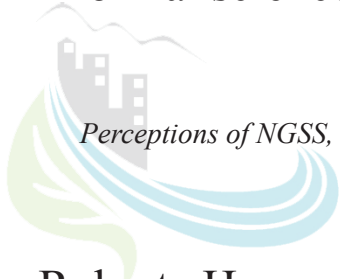


Informal science educator professional identity



Perceptions of NGSS, work with teachers, and the centrality of place

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Abstract

There have been calls for meeting the goals of the Next Generation Science Standards (NGSS) through instruction and experiences in out-of-school, informal science education contexts. To maximize the effectiveness of such experiences, teachers and informal science educators must collaborate to create meaningful science learning experiences. However, in contrast to teachers, there has been little work done with informal science educators (ISERs), and their professional identity and motivations are not well understood. This paper presents the results of a survey and interview study with informal science educators in a state in the U.S. Midwest. Using a sociocultural framing of identity, we examined the values and positioning of ISERs through two avenues: their work with teachers, and the role of place/content in their work. We found that ISERs see their work as complementary to that of teachers. In addition, the place of their work or the content they teach were valued in different ways. We conclude with a discussion of how informal science educator identity can influence collaboration with teachers to the benefit of students.

Keywords: Informal science education, identity, place, teachers, NGSS

Introduction

Science learning takes place in many forms outside of classroom walls. A robust science learning ecology is life wide, life deep, and lifelong (Banks, et al., 2007; Bell, et al., 2009). An estimated 120 million people visit science centers globally each year (ASTC, 2016), and an estimated 11 million students visit environmental and outdoor education centers in the U.S. annually (Collins, et al., 2020). These informal science education (ISE) sites provide science learning opportunities to many children, families, and

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adults, which suggests that ISE is both impactful and worthy of investigation for deeper understanding. Though the balance is shifting as the importance of learning in multiple contexts has become apparent, much of the literature on science learning focuses on school settings. This is evident from a Google Scholar or EBSCO search for “science learning” or “science education” – the preponderance of results reference learning in schools and classrooms. What research has been done on informal science learning and education (ISE) focuses on students, largely rendering educators who work with them invisible (e.g. Bamberger & Tal, 2008; Davidson et al., 2009). This paper engages with informal science educators (ISERs) in a U.S. context to better understand their work and professional identity.

There have been several calls for bridging the gap between informal and formal science education and creating meaningful partnerships that promote coherent science learning across contexts (e.g. Hofstein & Rosenfeld, 1996; NRC, 2015; Stocklmayer, Rennie, & Gilbert, 2010). Work on the Next Generation Science Standards (NGSS) (NGSS; Lead States, 2013; NRC, 2015) suggests that ISE sites are a valuable part of the STEM learning ecosystem (Falk & Dierking, 2018), and provide K-12 students with rich science learning experiences that are not available in the classroom, such as direct experience of scientific phenomena and practical experience “doing science”. An understanding of the NGSS can facilitate these kinds of work – extending classroom learning and work with teachers – while still maintaining the nature of informal learning experiences. In addition, we propose that ISERs have instructional and content expertise and resources that could support teachers in providing new types of classroom learning. The NGSS should not be used to guide learning in informal spaces, rather knowledge of these widespread science learning standards can help ISERs better leverage the power of informal learning to support science learning in the broader ecosystem. In order to understand the entire STEM learning ecosystem we must understand perspectives of ISERs and how they work with formal educators as audience members and collaborators, alongside what ISERs prioritize in their teaching (e.g. Plummer and Small, 2013; Tran, 2007). Ultimately, a deeper understanding of ISER professional identity – how they see themselves and how they are seen by others in matters such as competency and agency, all constrained or supported by social structures within which they operate regularly – will help in leveraging their commitments and knowledge in supporting both teachers and their students in interacting with the scientific world in powerful ways. The goal of this study is to continue building on what is known about the factors shaping how ISERs approach their work (e.g., Ennes, Jones, & Chestnutt, 2020; Holliday & Lederman, 2014; Plummer, Crowl, & Tanis Ozcelik, 2021) by developing an understanding of how they work with teachers and what characterizes their professional identity.

Who is an informal science educator?

Though research on science learning beyond school walls has increased (e.g. PINTHONG & FAIKHAMTA, 2018; NRC, 2015; COLL & COLL, 2019), there remains relatively little research on the educators who work in these spaces (e.g. KING and TRAN, 2017; TRAN & KING, 2011). Even though millions of students go on field trips to

ISE sites each year (Collins, et al., 2020), research with and about ISERs falls short of that focused on K-12 teachers. This gap should be addressed for several reasons. First, using experiences in informal settings to support classroom science learning is a core feature of the NGSS (e.g., NRC, 2015). To make partnerships with professionals working in such settings productive, it is vital to understand more about ISERs and their work. Second, people learn a great deal about science outside of school settings (Falk & Dierking, 2018). This requires ISERs with diverse content and pedagogical knowledge and skills. ISERs have a great deal to offer in supporting reform-driven educational goals that center students and encourage students to figure out rather than learn about science in a variety of spaces (Blenkinsop, Telford & Morse, 2016).

For these goals to be achieved we must first identify who is an informal science educator.

Although ISERs work with audiences of all ages in a wide variety of settings, such as science centers and museums, nature centers, zoos, afterschool programs, youth development programs, and state parks, in this paper we focus on ISERs who work with K-12 students in out-of-school settings around science content. In addition, although this study focuses on and defines ISERs more broadly, we do have a large number of ISER participants who teach science in outdoor education settings due to our sampling methods, which will be elaborated on below. Just as a science museum has affordances such as multimedia presentations that help visitors learn about science and their role in it (National Research Council, 2009), outdoor and environmental education sites are important ISE venues that can themselves be the topic of study for environmental science on field trips (Storksdiel, 2011) and allow for experience with doing science in authentic environments (Rios & Brewer, 2014). In a recent survey of environmental education providers (Collins, et al., 2020), 86% reported offering science, and 80% of programs were for grades 1-12 programming. Most of the programming was reported to be day-long or partial-day. ISE as a profession is evolving (Morrissey, Heimlich, & Schatz, 2020; Tran & King, 2007). While ISERs have a variety of backgrounds and training, ISE as a field certainly has sets of norms, professional associations, and various forms of certification (Morrissey, et al., 2020). However, *becoming and being* an ISER – or any kind of professional, for that matter – is shaped by one’s professional identity (e.g., Beijaard et al, 2004; Luehmann, 2007); we turn to that construct below.

