

INTEGRATING ART INTO STEM: AN INTERSUBJECTIVE AND PARTICIPATORY EXPERIENCE WITH FELLOW SUBJECTS

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Abstract

Integrating artistic practice into STEM to create STEAM offers learners intersubjective experience with subjects they study. This contrasts with traditional STEM education which upholds an ontological belief in human separation from the world they observe. This ontological separation justifies the absence of ethical considerations towards those subjects we study. In the context of our environmental crisis, this is problematic because humans are neither separate nor free from ethical ties to those we study. Rather, we are dependent on those who spark our curiosity and sustain our lives. Integrating artistic practices such as oil painting into STEM education brings intersubjectivity into scientific learning. Creating art depends on treating our affective and embodied responses to subjects as valid data and sources of knowledge. This brings learners into dialogue with fellow subjects and shifts from a traditionally objectifying stance towards one of kinship. The author demonstrates her embodied dialogue with a wild doe through various stages of painting an image of the doe onto plywood. Her creative process shows a participatory relationship arising between herself as researcher and the doe, her fellow subject. Throughout the painting's development, diverse subjectivities emerge, including the doe, the plywood and the author, creating a participatory collaboration and an intersubjective experience. This article draws on David Abram's and Goethe's theories of participatory observation and embodied knowledge of 18th-century artisans.

keywords: Artistic practice, Oil painting, STEM, Intersubjectivity, Animal, Plywood, David Abram, Goethe.

Introduction

Traditional STEM education teaches that humans are separate and unrestricted by ethical considerations towards the world they study. In the context of our environmental crisis, this is a problem. Humans are neither separate nor free from ethical ties towards those we study. Instead, we are dependent upon and beholden to the world that sustains us. Notions of scientific objectivity and detachment are false conceits that need rethinking. Integrating relational, subjective and ethical considerations into STEM education offers learners intersubjective experiences and empathy towards their subjects.

Artistic practices such as writing and oil painting are subjective, intersubjective and affective experiences. These experiences forge relational connections with others, including those we study. The artist taps into feelings arising during the creative process. Attuning to my affective response while making art creates space to be in dialogue with my fellow subject. Through dialogue, I shift from objectifying those who interest me as passive objects towards being in community with them as fellow subjects. This shift offers potential for kinship with other subjects. Kinship implies *we* instead of *me as objective scientist* observing a passive object. A kinship ontology implies I have obligations towards my kin, my fellow subjects, including those I seek to understand through science. While traditional STEM education separates learners from the world we study, art involves us personally and affectively, offering us intersubjective experiences with our fellow beings. Thus, given our current ecological crisis, integrating artistic practice into STEM to create STEAM makes good pedagogical sense.

As artist-author of this paper, I demonstrate my dialogic embodied conversation with a wild doe I encountered in June 2022. This process is illustrated through various stages of a painting in progress (see Figures 1-5).

Figure 1. *A Wild Doe Emerges as A Fellow Subject Through the Artistic Practice of Oil Painting. Oil On Plywood, 24 X 20 Inches, 2023. Painting By Author.*



My creative process shows a participatory relationship arising between myself, as I seek to understand my fellow subject, the wild doe. Throughout the painting's development, diverse subjectivities emerge, including the doe, the plywood and myself, giving rise to an intersubjective experience for myself and possibly others with whom I'm in dialogue. While participation, intersubjectivity and embodied knowing are integral to artistic creation, these qualities are not recognized in traditional STEM education. However, examples of these qualities exist in particular pockets of Western epistemology. Three examples are discussed below.

Participatory Observation, Intersubjectivity and Embodied Knowing: Goethe's Delicate Empiricism, Abram's Phenomenology and Artisanal Embodied Epistemology

Goethe's 18th-century epistemology recognized the reciprocal relationship between Goethe the scientist and the world he studied. Goethe coupled direct embodied experience in nature with careful observation. This coupling gave rise to a dynamic dialogic relationship between Goethe the scientist and the natural world he studied. When observing beings in nature such as animals and plants, Goethe perceived them as active participants in his experience of observation. For Goethe, this fostered empathy for those organisms, formed the basis for his participatory scientific method (Wahl, 2005, pp. 58–61).

