A Phenomenological Study of Teacher and Student Experience Within a Community of Inquiry: Utilizing Wonder-Infused Pedagogy in an Elementary Outdoor Classroom

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Abstract

This interpretive phenomenological study explores how wonder-infused pedagogy, enacted within an elementary outdoor classroom, supported the development of a community of inquiry. We position community of inquiry as the overarching framework for cultivating social, cognitive, and teaching presence; wonder as the pedagogical driver; and outdoor learning as the authentic context for engaging in science practices. In response to schooling contexts that often privilege testing and individual achievement over collaborative inquiry, we examined an eight-week outdoor wonder project with third- through fifth-grade students. Data sources included group interviews, student journals, teacher reflections, and photographs. Students engaged in weekly wonder journaling and culminated the project in a school-based wonder fair focused on self-selected scientific phenomena. Findings indicate that wonder-infused pedagogy fostered joyful struggle, collaborative sensemaking, and shared vulnerability, strengthening students' engagement in science practices and deepening classroom community. The teacher's intentional design and facilitation were central to sustaining open-ended inquiry. The project also extended discourse beyond the classroom, broadening the community of inquiry to include families and the wider school community.

Key Words: science education, outdoor learning, wonder, community of inquiry, phenomenology, pedagogy, learning, nature, environment

Introduction

This project utilizes wonder-infused pedagogy to build an effective community of inquiry as well as a pathway for engagement with science practices. More specifically, we examined how using open inquiry, driven by wonder, can support the development of a community of inquiry in an elementary outdoor learning context. We position community of inquiry as the overarching framework, wonder-infused pedagogy as the pedagogical driver, and outdoor learning as the setting that enables authentic engagement with science and one another.

Despite the documented benefits of inquiry-oriented and community-based science education, formal schooling often prioritizes standardized testing and individual achievement over collaborative, curiosity-driven learning (Bybee, 2020). This is not a new problem, as the continued focus on standardized testing in schools has a significant influence on the pedagogical choices teachers make in the classroom (Aydeniz & Southerland, 2012), and the culture of classrooms is not favorable towards implementing inquiry (DiBiase & McDonald, 2015). Elementary science contexts continue to focus on testing, which reduces time spent engaging in science practices and such 21st century skills as "creativity, critical thinking, collaboration, and communication" (Nahar, 2023, p. 36). We argue that enacting a community of inquiry responds to this problem as we explore how an outdoor inquiry project, framed through wonder, can support the community of inquiry to cultivate social, cognitive, and teaching presence in ways that work to center joy, agency, and authentic scientific engagement.

Our approach utilized student-driven wonder investigations, as children explored outdoor spaces adjacent to their school. During these excursions, students would look, notice, and observe various natural phenomena and then use their scientific wonderings as the basis for building hypotheses and investigating them for a classwide wonder fair. Through a phenomenological approach, we explored students' experiences engaging in wonder as they worked within a community of inquiry toward better understanding these wonders, and we also highlight the teacher's perceptions of the experience. The research question that guided our phenomenological inquiry was geared at understanding the lived experiences of students and the teacher who participated in scientific inquiry within the context of a community of inquiry: How do third- through fifth-grade students and their teacher experience science as a social activity, within a community of inquiry, while engaging in wonder?

Related Literature

Outdoor Learning as Wonder Laboratory

Rather than assuming a dichotomy between an indoor and outdoor educational setting, outdoor learning suggests that the curriculum can be contextualized by the natural, outdoor environment (Beames et al., 2024; Lee et al., 2022; Nikbay Arslantaş & Bavlı, 2022). Within science education, outdoor learning can complement science standards, such as the Next Generation Science Standards (NGSS) which frame an inquiry-based approach to school science, where the outdoors can be considered a living, local laboratory (2013). This becomes a vehicle for rich observations, student engagement, sensemaking, hypothesis building, and constructing arguments across science content and processes. This often-untapped resource of the school yard and the surrounding natural sites can be both a setting and source for engaging in authentic science approaches (Ferreira et al., 2012; Lindgren et al., 2023).

Outdoor learning not only provides a setting for science, but it also creates conditions in which the core practices of science can be meaningfully enacted. NGSS (2013) identified eight essential practices that encompass both the relevant knowledge and specific skills that students need to be actively engaged in science. These practices include: asking questions and defining problems; developing and using models; planning and carrying out investigations; analyzing and interpreting data; using mathematics and computational thinking; constructing explanations and designing solutions; engaging in argument from evidence; and obtaining, evaluating, and communicating information (NGSS, 2013, p. 1). The goal of these practices is to foster science as a way of understanding the world (Antink-Meyer & Meyer, 2016) and to put the intellectual work of science sensemaking in the domain of the student (Bismack et al., 2022). The outdoor setting provides ample opportunities to engage children in these key science practices.

The outdoors served as both a catalyst and a context for engaging children in their observed wonders through wonder-infused pedagogy. Wonder-infused pedagogy intentionally overlaps with tenets of inquiry, where a pedagogy of wonder begins with a phenomenon, noticing, or question, and the goal is for students to map out their thinking and understanding of the phenomenon through hypothesizing possibilities in order to connect learners emotionally, intuitively, and cognitively to the world that surrounds them (Conijn et al., 2021). This pedagogical approach has demonstrated promise for building: science content understanding (Hadzigeorgiou, 2022), joyful connections to content (Gilbert & Suh, 2026), and broad-based experience with scientific practices (Dean & Gilbert, 2021), while also using mystery as a driver for learning (Schinkel, 2017; 2019). Wonder "is connected to not knowing, wanting to know, getting to know, and everything in between. It is deeply emotional, but still bound to thinking" (Glăveanu, 2020, p. 22). These emotional connections to wondering can offer incentive to answer a question and provide the needed fortitude to overcome challenges even when it becomes difficult (Jaber & Hammer, 2016). Overall, the Greenwood School community was deeply committed to connecting its students to nature, which provided a rich context for this study (note: school name is a pseudonym).

