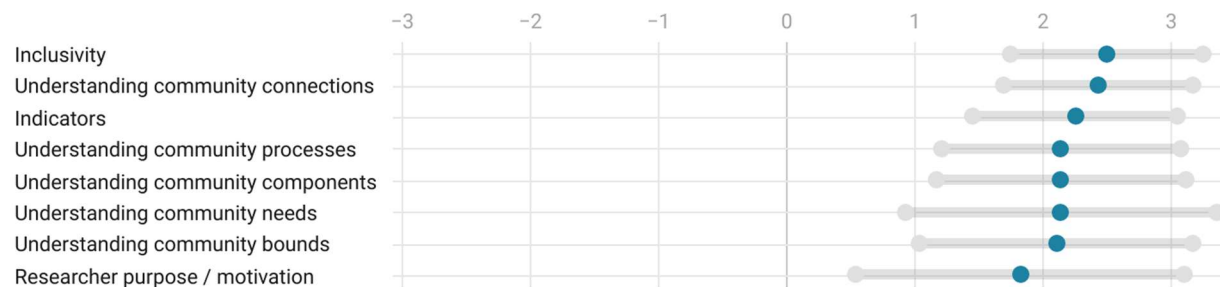
- (1) the degree to which participants agreed on the importance of that theme,
- (2) the main points of participant feedback we received related to that theme, and
- (3) a modified version of the theme that incorporates participant feedback.

We will then ask you to rate your level of agreement with the modified theme.

Just as you saw in the first section focused on conceptualizations of CLEL, below is a graph that summarizes the level of importance that the study participants (including you!) ascribed to each of the measurement consideration themes presented out in Survey 2.

The scale ranges from strongly disagree (-3) to strongly agree (3). The mean reported importance is shown in teal, with one standard deviation above and below the mean shown in gray.

How important is this theme as part of a complete list of considerations to take into account when measuring CLEL?



Created with Datawrapper

We will now focus on each measurement consideration theme individually, starting with the theme that received the highest importance ranking and then moving to themes with progressively lower reported importance from there.

Inclusivity

Original theme

In Survey 2 of this Delphi study, we showed you the following theme title and description that attempted to capture commonalities across responses to Survey 1.

Inclusivity

CLEL measurement strategies need to be inclusive of varied values, life experiences, ways of knowing, and stakeholder perspectives. Because of the pluralistic nature of communities, this may require a certain level of acknowledging and embracing difference and disagreement. It may also help to engage the community members themselves in the measurement process.

Level of agreement

When asked "How important is this theme as part of a complete list of considerations to take into account when measuring CLEL?" on a scale of not at all important (-3) to extremely important (3), the summary statistics were as follows:

Mean reported importance: **2.50**

Standard deviation: **0.75**

Summary of feedback

This theme had a very high level of agreement amongst respondents.

- Several respondents brought up the idea of how power needs to be discussed alongside inclusivity—not just power dynamics within the community, but also power structures that act upon the community from the outside.

Our suggested solution: Emphasize power dynamics within the theme description

Modified theme

Based on this feedback, we modified the original theme title and/or description and propose the below language as a replacement:

Inclusivity

CLEL measurement strategies need to be inclusive of varied values, life experiences, ways of knowing, and stakeholder perspectives. Because all communities are impacted by inequitable power structures acting within and/or upon them, CLEL measurement efforts must counteract these power structures in order to lift up less privileged perspectives. Additionally, the pluralistic nature of communities necessitates that communities and researchers expect and embrace a level of difference and disagreement. Engaging community members in measurement is an effective strategy for bringing a variety of local knowledges into the process and mitigating potential power differentials between researchers and community members.

How much do you agree with the following statement?

The modified theme is an improvement on the original theme.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
	○		○		○	

☐

☐

☐

☐

How much do you agree with the following statement?

The modified theme is important to consider when trying to measure CLEL.

Strongly
disagree

☐

Disagree

☐

Somewhat
disagree

☐

Neutral

☐

Somewhat
agree

☐

Agree

☐

Strongly
agree

☐

Understanding community connections

Original theme

In Survey 2 of this Delphi study, we showed you the following theme title and description that attempted to capture commonalities across responses to Survey 1.

Understanding community connections

Given that this type of literacy is driven by connection, understanding the nature of social connections within the community of interest is important to effectively measuring CLEL.

Level of agreement

When asked "How important is this theme as part of a complete list of considerations to take into account when measuring CLEL?" on a scale of not at all important (-3) to extremely important (3), the summary statistics were as follows:

Mean reported importance: **2.43**

Standard deviation: **0.74**

Summary of feedback

When we asked for your open-ended feedback on this theme, the group offered up many insightful comments, including the following pieces of constructive criticism:

- While this theme is generally good, more specificity might be helpful.
 - Naming some tools could be useful.
 - Specifying that these connections are dynamic is important.
 - It could be helpful to discuss how understanding a lack of connection—perhaps due to historic injustices—can help with understanding how CLEL is formed and how strongly.

Our suggested solution: Keep the title and initial sentence of the theme description, but also add additional specificity as suggested above

Modified theme

Based on this feedback, we modified the original theme title and/or description and propose the below language as a replacement:

Understanding community connections

Given that CLEL is driven by connection, understanding the nature of social connections within the community of interest is important to effectively measuring this type of literacy. Some forms of connection to investigate include social cohesion, the distribution of social capital, and the structure of social networks, including which “nodes” might have power as connectors or gatekeepers of knowledge or action. It is also important to understand which community components might be disconnected from each other and why; this becomes all the more important if connecting those components might afford more opportunities for effective collective action. Tools such as social network analysis and measurement of diffusion of innovation can be helpful in understanding these complex, dynamic connections.