While traditional STEM education relies on isolating phenomena, Goethe's method was to leave beings integrated and intact within their familiar context. This method was called "delicate empiricism." It enabled him to observe organisms functioning within whole ecological systems in which he saw himself as an active participant. Goethe often incorporated artistic practices such as drawing and poetry into his observations of nature. Goethe's epistemology, which included participatory observation, delicate empiricism and art, is an example of intersubjectivity in Western science. His use of intuition in his scientific method shares an element of intersubjectivity with artistic creation (Wahl, 2005, p. 58).

Similarly, phenomenologist David Abram emphasizes the embedded participatory role of observer within the world. He describes the "active interplay" between observer and fellow subjects (1997, p. 57). Abram's epistemology builds on phenomenological theories of earlier thinkers such as Husserl, Merleau-Ponty and Levy-Bruhl. He argues that Cartesian science, upon which traditional STEM education relies, falsely dualizes and separates scientist from her inner and outer worlds.

Cartesian dualism isolates the scientist's intellect from her body and from the world she studies. For Abram, these separations are mistaken. They deny integration of the human mind within the body, as well denying human dependence on our surrounding ecology. Like Goethe's participatory observation, Abram proposes that humans, including scientists, collaborate with fellow subjects in a subjective sentient world. He perceives reciprocal participation between the observer and the observed. This relational dialogue is an ongoing process that never stops. "Neither the perceiver nor the perceived, then, is wholly passive in the event of perception... since the act of perception is always open-ended and unfinished, we are never wholly locked into any particular instance of participation" (Abram, 1997, p. 53, 59). For Abram, making art is a way to forge reciprocal and collaborative relationships with our fellow subjects.

Genuine artistry... does not impose a wholly external form upon some ostensibly 'inert' matter, but rather allows the form to emerge from the participation and reciprocity between the artist and his materials, whether these materials be stones, or pigments, or spoken words (Abram, 1997, p. 288).

Themes of active participation and reciprocity that emerge in Goethe's and Abram's epistemologies resonate with the embodied knowledge of 18th-century artisans described by Smith (2004). Artisans work with their whole bodies, including their hands *and* minds which are located in the body, to create artifacts such as decorative art and tools. Smith argues that 18th-century artisanal knowledge represented an embodied epistemology of nature, a way of understanding the world through physical contact with the world.

For artisans, experience and the production of things were bound up with their own bodies... they articulated in their writings and in their works of art a view that certainty is located in matter and nature and that knowledge can be gained by observing and experiencing—often by bodily struggle—the particularity of nature (Smith, 2004, p. 6).

Dominant 18th-century European ontology dualized mind over matter. Mental cognition was held in higher esteem than embodied knowledge. Because artisans worked with their hands and bodies, their work was regarded as lower status than abstract cognitive work (Smith, 2004). However, as 18th-century artisans took on increasing commissions from wealthy patrons, their embodied knowledge and skills gained increasing respect (Smith, 2004, p. 8).

The embodied nature of 18th-century artisanal epistemology resonates with Goethe's participatory observation and Abram's phenomenology. Artisanal knowledge was developed *only* through direct embodied experience. "We can find in their works both epistemological claims—what I call the "artisanal epistemology"—as well as a vernacular "science" of matter" (Smith, 2004, p. 8). Integrating embodied, artisanal and artistic practice into STEM brings embodied epistemology into dialogue with traditional scientific epistemology. This confluence taps into what Smith calls artisanal "non-verbal literacy" and "material language" offered by embodied artistic practices (Smith, p. 8, 2004).