School and Classroom Community

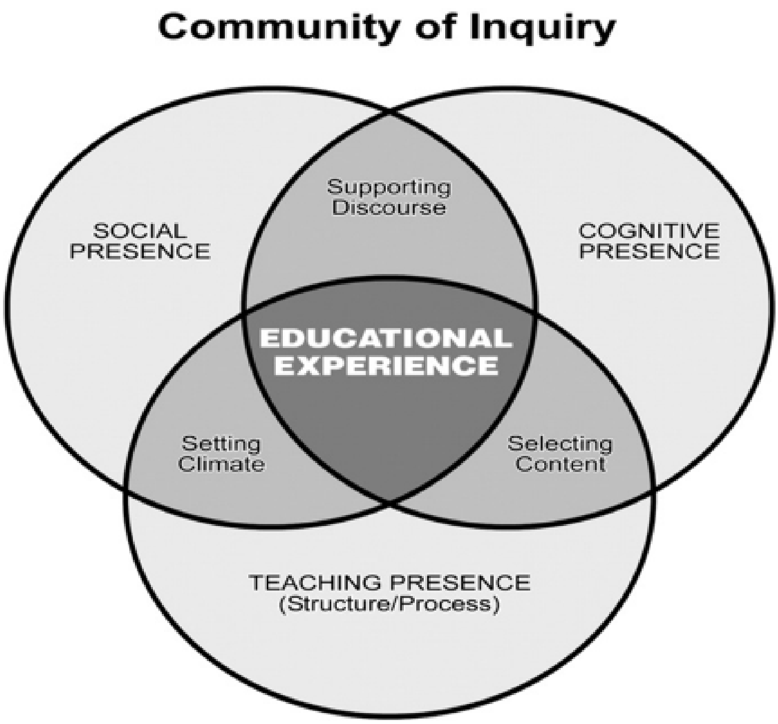
Broadly speaking, a school community represents not only a school—its students, teachers, and staff, but also is inclusive of families and others beyond the school walls, and it operates on shared educational values, expectations, and goals (Redding, 2001). All aspects of building healthy classroom communities are grounded in establishing positive and trusting relationships between all members of the classroom (Boyd & Edmiston, 2021). This trust, coupled with a respect for students' ability to ask questions and relate learning to their lives, is central to building a classroom community based in inquiry. This creates conditions that allow for risk-taking, problem-solving, failure, success, and ultimately engaging in the positive affect of the science process itself (Jaber & Hammer, 2016), where a direct link exists between positive emotions and increased cognition (Davidson et al., 2020; Huinker et al., 2020). The connection between classroom community and place was central to our efforts to construct a healthy risk-taking environment that connected children to their school and its natural surroundings.

Theoretical Framework – Community of Inquiry

Community of inquiry as a theoretical framework was originally designed for use with online teaching communities to tackle the challenge of building inquiry in online contexts (Ang et al., 2024; Garrison et al., 2010a). However, it has gained strength as a framework that provides similar theoretical clarity for face-to-face contexts (Ariati et al., 2023; Garrison, 2023). We utilized community of inquiry as a framework to map the multifaceted interactions needed to engage with challenging science content that is directly connected to students' lives and grounded within a constructivist dialogic process. Constructivism emphasizes that learners actively build understanding through experience, reflection, and social interaction (Dewey, 1938; Piaget, 1970). Articulating community of inquiry's constructivist underpinnings, Nichols et al. (2022) stated, "the process of the community of inquiry has a core intention to promote the skills and competencies to participate in the practices of discipline-based communities of inquiry and in that process take on the habits and behaviors of the disciplines" (p. 2528). Lastly, a community of inquiry can develop those 21st century skills, such as critical thinking and peer connection, that drive interaction during inquiry processes and can act to broaden knowledge and understanding across the group (Zeivots et al., 2024).

Community of inquiry, when enacted as part of a pedagogical process, leans heavily on tenets of inquiry teaching with scaffolded phases including a triggering event, exploration, integration, and resolution (Garrison et al., 2010b). Community of inquiry frames three key areas: social presence, cognitive presence, and teaching presence, which overlap and support the overarching educational experience of those involved in that classroom (see Figure 1).

Figure 1. Community of Inquiry Framework (Garrison et al., 2010a)



Social presence is framed across three dimensions in which participants identify within a specific community, are able to engage in dialogue with purpose and in a trusting environment, and work toward developing healthy interpersonal relationships (Garrison, 2010a). *Cognitive presence* relates to how participants engage with critical noticing, reflecting, and constructive collaboration to integrate problem-solving as a means to find a resolution to the content-based challenge they are facing (Ariati et al., 2023). *Teaching presence* pertains to the "design, facilitation, and direction" (Garrison et al., 2010a, p. 7) that the teacher creates within their classroom setting to build toward positive educational outcomes. *Teaching presence* utilizes cognitive and social issues to reach content goals while simultaneously supporting the development of classroom community (Ariati et al., 2023). The process we undertook was directly informed by Nichols et al. (2022), who utilized design thinking to engage students in scientific thinking and processes.