How much do you agree with the following statement?
The modified theme is an improvement on the original theme.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How much do you agree with the following statement?
The modified theme is important to consider when trying to measure CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Indicators

Original theme

In Survey 2 of this Delphi study, we showed you the following theme title and description that attempted to capture commonalities across responses to Survey 1.

Indicators

Measuring CLEL requires researchers to be clear about how they are defining and operationalizing indicators of CLEL (the components defined in the first section of this survey). For example, researchers should be clear about how they are defining knowledge--is it distributed unevenly across the community, or does everyone need to have the same level of knowledge? Is it enough to have knowledge, or are other attitudes, motivations, or values necessary? Is the researcher measuring CLEL as a continuous process or as an endpoint that a community reaches once they get to a certain level of these indicators or a certain goal is achieved?

Level of agreement

When asked "How important is this theme as part of a complete list of considerations to take into account when measuring CLEL?" on a scale of not at all important (-3) to extremely important (3), the summary statistics were as follows:

Mean reported importance: **2.25**

Standard deviation: **0.80**

Summary of feedback

There was broad agreement on this theme and its description. A few small notes came up, as follows:

- This theme should explicitly give space for qualitative indicators in addition to quantitative ones, perhaps mentioning emergent states.
Our suggested solution: Specify this in an additional sentence within the theme description
- Definitions should be co-created by researchers and community members.
Our suggested solution: Specify this in an additional sentence within the theme description
- Social norms around environmental concern might be important in addition to distributed knowledge.
Our suggested solution: Add "community norms" to the theme description
- Communities must be able to leverage distributed knowledge in order for it to be useful.
Our suggested solution: Add "and leveraged collectively" to the theme description

Modified theme

Based on this feedback, we modified the original theme title and/or description and propose the below language as a replacement:

Indicators

Measuring CLEL requires clarity in the definitions and operationalizations of the indicators of CLEL. For example, there must be clarity in how knowledge is defined--can it be distributed unevenly across the community and leveraged collectively, or does

everyone need to have some baseline level of knowledge? Is it enough to have knowledge, or are other attitudes, motivations, or community norms necessary? Is CLEL being measured as a continuous process or as an endpoint that a community reaches once they get to a certain level of these indicators or collective action is undertaken? These questions should be answered and definitions reached collaboratively between researchers and community members. It is also important to note that the idea of an indicator here is defined broadly, giving room for qualitative indicators (e.g., emergent states investigated through interviews) in addition to quantitative indicators (e.g., knowledge of local socio-ecological topics measured via a close-ended survey).

How much do you agree with the following statement?

The modified theme is an improvement on the original theme.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How much do you agree with the following statement?

The modified theme is important to consider when trying to measure CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Understanding community processes

Original theme

In Survey 2 of this Delphi study, we showed you the following theme title and description that attempted to capture commonalities across responses to Survey 1.

Understanding community processes

Community processes, both civic and otherwise, impact how a community builds CLEL. It is therefore important to understand these processes to better understand the context in which CLEL is created (or limited).

Level of agreement

When asked "How important is this theme as part of a complete list of considerations to take into account when measuring CLEL?" on a scale of not at all important (-3) to extremely important (3), the summary statistics were as follows:

Mean reported importance: **2.14**

Standard deviation: **0.93**

Summary of feedback

When we asked for your open-ended feedback on this theme, the group offered up many insightful comments, including the following pieces of constructive criticism:

- This theme is a bit nebulous as-is.
 - Specify that political processes are part of this theme.
 - Acknowledge that many communities may totally lack any process for ground-level involvement in decision-making.

Our suggested solution: Add to the theme description to clarify the above points

Modified theme

Based on this feedback, we modified the original theme title and/or description and propose the below language as a replacement:

Understanding community processes

Community processes, both civic and otherwise, impact how or whether a community builds CLEL. It is therefore important to understand these processes to better understand the context in which CLEL is created (or limited).

Examples of community processes include the political processes that allow for community involvement in decision-making and, equally importantly, those that do not allow for community involvement either through intentional exclusion or through a lack of established inclusionary processes.

How much do you agree with the following statement?

The modified theme is an improvement on the original theme.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How much do you agree with the following statement?

The modified theme is important to consider when trying to measure CLEL.

Strongly
disagree
☐

Disagree
☐

Somewhat
disagree
☐

Neutral
☐

Somewhat
agree
☐

Agree
☐

Strongly
agree
☐

Understanding community components

Original theme

In Survey 2 of this Delphi study, we showed you the following theme title and description that attempted to capture commonalities across responses to Survey 1.

Understanding community components

Measuring CLEL requires understanding the makeup of the community. Study participants discussed three broad types of community components: people, institutions, and the physical environment. A researcher should familiarize themselves with these different elements of the community to more effectively measure CLEL.

Level of agreement

When asked "How important is this theme as part of a complete list of considerations to take into account when measuring CLEL?" on a scale of not at all important (-3) to extremely important (3), the summary statistics were as follows:

Mean reported importance: **2.14**

Standard deviation: **0.97**

Summary of feedback

When we asked for your open-ended feedback on this theme, the group offered up many insightful comments, including the following pieces of constructive criticism:

- This feels like a foundational preparatory step rather than something to first be considered during measurement—though considering it during measurement is important, too, given that community components are as dynamic as the communities themselves.
Our suggested solution: Add two sentences specifying this within the theme description
- Repeatedly referring to “researchers” and “community members” separately feels antithetical to the collaborative, participatory approach this research should ideally take.
Our suggested solution: Remove this dichotomous language and use “CLEL measurers” to be inclusive of both researchers and community members
- The phrase “people, institutions, and the physical environment” does not cover other important community elements, nor are all of these present in all communities.
 - Community norms, power structures, and history (particularly past injustices) are all key to understanding the current dynamics of the community.
 - Not all communities will have all of these components. Online communities, for example, will not have a shared physical environment.*Our suggested solution: Add these additional community components to the theme description, clarify that the list is not exhaustive, and specify that not all communities must contain all components*

Modified theme

Based on this feedback, we modified the original theme title and/or description and propose the below language as a replacement:

Understanding community components

Effectively measuring CLEL requires understanding the makeup of the community. Key parts of the community include its tangible components—such as people, institutions, and

the physical environment—as well as more abstract concepts—like community norms, power structures, and history (including past injustices). While all of these listed components will not necessarily be present in all communities, CLEL measurers should spend time before engaging in the evaluation process identifying and familiarizing themselves with the components that are relevant to their specific community. Given the dynamic nature of a community and the elements that comprise it, these components should also be revisited throughout the measurement effort.