Integrating Art into STEM To Make STEAM

Educators recognize that artistic practice enhances creativity and problem solving and builds cognitive and social skills. Integrating art into STEM improves student engagement, innovation and collaboration (Perignat & Katz-Buonincontro, 2019, pp. 31–32). The reasons behind art's benefits to cognitive processes and skills are unclear since artists' methods are not easily measured, observed or quantifiable. Artistic knowledge arrives through intuition and embodied processes while making art; not looking at art or thinking about art, but *doing* it with our hands, bodies and inner emotions. These qualities involve us in a reflexive dialogue with our fellow subjects we seek to understand.

Writing scholar Elizabeth Adams St. Pierre writes about how “fugitive, fleeting” knowledge arrives *only through* the embodied and affective experiences of writing.

These data were neither in my interview transcripts nor in my field notes where data are supposed to be, for how can one textualize everything one thinks and senses in the course of a study? But they were always already in my mind and body, and they cropped up unexpectedly and fittingly in my writing—fugitive, fleeting data that were excessive and out-of-category. My point here is that these data might have escaped entirely if I had not *written*; they were collected *only in the writing* (Richardson & St. Pierre, 2011, p. 829, emphasis in original).

St. Pierre’s claim about writing as an embodied portal to knowledge can be transposed to other artistic practices such as oil painting. In exploring the intersection between art and traditional STEM education, I engage with a wild doe through my creative practice of oil painting and through consulting scientific texts about the doe’s physiology and adaptation to her native environment. I painted on scrap plywood found on the Francis Peninsula, B.C., close to my encounter with the doe (Figure 1).

Plywood: Dialogue with Ancient STEM Technology

Plywood is an ancient technology developed by ancient Egyptians and Greeks. They found that by placing thin layers of wood together at 90-degree angles and adhering them together, a building material stronger than solid wood was created for building and decoration. This was particularly useful in areas where wood was scarce (“Plywood,” 2023). Still used today, this ancient STEM technology beautifully exemplifies the intersection of science, technology, and the natural more-than-human world. Plywood’s material is earthen. Each layer, or ply, demonstrates organic processes that supported trees’ absorption of water, nutrients and light, including seasonal cycles and rainfall. The technology is human and embodied; made of thin layers of wood, the whorls on plywood’s surface are trees’ seasonal three-dimensional growth rings flattened into two dimensions (Figure 2). By painting on this technical organic material, I integrate ancient STEM with art and more-than-human processes such seasonal change.

Figure 2. *Whorls And Knots Indicate Seasonal Growth Rings On Plywood*



Scientific Data Objectifies the World

Before beginning my painting, I consult scientific texts to learn about the doe's physiology, behavior and adaptation to her environment. White patches on her belly, neck and legs distinguish her as a Coast Deer, also known as a Columbian Blacktail. She's subspecies of the Blacktail Deer (Grzimek, 1973, McTaggart Cowan & Guiguet, 1978, p. 366). She eats succulents and swims between islands off the B.C. coast. Further scientific facts:

Weights of adult males *including viscera* may vary from 110 to 250 pounds; females 70 to 140 pounds, fawns at birth 3 to 6 pounds; *deduct one-fifth for dressed weight* (McTaggart Cowan & Guiguet, 1978, p. 367, emphases added to original).

Bucks castrated after the eighth month develop permanent misshapen antlers that do not lose the velvet (McTaggart Cowan & Guiguet, 1978, p. 368).

These scientific metrics objectify the deer. They deny an ethical obligation to respect her innate right to exist outside of scientific fact finding. Do we really need to know what happens to a buck's antlers after he is mutilated through castration? This false assumption of scientific detachment contributes to our ontological crisis of separation from Earth's creatures, our fellow subjects. Introducing artistic practice into scientific research allows us to relate to those we study. It invites us to recognize fellow subjects as agentic, sentient and worthy of ethical consideration.