Research Design

Phenomenological Approach

Phenomenological research is grounded in philosophy and reflects a way of living, seeing, and being in the world (Vagle, 2018). Because phenomenology frames philosophy and methodology as inseparable, this study was guided by an interpretive (hermeneutic) phenomenological orientation (Clifden & Vagle, 2021). From this perspective, the goal is not to suspend interpretation but to thoughtfully engage it in order to illuminate the meanings embedded within lived experience.

Central to this inquiry was a commitment to approaching the phenomenon holistically while remaining attentive to the meanings that emerged through participants' *lifeworlds*—the prereflective, taken-for-granted world of lived experience through which individuals make sense of their everyday realities (van Manen, 1997). We sought to understand these experiences related to wonder, science, and community by examining both the phenomenon itself and how it manifested within students' everyday educational contexts (Clifden & Vagle, 2021). In this study, the phenomenon under investigation was the lifeworld of student scientists as they engaged with wonder within a shared community.

Consistent with interpretive phenomenology, we, as researchers, engaged in ongoing reflexive practices to critically consider how prior experiences, assumptions, and theoretical commitments shaped the research process (Vagle, 2018). Rather than attempting full bracketing, which is generally associated with transcendental phenomenology, we adopted a posture of reflective openness, meaning we continually questioned our interpretations while remaining focused on participants' meaning-making. This iterative movement between parts and whole supported phenomenological reduction as a process of deepening attentiveness to the phenomenon rather than a procedural step.

Phenomenological reflection guided our analysis as we engaged in sustained, thoughtful examination of participants' descriptions to discern the essential themes that give the experience its distinctive character (van Manen, 1997). Through reflective reading and writing, we sought to distinguish essential meanings from those that are incidental. Across data collection, analysis, and representation, our research team remained oriented toward illuminating the nature of students' lived experience rather than producing abstract generalizations.

Context of the Study

Students at Greenwood School (pseudonym), a private K–8 school in a suburban context, participated in an eight-week wonder project embedded within a weekly outdoor enrichment block. During this time, classroom teachers facilitated rotating stations centered on disciplines such as literacy, art, and STEM (science, technology, engineering, math). Students were intentionally grouped across grade levels (third through fifth grade), with an average group size of approximately 15, and rotated through the stations each week. One station was dedicated to the wonder project, during which students explored the natural area surrounding the school and completed a wonder journal entry guided by a Greenwood teacher. Thus, this was both a shared experience within the mixed-grade learning community, but also one where students were encouraged to think about their individual wonderings, sharing those with classmates throughout the process. Students were encouraged to spend time sitting in nature, noticing the world around them, and leaning into wonder-filled experiences. Independent wonder journaling was a way for them to record their observed wonders through sketches, poems, questions, or other approaches that they chose. There were some teacher scaffoldings as part of this process; students could choose to respond to the teacher's idea (e.g., "Lay on your stomach and wonder about something on the ground"), or they could decide to wonder about whatever fascinated them. Although the wonder journaling activity was, by nature, an independent task, students were never discouraged from talking to their peers during these sessions. At the conclusion of the time, the teacher brought the students together in groups of 10–15 to share, discuss, and celebrate their wonders.

At the end of six weeks of wonder journaling, students developed wonder fair projects and shared them in a gallery-walk presentation during the outdoor enrichment block. The wonder fair process leans heavily on the goals and processes of standard science fairs; however, all aspects were completed in school to lessen stress and decrease pressure on families (Fields et al., 2022). The students would begin by choosing one of their wonders to further explore, either working alone, with a partner, or in a group. Students were able to choose their partner options as well as which scientific phenomenon they wanted to investigate. They did not have to go through a traditional science fair procedure or engage in experimental design; rather, students would consider various ways to explore their questions, coming up with possibilities for scientific investigations. The wonder fair was designed to be open-ended, allowing students to take on the role of scientists, freely examining a natural phenomenon that filled them with wonder. One requirement of the wonder fair, however, was a visual poster board that would highlight the wonder. The teacher encouraged them to share background information, such as their choice of wonder's impetus, as well as how they could possibly investigate it. Some students decided to participate in a formal inquiry, but this was not compulsory. Overall, these processes parallel standard science fairs by providing an opportunity to ask questions, collect data, analyze findings, and present in a public forum (Banilower et al., 2018; Fields et al., 2022). This context frames the examination of how children engaged within a community of inquiry and documents the lived experiences of the students and teacher who participated in the wonder project.

Data Collection

We received Institutional Review Board approval prior to data collection, and 20 students received parental consent to participate. Additionally, we asked our students to give their verbal assent as well, agreeing to be part of the group interviews or have their journals formally analyzed. Data were collected throughout the eight-week wonder project process, with the primary form of data being the student group interviews conducted at the end. When the wonder fair had concluded, a total of 20 students were interviewed, mirroring the broader student population of 45 students involved in the wonder project. Author 1 interviewed student participants in groups of three to five, and each interview lasted around 30–45 minutes. These group interviews sought to solicit understanding regarding the lived experiences of the children; questions centered on describing the wonder project, discussing what it was like, and giving illustrative examples.

