

## Dialogues Without Words: Multispecies and Multimattered Creativity in Maker Education

Isabel Correa, Nathan Holbert, Blake Danzig, Lucius Von Joo  
mic2130@tc.columbia.edu, holbert@tc.columbia.edu, bpd2119@tc.columbia.edu, lav2111@tc.columbia.edu  
Teachers College, Columbia University

**Abstract:** In response to the tendency of making to control and harness the material world, we propose the ‘creative pluriverse,’ which can fit many worlds, as a framework to design and study the possibility of multispecies and multimattered creativity. We ground this concept in process philosophies, theories of embodied cognition, and ecological materialism to advance a posthumanist conception of creative making. Using a design-based research approach, we reimagine making, particularly biomaking with fungi, as a ‘dialogue without words’ that nurtures didactic tensions and relations between learners and other-than-human entities and elements. By examining a series of dialogues—between a boy, a tree, clay, and fungi—we observe instances of learning through multispecies creative production and discuss implications for learning design in hybrid pluriverse worlds.

*“Queremos un mundo donde quepan muchos mundos.”*  
*[We want a world where many worlds fit]. (Zapatista Movement, in Escobar, 2018, p. xvi)*

### Introduction: Makers, not masters

In the past few years, we have learned that viruses can jump from corralled animals into human bodies, that wildfires and rising seas know nothing about urban boundaries, and that human-made stuff now weighs more than all remaining living biomass (Elhacham et al., 2020). As the tensions between social, environmental, and technological forces grow and manifest at all scales, we wonder *what counts* as making and *who counts* as a maker in a world that seems to be making and unmaking itself. In times of human-nature fragmentation and reconfiguration, we explore how posthumanist and embodied lenses can help us make sense of maker education as a practice situated within the creative ebbs and flows of the earth.

Informed by constructionist pedagogies, we have explored how constructionist maker education provides students with opportunities to critically engage with social and environmental challenges in personally meaningful ways while gaining valuable knowledge and skills (Holbert, Dando, & Correa, 2020). Still, we are becoming increasingly aware of the subtle ways maker education reproduces the rhetoric of mastery and control that leads us to the same crisis we aim to confront. Contemporary maker education remains situated mainly in the modern imaginary of progress, growth, and innovation. The environmental crisis is acknowledged but framed as yet another technoscientific challenge for young minds in preparation for their future ahead (Kohtala & Hyysalo, 2015). Methodologically, most maker education initiatives leverage human-centered design and problem-solving frameworks for students to produce innovations that respond to immediate problems without questioning their root causes. In the meantime, the planet can barely keep up with the pace of human-centered innovation and its associated patterns of linear extraction, production, consumption, and disposal.

Although practices of recycling, upcycling, and repair are increasingly encouraged (Dew & Rosner, 2019), it is commonplace to give students open access to tools and materials to generate prototypes and artifacts that tend to be discarded as fast as they are produced (Song et al., 2019). It can be argued that the main purpose of rapid prototyping and tinkering with materials extend far beyond the innovation itself through the long-lasting learning gained in the process (Ratto, 2011). However, learning in these terms ignores planetary boundaries and reinforces anthropocentrism. Learners are situated at the center of the material world and in a position of relative power. This leads to a fundamental contradiction: We actively seek students’ empowerment; we ask them to problem-solve, figure-something-out, put-it-together. Yet, we feel increasingly powerless amid the magnitude of more-than-human forces disrupting everyday life. Are we unintentionally asking students to be masters knowing that humans can only be makers? How can we expect them to *harness* the material world when the most we can do is to humbly join its untamed flows of matter?

The narrative of the master is not unique to the social trend branded ‘maker movement’ and its patriarchal imaginary of the maker (Buechley, 2013; Vossoughi et al., 2016). Even in well-intended educational research, maker and master tend to get muddled when learners are seen above the rest of the world. Students are undoubtedly relevant, but they exist only in relation to a larger complex socio-ecological system, and the condition of this system will inevitably shape learning. Socio-cultural frames of constructionism call us to look beyond the learner

and consider learning as a “bidirectional” dialogue with artifacts, materials, spaces, and communities (Holbert, Berland, & Kafai, 2020, p. 9). The question then is how to credit all parts in this dialogue without resorting to listening only to the human voice. Posthumanist scholars argue that the problem of socio-constructivist paradigms is that, by assuming human-meaning making and discourse as the starting point of the construction of reality, we inevitably get caught in an *anthropocentric gaze* that obscures the active participation of other-than-human entities and elements (Alaimo & Hekman, 2008; Hultman & Lenz Taguchi, 2010). Rousell and colleagues (2022) note that the participation of materials gets constrained to the role of *resources* as they hold no value aside from imposed socio-cultural meanings. Furthermore, the participation of other living beings, and their idiosyncratic ways of meaning-making, are often ignored, silenced, or relegated as resources alongside other materials.