Professional identity

Research has been done on children’s identity work in informal spaces (e.g. Hull and Greeno, 2006; Todd & Kvoch, 2019), but despite some notable exceptions (e.g., Ash, Lombana, & Acala, 2012; McLain, 2017) there is little research on the identity of educators who work in such spaces. There are a variety of conceptions of professional identity; we use a sociocultural perspective (e.g. Author 3, 2016; Vagan, 2011) in which identity is considered to be dynamic, involves the processes of creating and refining, and is a result of the interaction of the individual with others and within particular physical, social and cultural contexts. It is influenced by the people, places, and systems where one works, as well as shaping one’s work in return, and is thus of interest to those who are interested in groups and individuals

such as ISERs. We consider identity to be shaped by positioning and values – (See, for example, Author 3, 2018; Author 3, in press).

We consider positioning to be how the individual narrates themselves and their interactions in relation to others who inhabit the same community and the way others do the same with respect to the individual (e.g., Author 3, 2018; see also Arvaja, 2016; Hermans, 2003). Individuals can also position themselves in parallel with or in opposition to the sociocultural spaces they inhabit (Author 3, in press). So, for example, a beginning educator may position themselves in parallel with the teacher preparation program from which they graduated or they might position themselves in opposition to other members of the science department where they teach.

The second component of identity – values – refers to those ideas, goals, or priorities that drive an individual's or an entire community's actions (Author 3, 2011). An educator might prioritize students' developing deep understanding of scientific ideas and thus plan and respond to students with this in mind, or prioritize the experiential nature of their programming and respond to students differently. While every educator possesses a set of values, these values can change over time, with some being prioritized over others. Additionally, these values will not necessarily be prioritized if the context or the community does not support actions aligned with these values. This is where the constructs of self-efficacy and agency come into play.

Agency can be viewed as the result of the educator recognizing a challenge, developing a plan to address that challenge, and putting that plan into action (e.g., Bandura, 1986, 1989).

Additionally, when a particular action is aligned with an individual's values and yields some level of success, it is more likely that the individual will engage in that action in the future, and as a result of this process, agency develops (Author 3, in press). Similarly, the confidence that accrues as a result of a history of success contributes to a sense of control an individual feels with respect to their behavior and their social environment and thus to a greater sense of self-efficacy (e.g., Bandura, 1977). Our view is that this interpretation of identity applies as well to informal science educators as it does to classroom educators.

Collaborations between informal and formal science educators

Student learning occurs both in and outside the classroom, and informal spaces have benefits for students' science learning (e.g. Dunlop, Clarke, and McKelvey-Martin, 2019; National Research Council, 2009). Developing a productive science learning ecosystem calls for connecting multiple places, and this requires collaboration and communication between educators who know and work in those places, as well as family members. Here we focus on the work that occurs when teachers and ISERs come together, what types of collaborations are most common, and how more meaningful collaborations could be formed.

Beginning to understand how partnerships between formal and informal science institutions might yield more powerful learning requires identifying how it is that educators who work in these settings collaborate with each other. ISERs and teachers interact in many ways that support science teaching and learning both on the personal level and at a field level. Such conversations may for example address

how to make the most of field trip experiences by aligning field trip content with what students are learning in class, or providing suggestions for simple investigations that teachers could conduct with their class. We focus in this section on two common types of synchronous collaborations documented in the literature: school field trips and teacher professional development (PD). The literature on school field trips is focused primarily on youth cognitive or affective outcomes (e.g. Bamberger & Tal, 2008; Davidson et al., 2009; Dunlop, Clarke, and McKelvey-Martin, 2019; Lavie, Alon, & Tal, 2015). There is much less attention to how formal and informal educators collaborate with each other before, during, or after the field trip or how ISERs facilitate outcomes for youth, though research suggests that informal science learning experiences can be more powerful if they are connected to classroom learning through activities before and/or after a field trip (e.g. Davidson, et al., 2009).

Another common time that formal teachers and informal science educators interact is during PD at an ISE site. Studies on this type of teacher PD often focus on particular outcomes for teachers such as science content knowledge (e.g. Goodale and Sakas, 2019; Melber & Cox-Peterson, 2005; Miele et al., 2010; Pecore et al., 2013) or attitudes about teaching science (e.g. Melber & Cox-Peterson, 2005; Pecore et al., 2013). These studies do not typically focus on the interactions between ISERs and teachers or on the goals they each bring to the PD experience. Again, the ISERs are most often missing from the analysis altogether, despite facilitating outcomes that researchers are measuring.

Though science content knowledge is a common goal of PD led by ISERs for teachers, a focus on content alone is insufficient for fostering effective classroom science teaching. The NGSS (NGSS Lead States, 2013) have changed the landscape of science education in the United States since they were introduced. The NGSS called for the interweaving of science and engineering practices, disciplinary core ideas, and cross-cutting concepts to re-shape teaching, learning, curriculum, and assessment in the classroom. While the NGSS have had smaller reach to ISE contexts, the National Resource Council (NRC, 2015) has recommended organizations that provide ISE be used as resources to expand classroom science learning. ISERs may have goals that are not always centered on NGSS implementation for K-12 students, such as family and public education, conservation, attendance, or historical preservation (Reid, 2013), yet the NGSS are relevant if providing professional development to teachers.

As a first step in articulating the understanding necessary to support deeper and more meaningful science learning, we investigated two research questions in this paper:

1. How do ISERs position themselves and their professional work and how does that contribute to their professional identity?
2. What experiences do ISERs have in working with teachers and how do they interpret these interactions?

Methods

Researcher Positionality

It is important to consider our own positionality with regard to the people we work with and seek to learn about. We are three white women at varying stages of our careers. [Author 1] was an informal science and environmental educator for over twenty years and a researcher working with formal and informal educators before moving to the state where this study took place. [Author 2] was a naturalist and outdoor educator before becoming a PhD student studying science education, but is also new to the state. [Author 3], originally a bench scientist, is an experienced researcher and faculty member with a long history of scholarship focused on professional identity and deep knowledge of the formal education system. Together, we have an interest in understanding the informal science educator perspective in order to better inform our own work with both educators.