These group interviews had various benefits that became evident throughout the data collection process. First, they helped mitigate the power differential between the adult researchers and the young students (see Eder & Fingerson, 2003). The group interviews also enabled students to engage in a dynamic and interactive dialogue regarding the wonder project, and this, in and of itself, contributed towards understanding science as a shared social experience. The group served as a small community, a microcosm of the broader science community that students experienced throughout the course of the study. This is similar to what Vaughn et al. (1996) describe as a key reason to use group interviews: it allows participants to collectively explore an idea within context. We found this to be the case in our own study setting. Finally, the group interviews were simply more feasible for teachers at the school to schedule, allowing students from the same class to participate at the same time. Although the group interview transcripts were our primary source of data, we also analyzed the wonder journals from the students, photos of the wonder fair, and the facilitating teacher's reflective journal that she kept during the duration of the wonder project.

Data Analysis

Gathering together all the data, we were intentional about analyzing it as a whole, staying true to our phenomenological approach. Both authors read through the interview transcripts and teacher reflective journal, using the accompanying photos as a powerful form of visual data, and efforts were made to triangulate data across these sources as a means to support claims. We reflexively discussed our personal observations and wonderings regarding the lived experiences of our participants as they participated in a community of inquiry, engaging in shared social experiences related to science. Both authors then reread the data, highlighting portions that specifically pertained to what it was like for the students and teachers to participate in a community of scientists, using our research question to guide the process. It was at this point that we noted how powerful the student group interviews were in building upon these community experiences; students were re-living and re-experiencing the wonder project collaboratively and supporting each other's sensemaking. These moments were noted in the documents and considered part of the broader analysis.

As a research team, we met together again and collaboratively worked with our raw data. As we identified emergent codes, we worked to place them into the three key areas of community of inquiry: social presence, cognitive presence, and teaching presence. In taking into account the holistic data set as well as the individual pieces, we then went back and forth to determine the themes, or "meaning units" (Giorgi, 2009) that represented the broader educational experience of the students and teacher. This part of the analysis process included ways that we could consider the data through the framework of community of inquiry while still allowing opportunities for new meaning to develop, as evidenced by participants' lived experiences. We also analyzed the photographs from the wonder project, agreeing with Cleland et al. (2021) that "photographs can provide new ways of seeing the phenomena under study from their visual features" (p. 233). This visual data illuminated the phenomena in a new way, revealing the inner lifeworld of our participants (see Holm, 2008).

Findings and Discussion

We begin by presenting the findings and discussion organized according to the core elements of the community of inquiry framework: social presence, cognitive presence, and teaching presence. Within each element, we describe how the wonder project manifested, using evidence drawn from the data. We then turn to the overarching educational experience, highlighting the ways participants demonstrated intellectual engagement alongside joyful affect.

Social Presence – Discourse and Dialogue

Social presence is predicated on the ability to meaningfully engage with others and identify as part of the classroom community. The entire wonder project was social and collaborative in nature, and our participants discussed talking to other students about their wonder journal and wonder investigation. Although some students reported that it was challenging to communicate their thinking to their peers, they all were able to effectively articulate their science wonders. One student expressed how enjoyable it was to help her classmates comprehend her project on genetics:

> I thought the easy part was actually talking to the people about [my wonder]. I liked saying, "This is what I think. This is -." And getting them to understand, cuz they're seeing like, "Oh yeah, I get it now." I think that was the easy part and the fun part, too.

We noted a sense of confidence as other students described the wonder fair portion of the wonder project. Many students reported that discussing their scientific wonders was a highlight, since they had a chance to experience the back-and-forth discourse:

> It was fun to tell people about what we thought. They would come by and start wondering about it, and it was cool to see how they would wonder about it, 'cause sometimes you wonder about it a different way, and sometimes people just keep it in their mind and think about it.

This quote illustrates the scientific sensemaking that occurred within a community of inquiry as students participated in supporting discourse as a social activity. Jaber (2021) argued that this type of student sensemaking helps them gain insight into their own thinking and feelings as it relates to content. Further, dialogue serves as an essential process of sensemaking when building knowledge requires continued engagement with uncertainty and making that process public. This discourse went beyond the individual classrooms and included other grades within the school since the wonder fair included sharing their wonder with both younger and older students. This further fostered the community of inquiry both in the classroom setting as well as among the broader school community.

These discursive interactions were steeped in dialogic moments when children were able to interact in natural ways and they were not overly surveilled, providing the freedom to engage with one another during the wonder investigations. Brown (2019) provided clear examples for children's ways of speaking and talking that provide them with pathways to connecting their ideas to more formal scientific discourse and language. Consequently, the dialogue that occurred within the wonder project context became an avenue for connection within the community as well as for children's sensemaking in science. Interestingly, children also found this to be both challenging and enjoyable as they navigated their ideas within a public forum, as described by these students:

> For me, it was really fun. But it was also kinda confusing because people kept coming, and we had to, like, say it over and over again. But I thought it was really cool what other people were, uh, wondering about, and, uh, yeah, what they did.

The essential aspect here is that this process provided students with experience in communicating ideas and hypotheses, which is a key science practice. Most children framed this as a challenging aspect, but also one that ultimately brought them joy.

In addition, the community served as a safe space for children to engage with the ideas of self and others. The wonder project offered a counterpoint to many features of 21st century schooling, which often overprioritizes testing and low-level knowledge acquisition—approaches that may not fully support the development of social presence. Conversely, the wonder fair provided the participants opportunities to identify with the community and communicate in a trusting context, which helped to support and strengthen the community of inquiry:

> I also liked the Wonder Fair, but for some different reasons. I liked it because you got to see what other people are wondering about [two other students make the "me too" sign with their hands]…that you get to actually see what other people are wondering about.