How much do you agree with the following statement?
The modified theme is an improvement on the original theme.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How much do you agree with the following statement?
The modified theme is important to consider when trying to measure CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Understanding community needs [PROPOSED FOR REMOVAL]

Original theme

In Survey 2 of this Delphi study, we showed you the following theme title and description that attempted to capture commonalities across responses to Survey 1.

Understanding community needs

It is key to understand what a community wants as well as what might prevent them from achieving these goals. Measurement strategies can then be tailored accordingly.

Level of agreement

When asked "How important is this theme as part of a complete list of considerations to take into account when measuring CLEL?" on a scale of not at all important (-3) to extremely important (3), the summary statistics were as follows:

Mean reported importance: **2.14**

Standard deviation: **1.21**

Summary of feedback

Many respondents felt that this theme did not necessarily make sense as a stand-alone theme, as other themes seemed to cover this topic already. For example, the “inclusivity” theme and other theme descriptions already suggest CLEL measurement as a collaborative, participatory process, meaning that community needs would by definition be expressed and prioritized through the process. Likewise, understanding barriers or obstacles to CLEL could fall under the other “understanding community” themes.

Our suggested solution: Remove this theme and ensure that it is covered in other theme descriptions

Modified theme

Based on this feedback, we propose removing this theme.

How much do you agree with the following statement?

The modified theme is an improvement on the original theme.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Understanding community bounds

Original theme

In Survey 2 of this Delphi study, we showed you the following theme title and description that attempted to capture commonalities across responses to Survey 1.

Understanding community bounds

To measure community-level environmental literacy, we need to be clear about how we are defining the community in which we are working. Survey respondents talked about how communities can be bounded in many ways--by geography, by identity, by association, etc. Several people also emphasized that a community can change over time, as can its bounds, calling for flexibility on the researchers' part.

Level of agreement

When asked "How important is this theme as part of a complete list of considerations to take into account when measuring CLEL?" on a scale of not at all important (-3) to extremely important (3), the summary statistics were as follows:

Mean reported importance: **2.11**

Standard deviation: **1.07**

Summary of feedback

Respondent comments indicated agreement that defining community boundaries is important for measurement purposes. The overarching comments included the following:

- The community itself should be involved in its own self-definition—the researcher should not be the one defining the community.

Our suggested solution: Add a sentence specifying this within the theme description

- The boundaries need to be defined before starting in on the evaluation effort, and the researcher should regularly revisit this definition to ensure that they are still measuring within these bounds—or to note that the community bounds have shifted.

Our suggested solution: Add a sentence specifying this within the theme description

Modified theme

Based on this feedback, we modified the original theme title and/or description and propose the below language as a replacement:

Understanding community bounds

To measure community-level environmental literacy, the community needs to be clearly defined and bounded. The community itself should have the lead voice in this process; in other words, the boundaries of the community should reflect the community's understanding of itself.

Communities can be bounded in many ways—by geography, by identity, by association, and more. A community and its membership can also shift over time, which requires flexibility and regular revisiting of the community definition on the researchers' part.

How much do you agree with the following statement?
The modified theme is an improvement on the original theme.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How much do you agree with the following statement?
The modified theme is important to consider when trying to measure CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Researcher purpose / motivation

Original theme

In Survey 2 of this Delphi study, we showed you the following theme title and description that attempted to capture commonalities across responses to Survey 1.

Researcher purpose / motivation

Because a researcher's motivation for measuring CLEL impacts how they go about doing so, it is important to reflect upon this motivation and how it may impact the measurement processes and/or results. Is the purpose to be able to compare across communities? To help a community reach a certain collective impact goal? To understand the starting point of a community's literacy so that you can measure change? Something else?

Level of agreement

When asked "How important is this theme as part of a complete list of considerations to take into account when measuring CLEL?" on a scale of not at all important (-3) to extremely important (3), the summary statistics were as follows:

Mean reported importance: **1.82**

Standard deviation: **1.28**

Summary of feedback

Despite there being low numerical agreement on this theme, there weren't too many overwhelming disagreements brought up in the comments or suggestions for overhauling this theme. The main points of commentary were as follows:

- Researcher positionality relative to the community is important here, too.
Our suggested solution: Add positionality to the theme name and description
- This is all important to consider before starting in on the research, as well as to return to periodically throughout the research.
Our suggested solution: Add this to the theme description
- Community should be at the center of any effort to measure CLEL; in the words of one respondent, "a community's literacy is for them. It serves their purposes and meets their definitions."
Our suggested solution: Add an additional sentence in the theme description to emphasize this
- The use of first-person pronouns in this description should be rethought.
Our suggested solution: Change to third person pronouns to match the other theme descriptions

Modified theme

Based on this feedback, we modified the original theme title and/or description and propose the below language as a replacement:

Researcher purpose and positionality

Because a researcher's positionality and motivation for measuring CLEL impacts how they carry out and interpret the research, it is important for them to acknowledge and reflect upon this both before starting the research and periodically throughout the research process. Ultimately, CLEL belongs to the community, and the researcher should

ensure that their own research priorities or evaluation efforts do not impede the goals of serving the community's needs and answering the community's questions.