Entering Into Conversation with A Fellow Subject

Instead of objectifying those we study, queer theorist Halberstam invites us to become involved in conversation with them. “Conversation rather than mastery ... seems to offer one very concrete way of being in relation to another form of being and knowing without seeking to measure that life modality by the standards that are external to it” (2011, p. 12). Oil painting is akin to having a conversation with a fellow subject. Iterative, the artist responds to her subject taking shape over time. The doe prompts me to look at her gently, to not force her form into being. Her graceful form in the photograph asks me to keep my early sketching fluid and light-handed. The weathered plywood too implores me to paint lightly so that its hairline cracks, whorls and knots remain visible through the oil pigment (Figures 1-5).

Feelings arise within me as I observe the doe’s graceful relaxed form. Her resilience and dignity as a fellow being affect me. I feel myself moving towards her as she emerges. I want to honor her as a fellow being. She manages to survive and procreate in this coastal environment that’s increasingly encroached upon by suburban development (Figures 3, 4 and 5). Sketching the doe’s contours (Figures 3 and 4), I feel nervous I’ll fail to depict her grace and form. This feels dishonorable to this beautiful fellow being. I undergo an onto-epistemological shift through the painting process, which I detail below.

Artistic Practice Involves Surrendering What’s Known

I need to surrender what I *think* a doe looks like and refer back to the photograph I took in June 2022 during her tacit permission to be near her. Sketching multiple contours of her form, I struggle to get her posture right (Figure 3). I take a break from painting to pour myself a glass of water. As I re-approach the painting, I tell myself,

“you’re safe from perfection here; no one’s expecting anything from you. Relax. This isn’t serious. This is you, the doe and plywood. Take your time. *Slow down*. It’s going to be okay. There’s no right or wrong here.”

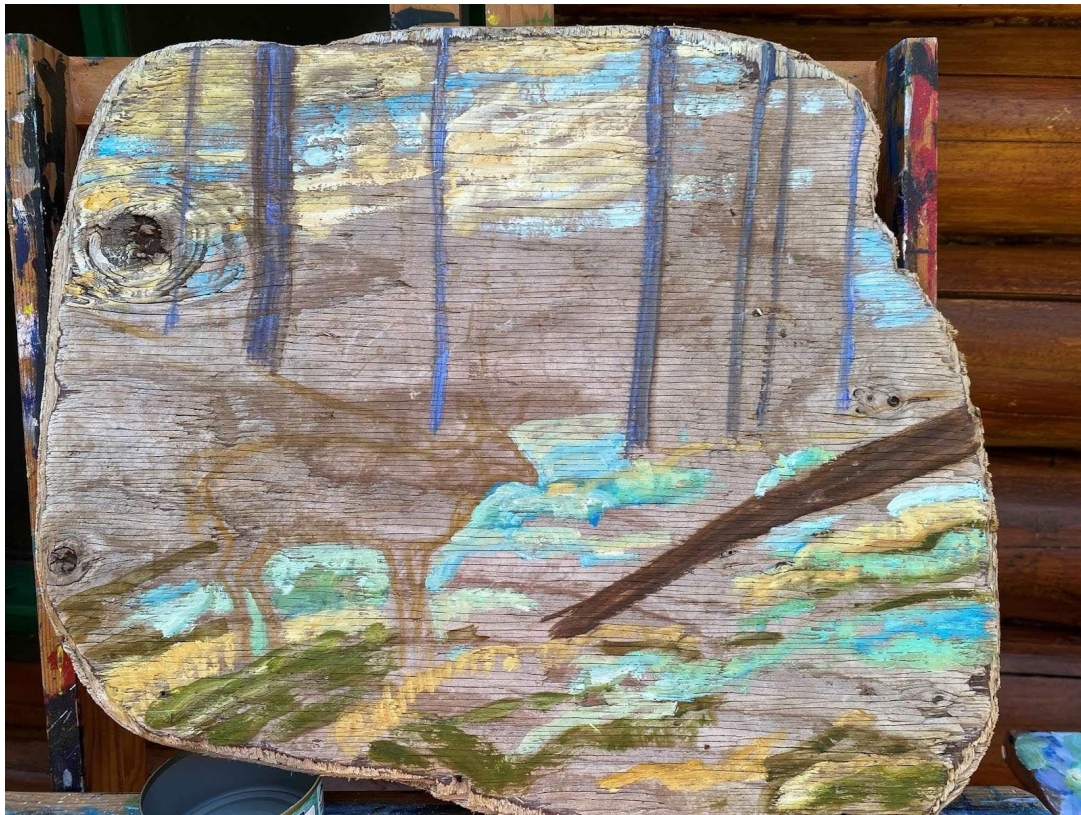
My self-soothing helps quell the encroaching feeling of inadequacy that’s creeping in while painting. This embodied sense of inadequacy is a common feature in my artistic process. I learn how to handle fear of failure through *doing* art. Not by looking at art or thinking about art, but by doing it, with my mind, body and feelings. Somehow, I come to understand more about the doe through my fear of failure coupled with my action of self-soothing. My contact with her emerging form pacifies these swirling insecurities. She speaks to me as she comes into being we’re in dialogue. She assures me I’m okay as a fellow being. She tells me I’m allowed to paint her because I respect her. This an intersubjective exchange between the doe and me.