Social situations that allow children to wrestle with uncertainty and allow for channels to share that uncertainty in a public setting build trust and set conditions for risk-taking within science learning (Krist, 2020). In addition, we found that the shared vulnerability children experienced during the wonder fair—where they publicly articulated an idea that they were working through—fueled connection across the peer group. Getting to see what others were thinking was a powerful way to connect children and provide them with confidence to share their own thinking in a public context. These aspects of social presence set the context for students to further engage in meaningful science practices and processes that we framed as cognitive presence with the community of inquiry framework.

Cognitive Presence

Science Decisions and Practices

Cognitive presence works to build and maintain understanding through sustained discussion and discourse within a community. Throughout the wonder project process, our participants experienced science as a discursive practice (Brown, 2019; Kelly et al., 2023) that framed the mental processes that they undertook related to their wondering. Although the wonder journaling was an independent activity, students regularly shared their wonders and took part in asking questions and planning investigations and engaging in meaningful discussions as a means to better understand the world around them. For the wonder fair, students had a choice of whether they worked alone, with a partner, or with a group of three. Some student participants reported the challenge of making decisions collaboratively and the challenges of selecting content:

> It took us so long to figure out which question we were going to do, because we were like, "Oh, what if we do this question?" But we can't really solve that. And then, we knew that we wanted to solve it. So it was kind of hard to find a question that we could solve.

This quote was reflected by other students during the group interviews, as many expressed the challenges with working collaboratively, particularly when it comes to making decisions. Students had to engage in high-level thinking, working through the challenges of being part of a science team.

Although the teacher was not intentional about explicitly including the science practices within the wonder project, we noted that it became a natural part of the community of inquiry in which students took part. Given authentic opportunities to wonder and explore these wonders and the appropriate teacher scaffolds, students had educational experiences that were embedded in science practices. These moments of engaging in science practices were experienced within community rather than as an individual. One student explained how enjoyable it was for him to be part of a team as a means to drive his cognition that helped him solve his wonder:

> I really liked doing the wonder fair because, number one, we got to do stuff in teams, which I think is really cool, 'cause I feel I do better in teams. And we got to really see how we could, if we could solve this problem.

These experiences were situated and sustained within a community of inquiry and rooted within their ongoing wonder investigations, where this sustained reflection and discourse fueled connections between class members and created the conditions that, when struggling to make sense of their ideas, were also an avenue toward joyful engagement with content and one another.

Joyful Connection to Self, Others, and Content

Students continually engaged in a process of inquiry as they shared their thinking, listened to others' ideas, and asked meaningful questions while they constructed their wonder projects and shared those publicly at the wonder fair. This sustained critical discourse lies at the heart of engaging in cognitive presence, and the students also framed this as both a difficult yet joyful pursuit. Students articulated how they approached novel problems, how communication grew their understanding, and that there were challenges in conveying their ideas to the larger learning community.

Teachers and researchers do not often equate struggle with joy. However, in the sciences, there is distinct joy in facing the difficulties and overcoming hurdles when figuring out solutions to wondrous questions and problems (Feynman, 1999). The students described both the challenges and the subsequent joy of wrestling with those ideas alongside their group members:

> Well, I thought it was fun. It was pretty hard, because we had to write all of the words. And it was kind of hard to think about it, because we

> all had different opinions about stuff. So, we had to agree on something.

Here, we see a hallmark of scientific communication when children are learning how to listen to ideas and build toward a solution within a working group. This simultaneously worked to build their confidence in sharing their ideas as they worked toward consensus, which, although not a simple task, students found it a joyful process. They also found joy in the creative freedom that they experienced in preparing their display and presentations for the wonder fair. This joy seemed to stem from the autonomy that children were able to actualize within their work from the start of their outdoor wondering to their finished wonder fair project.

> The wonder fair. I liked tying everything that we learned up, learned up into this project. And we could pick what we liked, like which question we wanted to ask, and then we could—I just, we got together, we drew a poster, we thought about it, and we researched. And, it was really fun because—it was probably my favorite part!

Learning should be both a challenging and joyful process. We often overlook joy as an essential component of the school experience. The students framed their experience as one that was joyful, but also challenging, which directly aligns with Boaler's (2024) claims that the joy of discovery builds learners' confidence while simultaneously helping teachers understand and share their students' intellectual and emotional experiences. We cannot expect children to deeply engage with science and scientific principles if they are completely devoid of joyfulness. When third grade students describe the work of the project process as "really fun," they are more likely to engage in the learning process.

Teaching Presence

Admittedly, the teacher played an outsized role in designing and implementing this wonder approach as she worked to cultivate a community of inquiry through the interweaving of classroom/school community, wonder, and outdoor learning. She set, curated, and maintained the commitment to all of these parameters throughout the outdoor wonder project.

The teacher's reflective journal, interviews, and researcher observation field notes provided a lens to make sense of the teacher's decision-making processes and the resulting open-ended pedagogy that was employed throughout the experience. In one of her first entries, the teacher describes both her excitement and apprehension about the process:

> I think it's important to have freedom within the teaching/learning environment for kids to explore, learn, and be curious. That being said, I also appreciate routines and control, seeing the benefit of these within the classroom, whether in- or outdoors. The wonder project will inevitably mean that I give up control.…Giving up control is slightly uncomfortable, but I am dedicated to seeing where this goes and how it impacts my 3rd, 4th, and 5th grade students.