How much do you agree with the following statement?

The modified theme is an improvement on the original theme.

Strongly
disagree
☐

Disagree
☐

Somewhat
disagree
☐

Neutral
☐

Somewhat
agree
☐

Agree
☐

Strongly
agree
☐

How much do you agree with the following statement?

The modified theme is important to consider when trying to measure CLEL.

Strongly
disagree
☐

Disagree
☐

Somewhat
disagree
☐

Neutral
☐

Somewhat
agree
☐

Agree
☐

Strongly
agree
☐

Now that you have reacted to these modified themes individually, let's consider them together.

How important are each of these themes as part of a complete list of considerations to take into account when measuring community-level environmental literacy?

	-3	-2	-1	0	1	2	3
Inclusivity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understanding community connections	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Indicators	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understanding community processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understanding community components	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understanding community bounds	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Researcher purpose and positionality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inclusivity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you have any overall feedback on this list of measurement considerations?

Synthesis statement

Thank you for giving us feedback on all of these themes! We have just one remaining question for you.

We brought all themes together into a potential framework for CLEL, seen below:

CLEL is the capacity of a community to work towards collective action related to socio-ecological challenges in their community. Key components of this capacity include collectively-held knowledge and skills related to local socio-ecological topics as well as collective commitment and ability to pursue a shared goal.

Achieving CLEL requires connection—both between community members and between the community and its environment—as well as intentional inclusion of the community’s diverse perspectives in decision-making. CLEL is dynamic due to the ever-changing nature of a given community, its environment, and the connections between and within these elements.

Efforts to measure CLEL must be inclusive of the community’s varied values and ways of knowing, actively engaging these different people and their perspectives in the measurement process. CLEL measurers, particularly researchers or evaluators who come from outside the community of focus, should examine their own goals and positionality before and during the measurement process to ensure that community needs and perspectives are always placed first.

Measuring CLEL requires a deep knowledge of the community of focus, including the following aspects of community: how it is bounded (e.g., by geography, by identity, by association); its major components both tangible (e.g., people, physical environment, institutions) and intangible (e.g., norms, power structures, history); the nature and structure of the social connections within it; and the processes that enable or prevent community involvement in decision-making.

How much do you agree with the following statement?

The framework above aligns with my conceptualization of CLEL.

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If you have any final comments or lingering thoughts, feel free to share them here.

Appendix D: Student Survey

Water Quality Student Pre-Survey

Thank you for your interest in taking this survey about water quality! In this survey, there are no right or wrong answers. We just want to hear your thoughts.

Before you take the survey, please be sure that you have read through the consent form. By continuing, you are telling us that you have agreed to be a part of this research study.

1. Your name (first and last)

2. School name

3. Environmental science teacher name

4. How old are you?

5. How important are each of the following issues to you?

	Not at all important		→	Somewhat important		→	Extremely important
Economy	1	2	3	4	5	6	7
Health care	1	2	3	4	5	6	7
Immigration	1	2	3	4	5	6	7
Income inequality	1	2	3	4	5	6	7
Racial justice	1	2	3	4	5	6	7
National security	1	2	3	4	5	6	7
Water quality	1	2	3	4	5	6	7
Climate change	1	2	3	4	5	6	7
Social security	1	2	3	4	5	6	7
Crime	1	2	3	4	5	6	7
Public education	1	2	3	4	5	6	7

6. In the last month, how often have you done the following?

	Never	Once	2-3 times	4-5 times	>5 times
Discussed water quality in your environmental science class	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Discussed water quality with your friends outside of class	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Discussed water quality with your family	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. When you think about improving water quality in your community, how important do you think the following issues are to address?

	Not at all important	→	Somewhat important	→	Extremely important		
Large pieces of trash in the water (like tires, bottles, and household items)	1	2	3	4	5	6	7
Small pieces of trash in the water (like food wrappers, cigarette filters, and plastic pieces)	1	2	3	4	5	6	7
Fertilizers in the water	1	2	3	4	5	6	7
Other pollutants in the water (like prescription drugs, GenX, or coal ash)	1	2	3	4	5	6	7
Fracking	1	2	3	4	5	6	7
Sea level rise	1	2	3	4	5	6	7

8. How much do you agree or disagree with the following statements?

	Strongly disagree → Neutral → Strongly agree						
I am willing to take actions to help solve environmental problems.	1	2	3	4	5	6	7
I know that there are things that I can do to help solve environmental problems.	1	2	3	4	5	6	7
I know what to do to help solve environmental problems.	1	2	3	4	5	6	7
At the present time, I am energetically pursuing ways to solve environmental problems.	1	2	3	4	5	6	7

9. How much do you agree or disagree with the following statements?

	Strongly disagree → Neutral → Strongly agree						
If everyone works together, we can solve environmental problems.	1	2	3	4	5	6	7
I believe that scientists will be able to find ways to solve environmental problems.	1	2	3	4	5	6	7
I believe people will be able to solve environmental problems.	1	2	3	4	5	6	7
I believe more people are willing to take actions to help solve environmental problems.	1	2	3	4	5	6	7
Even when some people give up, I know there will be others who will continue to try to solve environmental problems.	1	2	3	4	5	6	7
Every day, more people begin to care about environmental problems.	1	2	3	4	5	6	7

10. How much do you agree or disagree with the following statements?

	Strongly disagree → Neutral → Strongly agree						
Environmental problems are beyond my control, so I won't even bother trying to solve them.	1	2	3	4	5	6	7
The actions I can take are too small to help solve environmental problems.	1	2	3	4	5	6	7
Environmental problems are so complex that we will not be able to solve them.	1	2	3	4	5	6	7