Instruments

We developed a two-part explanatory sequential study (Ivankova, Creswell, & Stick, 2006) in which initial data collection is primarily quantitative to develop a baseline understanding of a phenomenon, and followed this with interviews to provide richer data to build out initial understandings. In the first phase, we distributed an online exploratory questionnaire to ISERs across the state. The pilot questionnaire, developed, piloted, and revised in the spring of 2020, consisted of 57 items representing a mix of closed-response, open-response, five-point Likert-type scales (strongly agree to strongly disagree, with an open-response item “Would you like to tell us anything else” at the end of each item set), and item ranking (Appendix A). Items were developed based on literature on ISER practice, teacher-ISER partnerships, and the lived experience of the two authors with ISER backgrounds. The questionnaire was distributed to a small number of educators who provided feedback on item clarity, and then items and scales were revised. Due to the limited scope of the questionnaire, and its chief role in eliciting patterns to follow up on in the interviews, it was not validated, and psychometrics were not calculated.

The questionnaire provided insight into two aspects of ISER identity:

1. What ISERs value about their jobs and their goals for working with learners (e.g. an open response item “What do you love about your job?”; ranking items about the challenges of their job).
2. How ISERs position themselves in relation to their organization, the field, and teachers (e.g. Likert-type items on informal science and formal science techniques, whether they feel respected by teachers, and interactions with teachers).
3. How they relate to the NGSS and their relationships with teachers, in which 1 and 2 are enacted.

While questions on agency were included in the survey the responses did not yield fruitful insight, and are not included in the analysis.

At the end of the survey, participants could express interest in participating in a semi-structured interview of 30 – 45 minutes. The goal of the interviews was to expand upon questions included in the survey. The interview questions (Appendix B) addressed their motivations and goals as informal educators and how they perceived their work with teachers. Because of the pandemic, the interviews were conducted via Zoom or phone and were recorded and transcribed.

Participants

Survey invitations were sent to two environmental and outdoor education professional organization listservs, and to professional contacts and science museum contacts across the state. There were 153 responses. Due to the distribution method (listservs), the number of people who encountered the invitation is not known, therefore a response rate was not able to be calculated. Seventy-three responses were removed due to incomplete responses. Responses by K-12 teachers (n=7) were also removed. In the end, 73 responses were analyzed. Of those participants who expressed interest in being interviewed, 12 were chosen using purposive sampling (Battaglia, 2008), “to produce a sample that can be logically assumed to be representative of the population” (Lavrakas, 2008). Interview participants were chosen to reflect as many of the work contexts represented in the surveys as possible (see Table 1). Teaching context and ability to participate in an interview were the only variables considered in participant selection. All participants and their places of work were anonymized to the greatest possible extent.

Survey participants represented 25% of the state’s counties and were chiefly concentrated in metropolitan areas. Asked to describe their place of work, 37% of participants selected environmental education centers or nature centers, 11% museums and science centers, 11% government (state parks, conservation districts, municipal recycling, etc.), and 10% in zoos and aquaria. The remainder worked various other settings. The mean time employed in the field of ISE was 14.4 years, with a mean time at their current site of 9.0 years.

Data collection was impacted by our sampling methods (using listservs and emails) and pandemic conditions. We speculate that the overrepresentation of outdoor and environmental educators resulted from sending the survey to a large environmental and outdoor education professional listserv and the fact that outdoor education centers were more likely to be open during the COVID-19 pandemic than indoor education sites. In addition, when emailing museum, zoo, and aquaria sites, we received many automated responses that staff were furloughed due to the pandemic or the sites were closed. A large number of our survey and interview respondents were long-time ISERs, possibly because early-career educators were more likely to have been laid off or furloughed during the pandemic.

Table 1. Interview participant profiles

Name	Work setting	Self-identify as	Years in ISE
Susan	Garden	Naturalist	16-20
Matt	Museum	Educator	0-5
Kristen	Nature center	Environmental educator	6-10
Peter	Lake boating facility	Informal science educator	0-5
Sarah	Corporate community relations	Informal environmental educator	>25
Kayla	Nature center	Interpreter	6-10
Chris	State park	Interpreter	>25
Hannah	Afterschool	Volunteer Informal science educator	11-15
Sean	University research lab	Informal science educator	11-15
Ann	Farm	Educator	0-5
Lily	Education consultant	Environmental educator	11-15
Jill	Non-profit environmental organization	Informal science educator	11-15

Data Analysis

Data analysis took place in two stages. We first performed both quantitative and qualitative analysis of survey responses. Quantitative analysis took two forms: frequency of responses to Likert-type and multiple-choice items and analyzing ranked items. Additionally, open response items were open coded to look for patterns following the procedure described below.

Interview transcripts were then collaboratively hierarchically coded (Saldana, 2016) by the first two authors in two stages. In the first stage, categorical coding was based on a priori categories of questions from the interview protocol (e.g. NGSS, collaboration, work with teachers). After applying these categories, we

co-developed subordinate codes for those parent codes. Interviews were open coded by the first two authors for other codes relevant to the study. Through discussion, these smaller codes were collapsed into larger categories such as place and content (Saldana, 2016). After the importance of *place* and *content* categories (these terms will be expanded upon later) to educators became apparent, an additional round of collaborative coding was completed to look for further examples. Themes were established through discussion among the three authors of codes and categories in relation to our research questions. Codes and excerpts are available in Appendix A. Results

Here we present the results from this study framed by two critical components of identity. In each of these sections, we will address survey and interview responses which centered on work with teachers and learners in ways that reflect participants' values and positioning. The survey provided a baseline of information and broader patterns, while the interview data allowed for deeper discussion and exploration of those patterns. This allowed us to develop a fuller appreciation for the ways in which ISERs saw their work, the people with whom they interact, and the places they work, and thus their professional identity. We also address the significant ways in which place and content shape values expressed by study participants.

Values

Survey participants were asked to rank goals for their work with learners from one to six (Table 3), and were given the opportunity to elaborate on them. These goals reflect some of the values they hold with respect to the work they do – what is important for them to provide to learners.

Table 2. Percent of survey participants (n=73) who ranked each goal as 1st or 2nd in importance.

<i>Goal “Learners will ...”</i>	<i>% ranked 1st or 2nd</i>
learn new things through fun and hands-on experiences.	80.82
have new hands-on experiences.	46.58
have fun	27.40
learn from someone that is knowledgeable about the topic.	19.18
develop new science practices.	16.44
meet one or more state standards.	9.59

Table 3. Percent of survey participants (n=73) who ranked each challenge of the job as 1st or 2nd most challenging.