The teacher is clearly pushing her own boundaries and trusting in her students to engage with their thinking in positive ways. This trust sets the stage for children to ask their own questions. Behr and Rydzewski (2021) argue that if we want children to persist in pursuing answers to difficult questions, we must find pathways to reducing the stress and anxiety that school contexts typically inflict. Teachers must curate the conditions for wonder and provide the freedom for children to look, notice, and consider their own ideas. This was evident in her approach during the student time in the outdoor space. We witnessed her efforts to "give up control" and deal with her own discomfort to provide children with opportunities to explore and document their wonders within the natural areas of the school grounds.

The students at Greenwood School were used to being outdoors, and the wonder observation journal was introduced during that outdoor enrichment block. The teacher begins by providing notebooks to students and starting the discussion about wonder journaling, "We are going to try something new today [holding up her notebook]. We are going to spend some time looking around the woods and document what wonders we encounter." She then continues to ask children about the meaning of wonder, "What do I mean by wonder?" There are several students who eagerly respond:

- "A mystery you are trying to figure out."
- "Wonder is like amazing, it is more than curiosity."
- "Wonder is thinking about a question."
- "Wonder is an adventure."

The teacher follows this up with framing her own experience and how sometimes we can forget that our wonders are important to engage with. "I have been going to the woods for years, but sometimes I forget to look and wonder." With this introduction, the teacher, along with the students, framed what wonder can be, and the teacher provided the invitation for them to wander and wonder through this small patch of forest. Afterwards, students shared their wonders with one another. The teacher used this as a launching point for children to keep their journals and add entries for the things they wonder about as they observe the natural world in their day-to-day lives. Later that day, the teacher describes this observation in her reflective journal:

> Students seem more apt to share their out-of-school wonders during our weekly check-ins. During the first few weeks, only one or two students volunteered. Now, it seems like most students have a wondering that occurred outside of the typical weekly outdoor session. A third grader even brought me a leaf with a small honeycomb on it at the end of last week, excited for me to show it during our wondering times.

She continually curated and tended to the students' wonders and their opportunities to engage with their wonders, document those wonders, and collectively share those within the community of inquiry. Brown (2019) reminds us that teachers must develop a deep understanding of classroom cultures and language as the teacher both sets and maintains the norms for classroom discourse. Further, this teaching presence was essential to building student confidence in their ability to notice the natural world and that they have important questions to consider. These wonders became the basis for the questions they tried to answer for the wonder fair.

At the close of the project, the teacher reflected on the impacts that this had on the community of inquiry for her students as well as the children beyond her own classroom. For example, one of the first grade students was inspired by his experience while attending the wonder fair. He brought his poster into school to share with his teacher, who then had him present his ideas to our teacher. She wrote about this in her reflective teacher journal:

> He had come to school with a poster that included a wonder question, hypotheses (more than one), and some of his thoughts. I chatted with the student, who was really eager to walk me through the poster. He was wondering why his dogs were spotted. Some of his ideas had to do with diet or sun vs. shade. He shared that his main thought was related to the dogs' parents.

It is sometimes difficult for teachers to get children to follow their own questions since school has often trained children that there is one correct answer or that the teacher has a particular goal for the students to achieve. Feynman (1999) reminds us that the first step in any scientific pursuit begins by being uncertain of an answer. Uncertainty is the actual currency of science, yet schools often deem this as unproductive or overly frustrating for children, which may negatively impact achievement. However, we see here how building the capacity of students within a community of inquiry provides them the courage to pursue those questions that are not easily answered. Further, this provides evidence for the power of intentionally working to expand the community of inquiry beyond the classroom toward an entire school community.

Educational Experience at the Core of Community of Inquiry

Social, cognitive, and teaching presence work together to shape the overall educational experience within the community of inquiry. From our analysis of the phenomenological data related to these wonder experiences, two key themes emerged that were particularly relevant to understanding that educational experience: joyful struggle and the broader community of inquiry ecosystem.

Theme 1: Joyful Struggle

The joyful classroom context and the outdoors as a wonder laboratory worked to build the foundation for children to make more sense of the natural world and their own abilities in designing and carrying out investigations to their conclusion:

> Well, it kind of helps you open up your mind and realize, it's like, there are a lot of cool things. And it helps you figure out on your own…it helps get you ready for the world. It helps you figure out answers on your own.

This student describes her experience with this wonder project process as opening her mind and the realization that the world can be an amazing place. This noticing becomes the backdrop for her questions and ways to answer those questions. Lastly, we see her developing confidence as a science learner, coming into focus with "ready for the world" and "figure out answers on your own."

The wonder project was not an easy task for the participants, who worked through their ideas and needed to figure out where to start with their wonders. In focus group interviews, students described a range of emotions while engaging in this work that included descriptions such as: embarrassment, exciting, difficulty, enjoyable, fun, complicated, stressful, mysterious, and frustrating. Many of the struggles came from their collaborations and communicating with others within a team setting. The following is a response to a question about challenges they faced: "But I think that was probably the hardest part, getting our hypothesis, getting to agree on what we both think it was. And just agreeing in general [laughs] on everything."