11. How often do you do the following activities?

	Never → Sometimes → Every chance I get						
Pick up trash when I see it outside	1	2	3	4	5	6	7
Avoid flushing items down the toilet besides toilet paper	1	2	3	4	5	6	7
Seek out ways I can improve water quality in my community	1	2	3	4	5	6	7
Talk to others about ways our community can work together to improve water quality	1	2	3	4	5	6	7
Participate in community events like trash clean-ups to improve water quality in my community	1	2	3	4	5	6	7
Organize community events like trash clean-ups to improve water quality in my community	1	2	3	4	5	6	7
Talk with school administrators about what rules our school can make to improve water quality around our school	1	2	3	4	5	6	7
Write to my local officials in support of policies that improve water quality in our community	1	2	3	4	5	6	7
Attend local government events (e.g., city council meetings) to voice my support of water quality policies in our community	1	2	3	4	5	6	7

12. How much do you agree or disagree with the following statements?

	Strongly disagree → Neutral → Strongly agree						
If I wanted to, I could pick up trash when I see it outside.	1	2	3	4	5	6	7
If I wanted to, I could avoid flushing items down the toilet besides toilet paper.	1	2	3	4	5	6	7
If I wanted to, I could seek out ways I can improve water quality in my community.	1	2	3	4	5	6	7
If I wanted to, I could talk to others about ways our community can work together to improve water quality.	1	2	3	4	5	6	7
If I wanted to, I could participate in community events like trash clean-ups to improve water quality in my community.	1	2	3	4	5	6	7
If I wanted to, I could organize community events like trash clean-ups to improve water quality in my community.	1	2	3	4	5	6	7
If I wanted to, I could talk with school administrators about what rules our school can make to improve water quality around our school.	1	2	3	4	5	6	7
If I wanted to, I could write to my local officials in support of policies that improve water quality in our community.	1	2	3	4	5	6	7
If I wanted to, I could attend local government events (e.g., city council meetings) to voice my support of water quality policies in our community.	1	2	3	4	5	6	7

13. How effective do you think the following strategies are for improving water quality in your community?

	Not at all effective		→	Somewhat effective		→	Extremely effective	
Picking up trash when I see it outside	1	2	3	4	5	6	7	
Avoiding flushing items down the toilet besides toilet paper	1	2	3	4	5	6	7	
Seeking out ways I can improve water quality in my community	1	2	3	4	5	6	7	
Talking to others about ways our community can work together to improve water quality	1	2	3	4	5	6	7	
Participating in community events like trash clean-ups to improve water quality in my community	1	2	3	4	5	6	7	
Organizing community events like trash clean-ups to improve water quality in my community	1	2	3	4	5	6	7	
Talking with school administrators about what rules our school can make to improve water quality around our school	1	2	3	4	5	6	7	
Writing to my local officials in support of policies that improve water quality in our community	1	2	3	4	5	6	7	
Attending local government events (e.g., city council meetings) to voice my support of water quality policies in our community	1	2	3	4	5	6	7	

14. To what degree would you support the following actions to improve water quality in your community?

	Would not support			→	Moderate support			→	Strong support	
Stronger local laws on water quality	1	2	3		4	5		6	7	
Higher taxes to address water quality issues	1	2	3		4	5		6	7	
Electing candidates that prioritize water quality	1	2	3		4	5		6	7	
Creating a more coordinated community response to water quality issues (e.g., creating a network of non-profits)	1	2	3		4	5		6	7	

15. How much do you agree or disagree with the following statements?

	Strongly disagree			→	Neutral			→	Strongly agree	
My parents think that I should take care of the environment.	1	2	3		4	5		6	7	
My parents usually take care of the environment.	1	2	3		4	5		6	7	
My parents think that taking care of the environment is important.	1	2	3		4	5		6	7	
My friends think that I should take care of the environment.	1	2	3		4	5		6	7	
My friends usually take care of the environment.	1	2	3		4	5		6	7	
My friends think that taking care of the environment is important.	1	2	3		4	5		6	7	
People in my community think that I should take care of the environment.	1	2	3		4	5		6	7	
People in my community usually take care of the environment.	1	2	3		4	5		6	7	
People in my community think that taking care of the environment is important.	1	2	3		4	5		6	7	

16. How much do you agree or disagree with the following statements?

	Strongly disagree → Neutral → Strongly agree						
I want to have as much say in my community or school as possible.	1	2	3	4	5	6	7
Youth like me can really understand what's going on with my community or school.	1	2	3	4	5	6	7
I feel like I have a pretty good understanding of the important issues which confront my community or school.	1	2	3	4	5	6	7
Youth like me have the ability to participate effectively in community or school activities and decision making.	1	2	3	4	5	6	7
My opinion is important because it could someday make a difference in my community or school.	1	2	3	4	5	6	7
There are plenty of ways for youth like me to have a say in what our community or school does.	1	2	3	4	5	6	7
It is important to me that I actively participate in local teen issues.	1	2	3	4	5	6	7
Most community or school leaders would listen to me.	1	2	3	4	5	6	7
Many local activities are important to participate in.	1	2	3	4	5	6	7

17. How much do you trust the following types of people to help improve water quality in your community?

	Not at all	A little	Moderate	A lot	A great deal	Unsure
Business owners	1	2	3	4	5	O
Farmers	1	2	3	4	5	O
Local politicians	1	2	3	4	5	O
Scientists	1	2	3	4	5	O
Family members	1	2	3	4	5	O
Teachers	1	2	3	4	5	O
Other adults in your community	1	2	3	4	5	O
Youth	1	2	3	4	5	O
Other group: <div></div>	1	2	3	4	5	O

In this next section of the survey, we will ask for the names of people that you talk to about water quality. This helps us understand how information about water quality spreads in your community. For example, if you and your classmate talk to the same person, we would be able to tell from your responses here. We will not share the names you write down with anyone, and the names will be deleted after we finish our research study.