<i>Challenge</i>	<i>% ranked 1st or 2nd</i>
Diversity and inclusion	50.68
The pay	42.47
Program enrollment or visitor levels	23.29
Supporting school curricula	21.92
Working conditions	17.81
Benefits	17.81
Other	15.07
Understanding how people learn science	10.96

The majority of respondents ranked “learn new things through fun and hands-on experiences” as their first goal. From these rankings, it was clear that the experiential nature of their work— including hands-on experiences – was important. A typical response was from a survey respondent who is an environmental educator at a watershed organization. They described what they value most about their job:

I love working face-to-face with youth and families to help them have memorable hands- on experiences that we hope will help them feel closer and more connected to the watershed. I get the most joy out of my face-to-face work leading programming with groups.

Learners having fun was also an important goal for ISERs. Their perception of fun focused on engagement and motivation over entertainment. One interview participant, Lily, who identified as an environmental educator, expressed:

By fun, I guess I don’t mean like it’s Chuck E Cheese partying, you know, I’m thinking about, did they create a memory? Did they make a memory that was different and will it stand out? So fun, I guess to me means like, is it a standout experience?

Values may also be represented in what is perceived as a challenge. In a question similar to the goals question described above, survey respondents were asked to rank the challenges of their work (Table 4). Diversity and inclusion was ranked first or second 50.69% of the time suggesting it is something they value. Diversity and inclusion was not defined in the instrument, but open responses focused mostly on urban-rural, racial, and socio-economic divides. Most saw it as a matter of representation, as expressed in this response:

Well, I work with a lot of inner-city kids. And still, when I’m going into their classroom, I’m a white woman, right? I’m trying to show them people who look like them. And it is hard, it is so hard to show them people that look like them. And

that is so important.

While another saw the issue of diversity and inclusion from a more structural perspective:

I think just having a voice at the table representing multiple types of people and that's race, inability, and socioeconomic status, I've found that in working nonprofits my entire life, the people that tend to hold these roles for any length of time without moving to another sector, tend to be people who are better off at home, have a spouse that makes a higher income to complement that work. And so the socioeconomic status of those people, and then those people making the majority of the decisions, they tend to kind of go hand in hand. We tend to, I've seen very few and I live and work within [City] and [City] and those are pretty diverse regions within this region. And there's just no people of color at the table. Our board, we try so hard to do community engagement, but we only have a few individuals who are people of color or anybody with any sort of disabilities, everybody's pretty affluent. It just doesn't seem like that voice is there at the table that needs to be. And when it is, it's almost like tokenism, and it's not intended to be, it just kind of rolls out that way, Thank and appears that way to the outside world, I would say as well.

Work with teachers

ISERs work with many groups and in many different formats (e.g., family programs, school field trips, professional development workshops). ISERs' work with teachers can be multifaceted, including informal interactions. The survey results showed that ISERs worked with teachers in a variety of ways (Table 5). When asked in a multiple response question how they have worked with teachers, the most common responses were informal interactions during visits, interacting with teachers during day-long workshops, and long-standing relationships with teachers. More in-depth, collaborative interactions such as co-developing curriculum, co-teaching and multi-day workshops were less common. However, ISERs were quick to note that they value many aspects

Table 4. Survey respondents' work with teachers (n=73)

<i>Type of interaction</i>	<i>% of participants</i>
Informal interactions during visits	94.52
Day-long workshops	60.27
Long-standing relationships	60.27
Short conference presentations	56.16

Co-developing curriculum	46.58
Co-teaching	39.73
Multi-day workshops	36.99
Other *	6.85
I don't interact with teachers	1.37

of their work with teachers. Many survey respondents said such work was important and leverage their own specialized knowledge, connecting it to the classroom. One interpreter at a nature center wrote:

We always work to connect our program learning objectives to state standards and classroom goals while prioritizing the importance of place-based, outdoor and STEM- focused activities. It's my preference to work WITH formal teachers every step of the way and be the best resource for them and their students.

An environmental educator put it this way: "One of the main things I strive for as an informal science educator is to connect and extend what kids are learning in the classroom. I believe a strong relationship with teachers is integral to what I do." An informal science educator in a research lab offered that "I believe supporting teachers is one of the most important jobs I can do." A naturalist in a nature center wrote "I feel modeling teaching outdoors is very important to show classroom teachers. We need to get down on the ground or into the water to "really" show effective teaching. We need to get dirty, be passionate, excited."

Place and content

Across the interviews and analysis, two factors appeared which seemed to reflect ISERs' values regarding their work with K12 students and teachers – place and content. Place was treated as where they engaged in their work. Content referred to what their work was about and was considered broadly to include disciplines [e.g. physics], concepts [e.g. nature], and curriculum [e.g. STEM workforce, teacher learning], independent of where learning took place. Each of these influenced how ISERs saw themselves, their jobs, and what they see as uniquely important about what they do. These two factors were not mutually exclusive, but some educators privileged one over the other, while others emphasized both equally. These are represented on the axes of Figure 1.

Some educators (Group 1) identified the place they work as one of the most important factors contributing to their work. Significantly, place was not restricted to the physical environment, but was inclusive of the social environment, including co-workers. Individuals in this group mentioned content that they teach as important, but place appeared to be the primary driver of that content and what

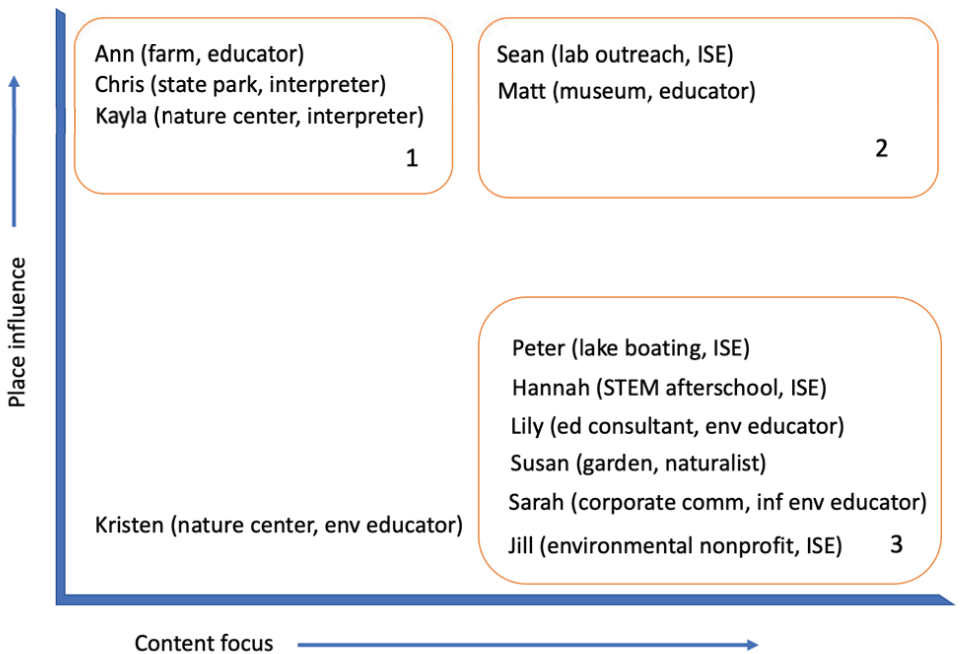


Figure 1. The extent to which participants prioritized place or content as a focus of their work illustrates professional values.