In addition, they were working to bridge from wonders to testable questions for the wonder fair. This was an intentional teaching approach designed to use wonder and wonder approaches to build understanding of science practices. Wonder has been used in similar ways in public school contexts, where children's uncertainty was the basis for investigation to both build and answer testable questions (Gilbert, 2024). In order for students to find success in their pursuits, they had to refine the scope of their wonderings so they could develop questions that were both testable and conceptually clear:

> "Oh, what if we do this question?" But we can't really solve that. And then, we knew that we wanted to solve it. So it was kind of hard to find a question that we could solve.

This working toward testable ideas is a key element for scientists and often one of the more difficult tasks of framing hypotheses and building a testable question. The wonder project provided scaffolding for children to make this leap, and the result was that they were excited to engage in this approach. One student remarked, "I already had something in mind, so it was just already, really, let's do this. And I was already really excited to share." A different student remarked, "And we got to really, like, see how we could, if we could solve this problem." The excitement and joy came through in the solving of a difficult problem, much like Richard Feynman (1999) described in the *Pleasure of Finding Things Out*. This is at the core of most scientific endeavors, and that joy and eagerness come through in the voices of these students as they described their interactions with their ideas and other members of the community of inquiry. The noticing, hypothesizing, thinking, researching and experimenting, and sharing are all part and parcel of doing science practices, where the process is often a mix of joy, challenge, and frustration…just like science. Schools have leaned so heavily into assessing the cognitive that the joy is often lost or relegated to a few short weeks of the school year after testing is complete. We argue that there is both a place and a need for joyful struggle in schools.

It is essential to also point out that this is a joyful journey for the teacher as well. We see in the following quote from our teachers' reflective journal how this approach can also build up teachers' sense of worth for their pedagogy and desire to continue these types of approaches:

> Today was the Wonder Fair! It was so much fun and went very well. The kids were excited about it. I heard from some parents that their child had mentioned the Wonder Fair and how eager they were to share their wondering…There was so much energy!... They expressed

> how fun it was to share without the pressure typically accompanying the science fair….My heart is full, and I'm eager to do this again next year.

Joyful teaching is also something we need to consider to guard against teacher burnout as they navigate multiple issues and the complex terrain of teaching in the 21st century (Mielke, 2019). Finding joy in the challenge of teaching is also important if we expect teachers to bring their very best efforts into the classroom each day. Importantly, this excitement and enthusiasm have outsized impacts on the broader school community as well.

Theme 2: Broader Community of Inquiry Ecosystem

Over a third of participants reported conversations with their parents or siblings at home, and how their wondering became an avenue for discussion with their families. These conversations served to extend the discourse beyond the school setting and, in essence, broadened the community of inquiry to include families. As an example, a student shared her interactions with her father when asked in the group meetings what was one of the most interesting aspects of the work. She begins, "I think it was kind of fun… because we could tell our parents about it." She continues to describe the nature of these discussions with her father in more detail:

> Um, well, when I shared it with my dad, when I would ask him, when I would say one of my questions, then he would lead that with like another question. So then we just kind of sat around for like an hour just going through all my questions, and then he would answer with a question, and then I would answer that question, and then he would give me another question.

The wonders and wondering never completely stopped at the classroom door. The community of inquiry evolved to move past the single classroom to include other grade levels, teachers, and students' families. There is power in family science talk for student learning and openness to future STEM-related opportunities (Dou et al., 2016). This was not an intentional goal of the teacher or the study, but this speaks to how the increased opportunities for science-related discourse can (and should) occur authentically in a way that further facilitates scientific inquiry through wonder and questioning.

There is a distinct lack of the centering joy in the learning process within 21st century schools, and this leads to frustration and lack of interest that can often culminate in a dislike of school for many children (Gilbert, 2024; Regan & Carroll, 2016). Interestingly, there is also a direct link between experiencing joyful affect in the learning process and increasing cognitive function and content understanding (Zhu et al., 2024). Utilizing wondrous approaches in the classroom context creates a less rigid, structured pedagogy with a focus on students following their questions that arise from their wondering. The wonder approach in an outdoor setting provided the canvas for the teacher to both construct and maintain the community of inquiry, which brought joyful affect to the students and drove positive experiences with science content as well as science and engineering practices. Less structured environments enable children to find a degree of agency and engage in a different type of science experience (Dou et al., 2019). The teacher was able to curate a less structured environment using wonder and the outdoors that led to positive engagement with science and the community of inquiry, which led to their broader engagement with peers, parents, and siblings.

Increasing familial participation in science-related discursive practices can have positive impacts on science identity formation and pursuing science further in formal learning and careers (Dou et al., 2019). Although not an intent of the project, children recounted in many ways that the work they were doing in class was the catalyst for discussing their thoughts and ideas with their families. In essence, the wonder project became a conduit for families to engage with their *funds of knowledge*, whereby families' cultural and historical ways of knowing and doing STEM are valued as important starting places for engaging youth with content and phenomena (Calabrese Barton & Tan, 2009; González et al., 2005). This facilitates families as STEM learners and doers through the lens of agency, as they "determine what forms of knowledge are valued and what practices of knowledge building are appropriate" (Goldman et al., 2021, p. 626). This approach helps families embody the joy of playful engagement with STEM problem-solving (Goldman et al., 2021). This positive affect is often an underutilized aspect for engaging diverse participants in STEM (Dean & Gilbert, 2021). Extending the community of inquiry to include students' families reflects a broader community of inquiry which exists beyond the population of the classroom into a circle of community that includes both the school and family context. This comprehensive circle can serve to help students better understand that they have a place in science and, more broadly, STEM.