Artistic Knowledge Arrives Through *Doing* Art

The drive towards precision and faithful rendering is a self-inflicted burden. I shake these unrealistic standards off like parasitic insects sucking my blood. This shrugging free comes only through the process of creating the painting of the doe. “There is so much more than the artist and the experience. There is the representation of that experience (and the materiality of that representation), as well as the *process of creation*” (Cutcher, 2007, p. 79, emphasis added to original). It’s in this process of creation that I perceive the doe as an active agent.

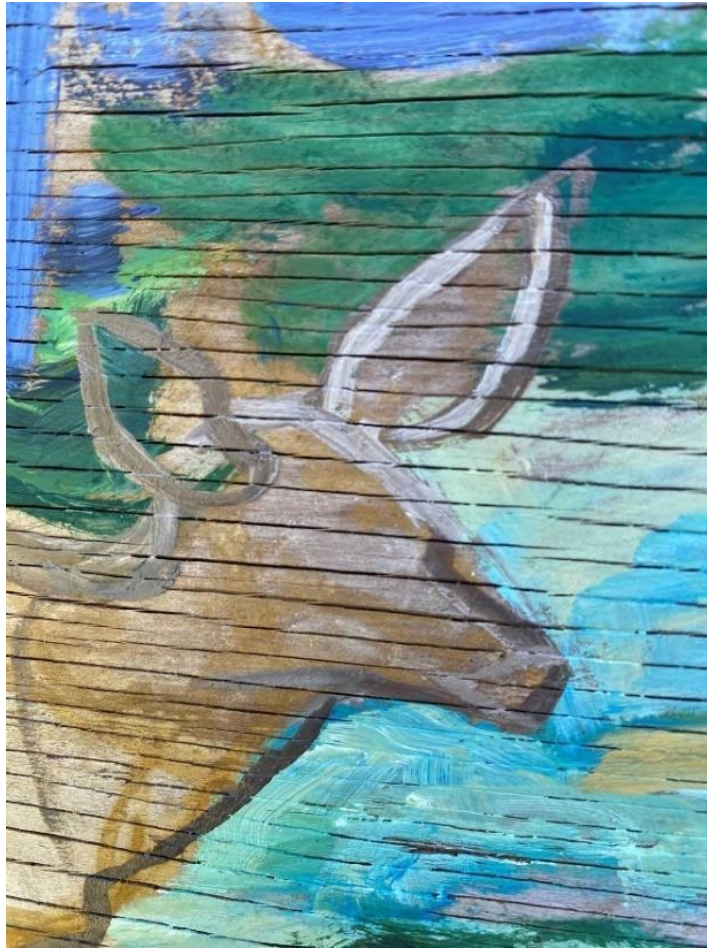
She is not a passive object provided by nature to me for detached scientific observation. No. I feel empathy for her as a fellow animal, a wild female creature who let me be near her despite having good reasons to mistrust me as a human. Exchanging the word ‘painting’ for ‘writing’ in St. Pierre’s earlier quote, “these data might have escaped [me] entirely if I had not *painted*; they were collected only in the *painting*” (adaptation of quote in Richardson & St. Pierre, 2011, p. 829, emphasis in original). Empathy is absent from traditional STEM education. How can we feel empathy for insentient objects from which we are separate and autonomous?