Having the farm as a place that they can come and test out and learn about things that they're learning in the classroom that they can't see in real life, where they are in their community, makes it really strong. I mean, just the working farm aspect. They can explore a lot of scientific concepts and ideas there. So I think our place is amazing.

Other educators (Group 2) focused on the content of their teaching when discussing their work. This could be a topic such as physics, water quality, or waste management, or a concept such as nature, teacher learning, or the importance of a particular pedagogy. These educators described cognitive aspects of their work much more frequently than affective elements, and regularly noted that this work could be (and often was) done in many different spaces such as lakes, classrooms, outdoor spaces. This is how Peter, an ISEr who helped found a boat-based water quality monitoring program, spoke of how he addressed his goal to feed the STEM

pipeline with his work:

Even though I think meteorology and probably groundwater and geology and a few other fields are even more critical than limnology, it's still one of the things that I hoped would be accomplished in doing this, is to introduce students to the idea that there are people who do real science outdoors in the environment, and that they're important.

A third group seemed to be driven equally by place and content. One educator did not provide enough detail in her interview to place her in any of the three groups and so was placed in the lower left quadrant of the graph. In the following paragraphs, we will highlight one educator from each of the three groups. These groups are not distinguished by having strict boundaries, but rather, by the extent of the foregrounding of the importance of place and content. Given the dynamic nature of identity and the role that values play in shaping it (e.g., Author 3, 2018), this lack of strict boundaries is not surprising; additionally, these influences can and do often shift with time and experience.

Group 1 - Focus on place

As can be seen in Figure 2, three interview participants were in this group. We focus on Chris in this section in order to give a detailed example of one specific participant who is an exemplar for a focus on place. Chris is a senior state park interpreter who has been in the ISE field for 30 years. He knew from a young age that he wanted a job in the outdoors and went to school to get a bachelor's degree in parks and recreation with an emphasis on interpretation. He worked at a county park and two other state parks before moving to his current park. This is the final state park he plans on working at "because there's nothing better than here." He mentioned frequently how important it is for the participants in his programming, both school and public, to get out to the park and experience the local ecosystem. Chris was particularly concerned with how the COVID-19 pandemic was affecting his ability to have people see the park's ecosystem in person and discussed how virtual programming was not the same because the participants were not there.

You know, if I'm talking about the sand dunes here at Rolling Hills State Park, by golly, I want them to be here and see the sand dunes. Yeah, I can do a virtual – I can have video and show you the sand dunes. But it's not the same as actually being here, feeling, touching, seeing the real thing.

Chris has a strong connection to the park he works in and recognizes its unique affordances for the work that he does, using its assets to engage his participants in his programming. Chris is also aware of structural and societal problems both in his local community as well as at the park that he would like to be able to change. He mentions that schools have less funding for field trips than they used to, which in turn leads to fewer school groups coming to the park. He is also aware that the park does not have a very diverse visitor population or staff. To Chris, this is a problem because he knows the assets for learning that his particular place holds and wants them to be accessible to everyone.

Group 2 - Focus on content

Six interview participants seemed to prioritize content in their work (Figure 2). We highlight Jill here because of her focus on content and teacher relationships and lack of discussion of place.

Jill is an education director at a local environmental non-profit. She identifies as an ISE, having begun her career working directly with students at the same organization. As she moved up in the organization, her work shifted to a focus on teacher professional development. She works primarily with grade 6-12 teachers in offsite locations – local universities, county parks, and the school districts themselves. When asked about her goals and motivation, she said students should learn new things through fun and hands-on experiences because “...If it’s not fun and engaging they won’t retain the information,” and that “...building environmental stewardship within our community and region and globally” is very important to her. Jill reports that a highlight of her work is “... becoming an expert in the material and helping to train others. That’s been a huge highlight of it all, is helping bring others into this world and, and help them to understand the field and curriculum and the importance of environmental education in general.”

The focus of Jill’s work is working with and supporting teachers so they can teach about watersheds meaningfully. She reports that she is in touch with multiple teachers daily, and recognizes that they have a demanding job. She prides herself on the support she provides:

I think a lot of people underestimate them and the work that they do. And I think it’s important to understand where they’re coming from and what their needs are. The biggest thing... I want to give them what they need without overwhelming admin and let them blossom.

Jill clearly values working with teachers and building relationships to support them in developing knowledge and teaching skills related to such issues as water quality:

We really let them know that we understand how pressed for time they are, and we try to make ourselves as available as possible and tools for them as available as possible so that they don’t have to put forth the effort of digging for specific activities or ideas.

Jill mentions the importance of working closely with teachers multiple times, yet she only mentions place twice – in terms of the watershed she works in and in contrasting the diversity in the major urban areas and its absence among the organization’s board members. Her emphasis on teacher engagement is detached from place, perhaps due to the fact that she teaches in many places, none of which are tied directly to her organization.

Group 3 -Focus on both place and content

Two interview participants seemed to focus equally on place and content without prioritizing one over the other (Figure 2). Here we focus on Sean, an outreach specialist for a university physics facility, because he had a clear connection to the place that he worked as well as the content that workplace focused on. He

believed visitors would benefit from the unique affordances of the place as well as the interesting content that they would engage with. He has worked at the facility for fourteen years, after completing a PhD in physics and “catching the bug” for teaching while serving as an instructor at the college level.

Sean’s identity is tightly tied to the facility in which he works – what he calls “world- class”, that will soon be “the best in the world”. He talks about all the ways the facility and campus afford his work – hosting tours, doing assessment with the university’s College of Education, working with students to create a show at the adjacent planetarium, working with someone in Communications to create an app about his field of science, access to the public during the science festival. “I started, you know, seeking out experts on campus who could do something that I could not.”