Often science teachers will argue that we must help children be more comfortable with science processes and content without emphasizing that part of science is dealing with the discomfort of uncertainty while working toward solutions (Dunkin, 2023). It is this discomfort—the experience of not knowing—that students must become accustomed to as they learn how to move forward in their thinking. Although there is limited research in this area, Krist (2020) identified three categories of vulnerability that comprise "trust-building processes" (p. 273): displaying intellectual uncertainty, a willingness to revise an idea that renders that understanding as tentative, and going public with those ideas. In our study, engaging in shared vulnerability provided a fruitful context for children to build each other up and develop their own content-related confidence. This sent the message to students that it is okay for them to feel discomfort when exploring, thinking about, and communicating new ideas. Consequently, working through their unease about sharing ideas in a public forum was essential in developing the scientific practice of communication.

Implications

Findings from this project have distinct implications for classroom pedagogy. Schools rarely engage with children's questions, particularly those that are open-ended or exploratory (Glăveanu, 2020); yet these are precisely the types of questions that most authentically engage students in scientific practice (Feynman, 1999). We found that a community of inquiry steeped in wonder-infused pedagogy, situated in the outdoors, provided a pathway to epistemic affect (Jaber & Hammer, 2016). This allowed children to get a sense for how scientists connect emotionally with their work. These help us envision pedagogical approaches that can serve as an antidote to the rising tide of anxiety in 21st century schools as called for by Kiviranta et al. (2024). This study provided further support for the power of enacting a community of inquiry within a face-to-face context (Ariati et al., 2023; Garrison, 2023).

A major contribution of this work is the power for developing shared vulnerability as a means to both engage children deeply in meaningful science as well as forge resilience toward enacting the science practices of questioning, data collection, hypothesizing, and communicating ideas in a supportive environment (Krist, 2020). Conversely, traditional science contexts have worked to restrict access based on gender and race (Harding, 2023; Kelly et al., 2023). This move away from science as an exclusionary practice to one that centers emotion, care, and wonder expands children's vision of who can do science as well as their place within it. More research is needed surrounding shared vulnerability and its potential in science learning, as well as exploring these factors in different educational settings and outdoor contexts, which could add important insights for the field. We argue that a well-developed community of inquiry is an essential context that offers a safe space for children to engage in these efforts.

Limitations

As a research team, we worked to create a detailed phenomenological investigation to better understand the lived experiences of participants pursuing wonders in the outdoors while immersed in a community of inquiry. However, there are some key limitations in the work that need to be considered when thinking about the impacts of this endeavor: the sample size of 20 students with limited diversity (race/ethnicity, socioeconomic status, etc.), and carried out in a private school context. While these factors constrain transferability, the findings may be applicable to other elementary contexts, particularly schools that prioritize outdoor education. This school's setting, next to an accessible wooded area and a large grassy field, may not exist in differing contexts. This may require creativity for teachers and researchers who wish to carry such endeavors out in more urban contexts, such as creating a school garden (Ferreira et al., 2012), simply using any small landscaped areas of the school yard (Feille, 2021), or engaging in gray spaces (parking lots, market squares, alleyways, etc.) that may not traditionally be considered for exploration (Zhang, 2024). Lastly, we also acknowledge that phenomenology itself relies on the interpretations of the researchers who work to triangulate data across sources and continually reflect and discuss our interpretations as a research team. There was also an outsized role of the teacher in this process to model wondering and build enthusiasm for the outdoors, such that the teacher's energy and commitment were vital to the success of this approach.

Conclusions

We argue the findings from this effort point to the value of both working within a community of inquiry and the powerful role that these conditions can play in the lives of young people. This is of particular importance within the current context of increasing youth anxiety and decreasing time spent outdoors (Kiviranta et al., 2024). The time spent wondering and wandering in the outdoors worked as a restorative, regenerative process that ultimately brought joyful connection to science content and to one another within this community context. Equally important were the connections to the practices of science that drew children into a community of inquiry (Garrison, 2010a). Students experienced science as an interactive social process where ideas were honed through collaboration, discourse, and dialogue (social presence). There was a distinct element of joy that was expressed during the sensemaking process as students wrestled with uncertainty, made decisions, designed approaches, and made conclusions based on their efforts within scientific inquiry and their understanding of their wonder (cognitive presence). This was coupled with an enthusiastic teacher who was willing and able to have children take charge of their own learning and sensemaking processes (teaching presence). She curated student experience with their observed wonders and built opportunities for engaging across the classroom community. We see how elements of the community of inquiry provided a context for supportive discourse, while selecting content and an outdoor setting all worked in concert to frame the overall educational experience. Ultimately, two key aspects arose as part of the students' broader educational experience: joyful struggle and expanding the community of inquiry into their homes and families. Building diverse families as epistemic agents will have profound impacts to realize the potential and promise of their cultural, familial, and linguistic resources when they are invited to bring those to bear in STEM contexts. We also contend that, although you could do this approach indoors, by engaging with phenomena and building wonders, the use of the outdoors provides a key setting. The regular outdoor engagement was a motivating factor for children and one that decreased anxiety and increased connection between members of the class in a low-stakes environment. This process also brought joyful engagement with content that offered motivation for children to continue working toward solutions even when the answers were unclear. Ultimately, the maintenance of this community of inquiry provided a context for enacting science as a shared, social, and community-driven process, which also demonstrated the power and possibility of utilizing the outdoors as a wonder laboratory.

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