18. Who have you talked to about water quality in the last month, outside of your environmental science class? List as many people as you can think of (up to 10), filling in their name and their relationship to you. Please do NOT list people in your environmental science class.

**Person 1's name
(first and last)**

**What is Person 1's
relationship to you?**

- ☐ Parent / guardian
- ☐ Sibling
- ☐ Other family member
- ☐ Teacher
- ☐ Friend
- ☐ Other:

**If Person 1 is a friend, they
are a friend from...**

- ☐ Scouting group
- ☐ Sports team
- ☐ Neighborhood
- ☐ Religious organization
- ☐ School club
- ☐ School
- ☐ Your job
- ☐ Other:

**Person 2's name
(first and last)**

**What is Person 2's
relationship to you?**

- ☐ Parent / guardian
- ☐ Sibling
- ☐ Other family member
- ☐ Teacher
- ☐ Friend
- ☐ Other:

**If Person 2 is a friend, they
are a friend from...**

- ☐ Scouting group
- ☐ Sports team
- ☐ Neighborhood
- ☐ Religious organization
- ☐ School club
- ☐ School
- ☐ Your job
- ☐ Other:

**Person 3's name
(first and last)**

**What is Person 3's
relationship to you?**

- ☐ Parent / guardian
- ☐ Sibling
- ☐ Other family member
- ☐ Teacher
- ☐ Friend
- ☐ Other:

**If Person 3 is a friend, they
are a friend from...**

- ☐ Scouting group
- ☐ Sports team
- ☐ Neighborhood
- ☐ Religious organization
- ☐ School club
- ☐ School
- ☐ Your job
- ☐ Other:

**Person 4's name
(first and last)**

**What is Person 4's
relationship to you?**

- ☐ Parent / guardian
- ☐ Sibling
- ☐ Other family member
- ☐ Teacher
- ☐ Friend
- ☐ Other:

**If Person 4 is a friend, they
are a friend from...**

- ☐ Scouting group
- ☐ Sports team
- ☐ Neighborhood
- ☐ Religious organization
- ☐ School club
- ☐ School
- ☐ Your job
- ☐ Other:

**Person 5's name
(first and last)**

**What is Person 5's
relationship to you?**

- ☐ Parent / guardian
- ☐ Sibling
- ☐ Other family member
- ☐ Teacher
- ☐ Friend
- ☐ Other:

**If Person 5 is a friend, they
are a friend from...**

- ☐ Scouting group
- ☐ Sports team
- ☐ Neighborhood
- ☐ Religious organization
- ☐ School club
- ☐ School
- ☐ Your job
- ☐ Other:

**Person 6's name
(first and last)**

**What is Person 6's
relationship to you?**

- ☐ Parent / guardian
- ☐ Sibling
- ☐ Other family member
- ☐ Teacher
- ☐ Friend
- ☐ Other:

**If Person 6 is a friend, they
are a friend from...**

- ☐ Scouting group
- ☐ Sports team
- ☐ Neighborhood
- ☐ Religious organization
- ☐ School club
- ☐ School
- ☐ Your job
- ☐ Other:

**Person 7's name
(first and last)**

**What is Person 7's
relationship to you?**

- ☐ Parent / guardian
- ☐ Sibling
- ☐ Other family member
- ☐ Teacher
- ☐ Friend
- ☐ Other:

**If Person 7 is a friend, they
are a friend from...**

- ☐ Scouting group
- ☐ Sports team
- ☐ Neighborhood
- ☐ Religious organization
- ☐ School club
- ☐ School
- ☐ Your job
- ☐ Other:

**Person 8's name
(first and last)**

**What is Person 8's
relationship to you?**

- ☐ Parent / guardian
- ☐ Sibling
- ☐ Other family member
- ☐ Teacher
- ☐ Friend
- ☐ Other:

**If Person 8 is a friend, they
are a friend from...**

- ☐ Scouting group
- ☐ Sports team
- ☐ Neighborhood
- ☐ Religious organization
- ☐ School club
- ☐ School
- ☐ Your job
- ☐ Other:

**Person 9's name
(first and last)**

**What is Person 9's
relationship to you?**

- ☐ Parent / guardian
- ☐ Sibling
- ☐ Other family member
- ☐ Teacher
- ☐ Friend
- ☐ Other:

**If Person 9 is a friend, they
are a friend from...**

- ☐ Scouting group
- ☐ Sports team
- ☐ Neighborhood
- ☐ Religious organization
- ☐ School club
- ☐ School
- ☐ Your job
- ☐ Other:

**Person 10's name
(first and last)**

**What is Person 10's
relationship to you?**

- ☐ Parent / guardian
- ☐ Sibling
- ☐ Other family member
- ☐ Teacher
- ☐ Friend
- ☐ Other:

**If Person 10 is a friend, they
are a friend from...**

- ☐ Scouting group
- ☐ Sports team
- ☐ Neighborhood
- ☐ Religious organization
- ☐ School club
- ☐ School
- ☐ Your job
- ☐ Other:

19. Please list any activities or clubs you have attended in person or virtually in the last month. Examples could include sports teams, school clubs, religious groups, scouting groups, or others.

20. Is English the primary language spoken in your home?

- ☐ Yes
- ☐ No, the primary language spoken with those in my household is:

- ☐ Prefer not to respond

21. If English is not the primary language spoken in your home, are you the main English translator for your family members?