Yet he also expresses clear goals related to the content of the facility. When he talks about working with teachers, he mentions that he wants “... them to be evangelists for nuclear science, especially at [this] university.” He talks about physics again when expressing frustration with NGSS, that physics is mostly covered in high school:

... by the time they get to high school there, they have a pretty good idea of what they like and what they don’t like, what they’re probably going to get into. And so if I want to essentially convert some students into STEM and physics, then I need to be aiming younger. So that’s for like middle school students, you can make it apply.

When asked about his goals for teaching, he talks about the limits of the one-off tours of the facility he provides and how he focuses on attitudes about science:

I can’t expect to actually teach them anything. So, essentially my goal in outreach is changing attitudes. And so attitudes, you know, a lot of things can stem from that afterwards. Right? If I can bring them in and say, here’s what nuclear science or science in general looks like, and they can come out and say, ‘Oh, that’s something I’m really interested in.’ ... it starts with, can I show them something they care about and that they get excited about? Thus, both place and content play strong roles in how Sean sees himself and his work. While Sean seems similar to Jill in their discussion of engagement, the focus on social and material resources of the facility in which he works is absent from Jill’s discussion which focuses on the importance of “fun” as a vehicle for engagement with the content. Sean’s access to the resources of his workplace and campus are integrated into his daily work that it is clear he values it highly, but this is absent from Jill’s conversation.

Positioning

Positioning refers to how an educator narrates themselves and their interactions in relation to others in the same community as well as how others do the same with respect to the individual. This can be in alignment with the sociocultural system or in opposition to it. We looked at positioning in several ways. In the survey, participants were asked how they describe themselves professionally (Table 5). Participants worked in a variety of contexts, with the greatest percentage at nature or environmental education centers. We also analyzed survey data for shared perspectives on teacher collaboration, understanding of the nature and importance of

Table 5. Survey responses to “I identify as...” (n=73)

<i>Identity</i>	<i>% of participants</i>
Environmental Educator	27.40
Educator	19.18
ISE	19.18
Naturalist	16.44
Interpreter	6.85
Other*	4.11
Director	4.11
Teacher	2.74

* Depends on audience, non-formal educator, and conservation education program coordinator

NGSS, their views of the importance of the place they work and the content they address in that work. Items that illustrated their positioning are shared below (Table 6). Overall, ISErs viewed their work as just as important as school learning; however, they also viewed this work as distinct from that of classroom teachers. As one respondent, a naturalist who has worked at an environmental education center, wrote in the survey:

Science-oriented, outdoor learning is the emphasis of all the programs I develop and lead at my facility. This offers program participants a way to directly observe and experience nature in a way that augments what they learn in their indoor classrooms at school. I regularly and very intentionally tie in science concepts/terms to the outdoor program experience for school groups.

An ISEr who works at a science center wrote:

Nothing of what I do can completely replace formal education; however, informal education has its own way of engaging learners that is sometimes lost in the formal education setting. Informal education almost looks at learning from a completely different lens. Our goals and assessment are measured in different ways and allows for learners to achieve success in ways that aren’t done in the classroom.

Work with teachers

ISER responses to questions about how they position themselves in relation to teachers were also analyzed (Table 6). When considering the statement “my skills and teachers’ skills complement each other,” and ranking from strongly agree (1) to strongly disagree (5), 97.26% chose strongly agree or agree. In an interview, Hannah, an ISER who runs an after-school STEM program said:

Well, the teachers have the know-it-all about how to get the information into the kids and that classroom management. Classroom management is a huge, huge part of anything dealing with kids, right. And that part they hold for me, I cannot do classroom management, I just don’t have that skill.

Table 6. Responses to identity-related survey items. (n=73) (1 = Strongly Agree, 3 = Neither Agree nor Disagree, 5 = Strongly Disagree)

<i>In relation to teachers</i>	Mode	Median
My skills and teachers’ skills complement each other.	1	1
I feel respected for my professional knowledge when working with teachers.	1	1
What I teach in my role is unconnected to what students learn in school.	5	5
What I teach in my role is more important than what is taught in school.	3	3
I have a strong understanding of how people learn.	1	1
I have a strong understanding of pedagogy.	1	1
The same methods are effective in classroom settings and at my site.	3	3
My skills and teachers’ skills complement each other.	1	1
<i>Organization related</i>		
I choose what I teach in my programs.	2	2

Educator is part of how I see myself professionally.	1	1
I intend to stay in this career long-term.	1	1
I feel respected for my skills by the upper management of my organization.	1	2
I have opportunities to better my professional education skills.	2	2
There are opportunities to advance professionally in my organization.	2	2

In addition, 93.15% of ISERs chose strongly agree or agree when considering the statement “I feel respected for my professional knowledge when working with teachers”. On the other hand, when considering the statement “teachers lack knowledge of informal science education,” the responses were spread more evenly between agree to disagree, with the most common answer being agree (46.58%). In open responses at the end of this question, a common thread emerged – “it depends.” Some teachers participated in field trips, some did not, some respected ISERs, and some did not. One educator at an interpretive center described the lack of respect they sometimes encounter thus:

Some respect what knowledge our staff and I have to offer while others don’t think we know how children learn outside a formal classroom. Even our own university education students don’t quite believe what we do requires training and skill. After nearly 30 years in this profession, I can tell you it isn’t just something anyone can do well and there are a variety of strategies and techniques that are effective for a variety of audiences.

In interviews, we asked participants what their ideal collaboration with teachers would look like. There was a sense that they had much to offer to teachers as learners, narrating themselves as educators for other professionals and in doing so, positioning themselves in a particular way.

Many ISERs noted specific teacher outcomes in their work. Initially, we assigned different outcomes distinct codes, then noticed a pattern of particular content-related outcomes when we looked across participants and so created a new parent code for outcomes. For example, some of the distinct codes included that ISERs wanted teachers to come away with more knowledge of how to teach in the outdoors, to develop science communication skills, develop more environmental awareness, or develop science content knowledge more generally. However, when looking across ISERs who focused on teacher outcomes in general, we saw a pattern of ISERs positioning themselves as educators with the expertise to support teachers in achieving such outcomes. When asked about teacher knowledge in the survey, many respondents saw teachers as lacking knowledge in some areas. However, they also viewed classroom educators as having specialized knowledge they

did not have, and sometimes complementary to the specialized knowledge they did possess. An additional thread that emerged was a desire for building longer-term relationships with teachers. For example, Jill expressed that relationship building was extremely important in her work with teachers and that building long-term relationships took a lot of work. She stated that relationship building required

Constant contact, even if it's just checking in or we're doing like right now, we're doing virtual coffee hours and things like that, so that they can meet with teachers from other schools and air their grievances and collaborate with one another and just giving them some open space, but not requiring it in any way.