Figure 3. *While Sketching, I Feel Nervous About Failing To Depict The Wild Doe Respectfully*



The dry plywood pulls pigment thirstily from my brushes. The doe, the trees and ancient STEM look back at me as speaking subjects, reminding me I’m not the sole knowing subject in this process. My relationship with these subjects grows as our entangled collaborative project takes shape. I peer at the doe’s seemingly unconcerned expression. She reposed with me for 10 minutes, affirming I was no threat to her. I feel kinship with her as she emerges in Figures 3-5.

Figure 4. *Sketching The Doe's Head and Ears*



Note. Her large ears tell me she is prey to others and needs good hearing to survive.

The Experience of Intersubjectivity

The wood says, “My worldly travels are part of this painting. I want them to show up within the work.” I surrender to the more-than-human voice of the plywood and paint with soft brush strokes and minimal pigment. I don’t have to get this ‘right.’ What I need to do is show up, listen to the doe and the wood and follow what they’re asking me to do. We are collaborators co-creating this painting together.

Creating art relies on my embodied feelings as a valid source of knowledge. I come to know the doe as a subject rather than as an object observed from a distance. My transcendent feeling of kinship during my encounter with the doe echoes in my experience of painting her. I want to know her and be known by her as a fellow being.

Figure 5. *As the Doe Emerges, I Experience Intersubjectivity with Her As A Fellow Subject*



“We ache to meet the limit of the human world, and to look past it” (Giggs, 2021 as cited in Klinkenborg, 2021, p. 4). My artistic knowledge arrives independently of rational logic upon which traditional scientific inquiry depends. “Art-based methods [make] use of a larger spectrum of creative intelligence and communications, generate important information that often feels more accurate, original, and intelligent than more conventional descriptions” (McNiff, 2012, p. 30). I experience intersubjectivity between myself, the doe, and the wood. I have not created this painting (Figure 1) alone but with collaborators participating in the painting’s becoming.

Conclusion

Art validates embodied affective responses as reliable knowledge sources. It offers language where we often lack words to describe or quantify what we are sensing. Doing art extends our vocabulary, spoken and unspoken, relating to those whom we seek to understand. Art invites fellowship with subjects we study, potentially shifting our stance from separation to kinship with the world. This ontological shift draws on Goethe’s and Abram’s epistemologies of participatory observation where we ourselves are observed while observing others.

When doing art, we may gently retire Cartesian dualisms. Instead of gazing objectively at mute objects with which we have no relationship, we discover we are connected to these fellow subjects in myriad ways that move us affectively. Through the practice of oil painting, I experience my affective embodied involvement with multiple subjectivities such as the doe and the plywood. Integrating art into STEM invites humans, including scientists, to co-arise with our fellow subjects.

Gathering knowledge is not neutral but laden with relational and ethical implications towards those we seek to understand through scientific inquiry. Through oil painting, I undergo an intersubjective experience with the doe. Intersubjectivity is akin to Halberstam's conversation with fellow subjects rather than scientific mastery over mute objects. Our embodied affective responses to fellow subjects are critical to understanding our reliance and relationships with multiple subjectivities. Art reconnects us to ourselves, our bodies, feelings and fellow subjects. In the context of species extinction and the climate crisis, integrating art into STEM education is critical to raising ecological understanding, empathy and kinship among educators and learners.

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