- ☐ Yes
- ☐ No

22. What is your gender identity?

- ☐ Boy / Man
- ☐ Girl / Woman
- ☐ Non-binary
- ☐ I identify another way:

- ☐ Prefer not to answer

23. What is your race or ethnicity? Select all that apply.

- ☐ White or Caucasian, non-Hispanic
- ☐ African-American, non-Hispanic
- ☐ Hispanic
- ☐ Asian or Pacific Islander
- ☐ Native American
- ☐ I identify another way:

- ☐ Prefer not to answer

24. How do you identify politically?

- ☐ Very conservative
- ☐ Lean conservative
- ☐ Lean liberal
- ☐ Very liberal
- ☐ Independent
- ☐ Prefer not to respond

25. If you have comments or questions, please write them here. Thank you for taking the time to complete this survey!

Appendix E: Supplemental Tables

These tables relate to the data generated from the student survey (Appendix D) for Chapters 3 and 4 of this dissertation. Item- and construct-level reliability are reported.

Table S1					
<i>Number of completed student surveys associated with each participating teacher, by semester</i>					
<u>Teacher</u>	<u>Fall 2020</u>	<u>Spring 2021</u>	<u>Fall 2021</u>	<u>Spring 2022</u>	Total
Teacher 1		1			1
Teacher 2				15	15
Teacher 3				1	1
Teacher 4		37			37
Teacher 5		5			5
Teacher 6				7	7
Teacher 7				9	9
Teacher 8	14	12			26
Teacher 9	5				5
Teacher 10			2		2
Teacher 11	21				21
Teacher 12			24		24
Teacher 13		88			88
Teacher 14				4	4
Teacher 15		15	18		33
Teacher 16		7			7
Teacher 17		29			29
Teacher 18	3	1			4
Teacher 19		3			3
Teacher 20				39	39
Teacher 21		2			2
Total	43	200	44	75	362

Table S2

Construct reliability for frequency of behavior, with a different alpha calculated for each of the three different types of behaviors. Students were asked "How often do you do the following activities?" and were given the option to respond on a 7-point Likert scale from 1 = "Never" to 7 = "Every chance I get."

<u>Item</u>	<u>Mean</u>	<u>SD</u>	<u>n</u>	<u>Item-level Cronbach's α</u>
<i>Private-sphere behaviors</i> ($\alpha = 0.49$)				
Pick up trash when I see it outside	4.69	1.53	362	N/A
Avoid flushing items down the toilet besides toilet paper	5.91	1.54	362	N/A
<i>Collective non-activist behaviors</i> ($\alpha = 0.83$)				
Talk to others about ways our community can work together to improve water quality	2.55	1.65	361	0.79
Participate in community events like trash clean-ups to improve water quality in my community	3.03	1.90	362	0.79
Organize community events like trash clean-ups to improve water quality in my community	2.22	1.76	362	0.72
<i>Collective activist behaviors</i> ($\alpha = 0.95$)				
Talk with school administrators about what rules our school can make to improve water quality around our school	1.99	1.61	362	0.93
Write to my local officials in support of policies that support water quality in our community	1.95	1.64	362	0.90
Attend local government events (e.g., city council meetings) to voice my support of water quality policies in our community	1.91	1.59	361	0.94

Table S3

Construct reliability for environmental hope (scale-level $\alpha = 0.88$). Students were asked "How much do you agree or disagree with the following statements?" and were given the option to respond on a 7-point Likert scale from 1 = "Strongly disagree" to 7 = "Strongly agree."

<u>Item</u>	<u>Mean</u>	<u>SD</u>	<u>n</u>	<u>Item-level Cronbach's α</u>
I am willing to take actions to help solve environmental problems.	5.05	1.45	361	0.87
I know that there are things that I can do to help solve environmental problems.	5.45	1.38	361	0.87
I know what to do to help solve environmental problems.	4.28	1.44	361	0.88
At the present time, I am energetically pursuing ways to solve environmental problems.	3.47	1.62	361	0.88
If everyone works together, we can solve environmental problems.	5.89	1.33	360	0.88
I believe that scientists will be able to find ways to solve environmental problems.	5.50	1.31	361	0.87
I believe people will be able to solve environmental problems.	5.06	1.49	360	0.87
I believe more people are willing to take actions to help solve environmental problems.	4.38	1.55	360	0.87
Even when some people give up, I know there will be others who will continue to try to solve environmental problems.	5.26	1.44	360	0.87
Every day, more people begin to care about environmental problems.	4.52	1.55	361	0.87

Table S4

Construct reliability for environmental hopelessness (scale-level $\alpha = 0.80$). Students were asked "How much do you agree or disagree with the following statements?" and were given the option to respond on a 7-point Likert scale from 1 = "Strongly disagree" to 7 = "Strongly agree."

<u>Item</u>	<u>Mean</u>	<u>SD</u>	<u>n</u>	<u>Item-level Cronbach's α</u>
Environmental problems are beyond my control, so I won't even bother trying to solve them.	2.89	1.54	361	0.7542
The actions I can take are too small to help solve environmental problems.	3.34	1.58	361	0.7258
Environmental problems are so complex that we will not be able to solve them.	2.72	1.47	361	0.7106

Table S5

Construct reliability for response efficacy, with a different alpha calculated for each of the three different types of behaviors. Students were asked "How effective do you think the following strategies are for improving water quality in your community?" and were given the option to respond on a 7-point Likert scale from 1 = "Not at all effective" to 7 = "Extremely effective."