Similarly, when talking about a specific program that they were developing along with a school district, Matt, a museum educator, said that he was "hoping to have that expand to be at least a multi-day program, if not a week-long program."

When asked what constraints prevent these ideal collaborations, ISERs identified lack of time both in their own and teachers' schedules. Many participants noted the large workloads that teachers have and that informal science experiences are often not a priority. Other ISERs had the perspective that informal science experiences were not a priority because teachers did not see the value in those experiences. For example, as Peter noted:

You have lots of teachers and administrators in schools who themselves did not have these kinds of experiences and because they never had that experience, they don't recognize the value of it or how they could leverage such an experience to really do more and better education. And they think of, they tend to think of it therefore as being, you know, a fun outing, you know, or a fluff or something insignificant. And that would cause them to not want to do it.

Discussion

The results from this study provide insight into two components of professional identity: values and positioning. Here we will discuss each of these through the lenses of participant reflections about working with teachers, and alignment with place and content – before turning to possible avenues for investigating agency, the third shaping influence of identity.

ISERs' Perceptions of Working with Teachers

Because of the importance and potential of ISERs working with teachers to build a stronger science learning ecosystem, it is key that we understand their current relationships with teachers. Most of the ISERs responding to the survey worked with teachers, reflecting national trends (Collins, et al., 2020). Generally, ISERs felt that their skills and teachers' skills complemented each other. They also expressed the desire to have longer-term collaborations. However, these more meaningful collaborations also require more time, which was the primary constraint that ISERs noted for teachers and for themselves. Many of our interview participants also felt that such collaboration was not a priority for teachers, either because they have too much on their plate already or because they don't value informal learning. Many also felt that teachers were lacking in some specific skills or knowledge that ISERs

could provide. It is clear that working with teachers is something that many of the ISERs in the study value, and that providing learning experiences aligns with their organizations' values as well, which implies that they may also experience more agency as a result of engaging in that work. This desire for long-term collaboration with teachers has implications for building the types of partnerships called for in the literature (e.g. Hofstein & Rosenfeld, 1996; NRC, 2015; Stocklmayer, Rennie, & Gilbert, 2010).

Survey comments point to ISER acknowledgement of the ways that teachers are different from themselves and reference ISERs' own lack of understanding of the life of a teacher. When asked about collaboration with teachers, interview participants often phrased it as what they could provide for teachers, as opposed to what they might learn from such partnerships. This may stem from a lack of prior collaborative experiences or a view of teachers as only one of the many audiences for whom they provide programming. They clearly valued the types of experiences they provide for students, and considered their role as equally important as that of teachers, but also distinct. ISERs positioned themselves as providers of complementary knowledge and experiences. This has implications for how ISERs might view their role and teachers' role in building partnerships that could leverage different kinds of students learning across the science education ecosystem. Avraamidou (2015) has shown that ISE experiences for pre-service teachers have a positive effect on their understanding of science and, learning related to inquiry-based science, and connecting it to their students' lives, all of which are afforded by ISE settings and educators.

Despite the generally positive feelings about collaborating with teachers, ISERs also were aware that they sometimes have different professional priorities. ISERs noted that many of the constraints they observed also depended on the districts, schools, or individual teachers they were working with and could also be found in their own organizations. Further work that focuses on relationships between teachers and ISERs, as well as on organizational affordances/constraints may help in building mutually beneficial partnerships among ISERs, teachers and the systems in which they work to better serve students throughout the science learning ecosystem.

The Role of Place and Content in the Formation of ISER Professional Identity

During our analyses, we found that among interview participants there were two forces at work in shaping views of the nature of work and motivation to work in the informal education field: the physical and social context (place) and, in a broad sense, the science content. In our study, the extent to which each of these two elements played a central role in participants' perspectives yielded a three-part typology: place-focused, content-focused, and a third group guided by both. Walker (2007) discussed the influence of physical place on identity formation, but place goes beyond physical parameters and involves culture, history, and social interaction (e.g., Lin & Lockwood, 2014; Tuan, 1979). Much like identity, then, place is constantly "under development".

What is it about place and content that contribute to identity? As we noted

previously, this sample was largely made up of environmental educators, and for many of these individuals, aspects of their work site fundamentally shape their daily work, which requires that they have a strong sense of place, both cognitively and affectively (e.g., Ardoin, 2006). Additionally, ISE contexts provide unique opportunities for an embodied sense-making that uses learners' physicality as well as interactions with both the physical and social components of the place (Shaby & Vedder-Weiss, 2021). This resonates with work on teacher identity which has illustrated the importance of physical, social, and cultural context or place in shaping the way these professionals see themselves in relation to others and how they move and interact within their professional spaces.

In contrast, ISERs in the content-focused group worked across multiple sites (such as visiting various classrooms), and either did not require making strong connections between a place and the learners they work with, or expressed high value for work that was not place-centered (e.g., helping students enter and navigate the STEM pipeline). ISERs' emphasis on the value of place or content present different opportunities for what they choose to do in their work with students and teachers. An ISER may reinforce this value by choosing teaching activities that reflect that value, and successful engagement with such activities can contribute to a sense of agency. A farm educator who values the place that they teach and its affordances for unique experiences may ensure that the students they work with have a chance to hold chicks or to harvest carrots. A content-oriented ISER may ensure that their students learn about water quality or STEM careers in any setting. Those educators in the third group, which balanced content and place, may negotiate the two constantly and choose activities that reflect the connection between the content they teach and the place they teach it. Both ISERs emphasized the social aspects of place in their interviews, so they may bring in content experts from their organization as part of their instruction.

Millions of children visit a variety of ISE sites in the U.S. each year yet little has been done to understand the ISERs who work with them. By identifying the strong influence of place and content on professional identity, the research reported here begins to build that knowledge base. Increased understanding of how ISERs see themselves in relation to their lives and intent, their work contexts, and the learners they interact with can help us understand the work they do with children, families, adults and, of most interest here, teachers. This can then lead to more effective professional learning design, and facilitate strong and sustainable collaborations with other educators in or out of school.

Limitations

While the research described here provides initial insights into the professional identity of ISERs, and how they work with teachers there also are limitations that should be addressed in further work. As described in the Methods section, study participants were not necessarily representative of the larger ISER population. In addition, the study was conducted during a pandemic, so responses may have been influenced by the stress and conditions of insecure employment that resulted. Finally, the recruitment materials invited "informal science educators" which may not enroll people doing ISE work who do not think of themselves as educators.