<u>Item</u>	<u>Mean</u>	<u>SD</u>	<u>n</u>	<u>Item-level Cronbach's α</u>
<i>Private-sphere behaviors</i> ($\alpha = 0.85$)				
Picking up trash when I see it outside	5.43	1.49	360	N/A
Avoiding flushing items down the toilet besides toilet paper	5.47	1.48	360	N/A
<i>Collective non-activist behaviors</i> ($\alpha = 0.87$)				
Talking to others about ways our community can work together to improve water quality	5.07	1.55	360	0.88
Participating in community events like trash clean-ups to improve water quality in my community	5.62	1.43	358	0.81
Organizing community events like trash clean-ups to improve water quality in my community	5.50	1.48	359	0.78
<i>Collective activist behaviors</i> ($\alpha = 0.91$)				
Talking with school administrators about what rules our school can make to improve water quality around our school	4.83	1.69	360	0.89
Writing to my local officials in support of policies that support water quality in our community	4.85	1.69	360	0.84
Attending local government events (e.g., city council meetings) to voice my support of water quality policies in our community	4.92	1.73	360	0.86

Table S6

Construct reliability for subjective norms (scale-level $\alpha = 0.91$). Students were asked "How much do you agree or disagree with the following statements?" and were given the option to respond on a 7-point Likert scale from 1 = "Strongly disagree" to 7 = "Strongly agree."

<u>Item</u>	<u>Mean</u>	<u>SD</u>	<u>n</u>	<u>Item-level Cronbach's α</u>
I am willing to take actions to help solve environmental problems.	4.82	1.54	358	0.91
I know that there are things that I can do to help solve environmental problems.	4.63	1.51	359	0.90
I know what to do to help solve environmental problems.	4.99	1.51	358	0.91
At the present time, I am energetically pursuing ways to solve environmental problems.	4.28	1.66	359	0.90
If everyone works together, we can solve environmental problems.	4.24	1.60	357	0.90
I believe that scientists will be able to find ways to solve environmental problems.	4.65	1.56	358	0.90
I believe people will be able to solve environmental problems.	4.43	1.50	359	0.90
I believe more people are willing to take actions to help solve environmental problems.	4.13	1.53	359	0.91
Even when some people give up, I know there will be others who will continue to try to solve environmental problems.	4.47	1.58	359	0.91

Table S7

Construct reliability for perceived behavioral control, with a different alpha calculated for each of the three different types of behaviors. Students were asked "How much do you agree or disagree with the following statements?" and were given the option to respond on a 7-point Likert scale from 1 = "Strongly disagree" to 7 = "Strongly agree."

<u>Item</u>	<u>Mean</u>	<u>SD</u>	<u>n</u>	<u>Item-level Cronbach's α</u>
<i>Private-sphere behaviors</i> ($\alpha = 0.87$)				
If I wanted to, I could pick up trash when I see it outside	6.04	1.42	361	N/A
If I wanted to, I could avoid flushing items down the toilet besides toilet paper	6.23	1.25	359	N/A
<i>Collective non-activist behaviors</i> ($\alpha = 0.91$)				
If I wanted to, I could talk to others about ways our community can work together to improve water quality	5.50	1.66	357	0.87
If I wanted to, I could participate in community events like trash clean-ups to improve water quality in my community	5.59	1.60	360	0.85
If I wanted to, I could organize community events like trash clean-ups to improve water quality in my community	5.08	1.88	360	0.87
<i>Collective activist behaviors</i> ($\alpha = 0.93$)				
If I wanted to, I could talk with school administrators about what rules our school can make to improve water quality around our school	5.25	1.80	359	0.92
If I wanted to, I could write to my local officials in support of policies that support water quality in our community	5.08	1.84	358	0.87
If I wanted to, I could attend local government events (e.g., city council meetings) to voice my support of water quality policies in our community	4.83	1.99	360	0.92

Table S8

Construct reliability for perception of youth power in the community (scale-level $\alpha = 0.91$). Students were asked "How much do you agree or disagree with the following statements?" and were given the option to respond on a 7-point Likert scale from 1 = "Strongly disagree" to 7 = "Strongly agree."

<u>Item</u>	<u>Mean</u>	<u>SD</u>	<u>n</u>	<u>Item-level Cronbach's α</u>
I want to have as much say in my community or school as possible	4.27	1.67	356	0.91
Youth like me can really understand what's going on with my community or school	4.57	1.66	355	0.91
I feel like I have a pretty good understanding of the important issues which confront my community or school	4.53	1.58	355	0.91
Youth like me have the ability to participate effectively in community or school activities and decision making	4.65	1.58	354	0.90
My opinion is important because it could someday make a difference in my community or school	4.67	1.61	353	0.90
There are plenty of ways for youth like me to have a say in what our community or school does	4.49	1.64	355	0.90
It is important to me that I actively participate in local teen issues	4.27	1.56	353	0.90
Most community or school leaders would listen to me	3.82	1.71	353	0.91
Many local activities are important to participate in	4.48	1.56	355	0.90

Table S9

Construct reliability for trust toward community (scale-level $\alpha = 0.74$). Students were asked "How much do you trust the following types of people to help improve water quality in your community?" and were given the option to respond on a 5-point Likert scale from 1 = "Not at all" to 5 = "A great deal."

<u>Item</u>	<u>Mean</u>	<u>SD</u>	<u>n</u>	<u>Item-level Cronbach's α</u>
Family members	3.03	1.33	345	0.71
Teachers	3.02	1.33	348	0.65
Other adults in your community	2.59	1.25	348	0.65
Youth	2.43	1.32	350	0.71

Table S10

Construct reliability for discussion frequency, within the social network construct (scale-level $\alpha = 0.54$). Students were asked "In the last month, how often have you done the following?" and were given the option to respond on a 5-point Likert scale from 1 = "Never" to 5 = "More than five times."

<u>Item</u>	<u>Mean</u>	<u>SD</u>	<u>n</u>	<u>Item-level Cronbach's α</u>
Discussed water quality in your environmental science class	3.19	1.25	362	0.67
Discussed water quality with your friends outside of class	1.56	0.86	362	0.32
Discussed water quality with your family	1.97	1.07	362	0.34