Future Research

Now that we have a greater understanding of ISERs' values and positioning, we can better investigate how they see work-related challenges, decisions they make to address these and the outcome of these decisions, i.e., agency, as well as the nature of the relationship of these decisions to existing values and positioning. If an ISER works in organizations whose values do not align with their own, might they have less agency, and be more likely to leave the organization or the profession? This has been documented for teachers (Dunn, 2018; Heikonen, et al., 2017; Author 3, 2022) and we might expect to see parallels among ISERs. Which types of decisions that ISERs make (Tran, 2007) can lead to greater agency? We hope to investigate these questions more deeply in the next study. In support of our finding regarding ISERs' perceived challenges of the field, Ennes, et al. (2020) also found that ISERs had low self-efficacy with regards to diversity and inclusion. As this issue gains momentum in ISE, it bears study to better understand ISER agency with regards to diversity and inclusion.

This work has revealed several aspects of ISER work and perspectives which shape their professional identity. It also has led us to several more questions that warrant further study. First, given the dynamic nature of both place and of identity, does an orientation towards place or content persist across a career or in different settings? If an ISER shifts working context from one that emphasizes place to one that privileges content, does their understanding of their work with students, teachers, and partners shift as well? Additionally, it would be useful to investigate whether these ISER groups hold different epistemologies, that is, whether there is a fundamental difference in how the three groups view knowledge and learning. For example, do they see learning as situated or as a linear process separated from context? Lastly, a fruitful area of related inquiry might be to explore whether these influences are present in non-K12 work done by ISERs. All of these areas of inquiry are likely to yield a greater understanding of both how ISERs teach and learn; knowledge of these practices and processes might also inform the development of effective partnerships with classroom educators.

Conclusion

Just as ISERs saw their knowledge and skills as complementary to that of teachers, we see their values, goals, and experiences also as complementary. This complementarity can be leveraged to improve both PD and practice across the STEM learning ecosystem (Allen, Brown, & Noam, 2020; Hecht & Crowley, 2020). For example, when providing PD opportunities to informal audiences, of which educators in this study reported a dearth, it would be wise to take into account the values (such as the importance of place or content or engaging hands-on instruction) of the ISERs and aligning instruction with them. The values that ISERs place on "doing science" which are so prominent in the context in which they work can be leveraged so that connections to not only the science and engineering practices of the NGSS (NRC, 2015) but to the cross-cutting concepts and disciplinary core ideas can help them move towards 3-D instruction that is congruent with their identity.

Establishing long-term partnerships between schools/districts and ISE providers can be informed by the research presented here. Well-constructed partnerships

which take into account the values and positioning of both sets of stakeholders would benefit ISers, teachers, and learners. Such partnerships can open up other possibilities for more meaningful engagement with the NGSS, and create opportunities for thoughtful connections between conceptual learning in the classroom and the field and community. Joint sustained PD that engages the positioning and values of both groups of educators in a community of practice (Lave & Wenger, 1991) can lead to a well-integrated learning ecosystem for students and their families. ISers' expertise fostering affective and motivational goals for a wide range of learners can provide mentoring for teachers who struggle with those matters.

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Appendix A. Sample codes with excerpts

Content Educators emphasize what they teach as important to their work		
Place-based ed	Educator emphasizes that their work is about place-based education, referring to it as a concept	I realized that place-based education, outdoor environmental education is really my passion. And it's two-fold. One is teachers are not taught to teach this way in pre-service teaching anymore - you're not taught to take students outside and those skills are not taught.
Science discipline	Educator emphasizes that their work is about a specific science discipline	I want them to be evangelists for nuclear science, especially at [University].
Career possibilities	Educator emphasizes that their work is about exposing students to career possibilities	it's still one of the things that I hoped would be accomplished in doing this is to introduce students to the idea that there are people who do real science outdoors in the environment, um, and that they have that they're important
Place Educators emphasize the place they work as key to their work		
Place - social	Educators mention social components of place as unique or meaningful	I started, you know, seeking out, uh, experts on campus who could do something that, that I could not... And I said, Hey, you make games. I got nuclear science, let's make a game. And now it exists... anybody can download it for free.
Place - Physical	Educators mention physical components of place as unique or meaningful	So I think the kids is like the main thing is just getting to see them learning, and see them so excited about being at the farm. And I think that's what, a place like the [Farm] itself is ... there's so much there that they don't get to see in their regular lives, but it's like so profound for them.
Value – Goals Their goals for student learning		
experience	Goal for student learning is for them to have a meaningful experience	Just having that that great introduction, where you have the gigantic elephant toothpastes experiment going off, or you see a butterfly emerging from the chrysalis for the first time. And knowing that you're doing science and that it's something cool, but just really having that really fun, kind of gateway experience into learning about all the different facets of it.

fun	Goal for student learning is for them to have fun	Okay, how do I view my program with students and the teachers, okay. Number one, they have to have fun. they'll remember more if they have fun... But this is an educational fun, this isn't recess fun. This isn't just time to run around and do whatever you want to do. This is a fun time for education.
fun and hands-on	Goal for student learning is for them to have fun and experience hands-on	if it's not fun and engaging, they won't retain the information. It's really the long and, the short of it is it, you know, it has to be exciting or they don't want to do it if it's too much like your typical classroom schoolwork
to connect to classroom	Goal for student learning is to connect ISE learning to classroom	Our dream is to be able to know what they're doing in the classroom, so we can really extend what they're doing in the classroom and not just make it like a tour of the farm, but like extend what they're doing.
Positioning –Work with teachers* What they do in their work with teachers and how they regard them		
developing relationships	In their work with teachers, they focus on building relationships with teachers	There are several [teachers] that I've had sort of long-term relationship, over the years, they've come to my program. They brought their students, we've done a variety of things with them and they have been really great evangelists for us.
disengaged	In their work with teachers, they have noticed some teachers are disengaged	the teachers aren't really paying attention to what I'm doing. So, so since they're not paying attention to what I'm doing, um, I just feel neutral about it. For the most part, those examples I gave of like the teacher, you know, talking about vocabulary in the classroom, bringing it back. That's, that's a very rare happening.
training	In their work with teachers, they do mostly teacher trainings	I train teachers on how to implement cross-curricular, um, watershed quality monitoring sixth grade through 12th grade format. So a lot of my stuff has to do with teacher training.