To make sense of our hybrid socio-techno-ecological world, several scholars in maker education (Keune & Peppler, 2019; Lemieux & Rowsell, 2020; Sheridan et al., 2020) and creativity (Chappell, 2018; 2022; Rousell et al., 2022) are looking into posthumanist frameworks. These perspectives emphasize how creativity and learning emerge from the enmeshment of people, materials, and artifacts through what Chappell (2018) describes as an “embodied dialogue” in which people and things are continuously “making and being made” (p. 282). Whereas most research has focused on foregrounding the participation of materials, objects, and technologies in making, we investigate the participation of other living beings in making with biology, also known as biomaking (Lui et al., 2019). We embrace a radical ontological and epistemological pluralism where humans and other-than-humans can coexist and create meaningfully through embodied dialogue.

In his book “Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds,” Escobar (2018) proposes an inclusive conception of design as world-making, a practice devoted to the creation of multiple ways of being and doing in attunement with the earth based on the radical interdependence of all beings. With the concept of pluriverse creativity, we aim to advance a multimattered and multispecies understanding of creative production that encompasses the unique ways in which all biotic and abiotic entities, in their different ways of being and doing, actively participate in the ongoing production of new worlds.

Creativity in the pluriverse shifts away from innovation and mobilize making towards lost meanings of creativity. To that end, we draw a theoretical framework from process philosophies, theories of embodied cognition, posthumanism, and ecological materialism. We then apply this framework to designing and implementing a biomaking program described as a “dialogue without words” in the methods section. Finally, we examine a series of dialogues—between a boy, a tree, clay, and fungi. We use this case to discuss instances of emerging learning through multispecies creative production and outline preliminary directions for a renewed understanding of creativity in maker education.

## Theoretical framework: Reclaiming pluriverse creativities

To move away from anthropocentric conceptions of maker education, we consider it necessary to reorient our practices toward creativity instead of innovation. However, as Rousell and colleagues (2022) observe, creativity and innovation are often treated as interchangeable concepts in education, emphasizing the latter. Except for recent deviations towards distributed (Glăveanu, 2014) and participatory (Clapp, 2016) models, the primary concern of creative research in education has been restricted to exceptional individuals and remarkable products. Research on individual subjects focuses mainly on psychometrics (Feldhusen & Goh, 1995) and giftedness (Howe, 1999) while research on final products evaluates them in terms of novelty and social value (Amabile, 2018). What is mainly absent is the study of creative processes. Sawyer (1998) noted that creativity research has “separated ideation, divergent thought, and insight on the one hand and execution, implementation, and performance on the other” (p. 11). The problem with this dualism, Ingold (2013) notes, is that creation is not the sudden actualization of preconceived ideas but the actual making of them.

Rather than proposing a new definition for creativity, some scholars propose a return to the word’s etymological roots and its original meaning in process philosophies (Ingold, 2013; Rousell et al., 2022). According to Meyer (2005), it was Whitehead, the 20<sup>th</sup> century philosopher and mathematician, who first introduced the noun ‘creativity’ as derived from the Latin verb *creare* meaning to bring forth, to produce, to grow. Although Whitehead (1978) avoided defining creativity directly stating that “there is no meaning to ‘creativity’ apart from its ‘creatures’” (p. 344), he referred to it as the principle of *becoming*, the “temporal passage to novelty” by which many disjunctive entities move towards unity or what he called the “production of novel togetherness” (p. 21). In his view, creativity is universal, embodied, procedural, and collective. Such perspective contrasts sharply with contemporary notions of creativity as an internal human trait or a property of socially acclaimed masterpieces. For Whitehead (1978), creativity is not about *who* produces or *what* is produced but about production and movement because there are no products but only moments, occasions, or creatures. A creature we see at any given moment, he argues, is just a moment in the flows of material circulations. In Whitehead’s process

philosophy, creativity, as well as thinking and becoming, are inherently productive processes that emerge not from individuals but from their relations in the ongoing reconfiguration of reality (Pickering, 2005).

Similarly, theories of the embodied mind see cognition not as an internal operational process but rather as a relational domain that emerges *between* the mind, the body, and the environment (Maturana & Varela, 1992). Thompson (2007) argues that cognition emerges from this interrelated system and defines it as “the exercise of skillful know-how in situated and embodied action” (p. 13). Cognition is not an exclusively human property but transversal to all adaptive life. From apes to amoebas, all living organisms are cognizant and autonomous, given their capacity to purposely regulate the flow of matter and energy through them to generate themselves, sustain their identity, and avoid dissolution (Thompson, 2007). Maturana and Varela (1992) coined the term “autopoiesis” (from Greek *αὐτο-* [auto-] ‘self,’ and *ποίησις* [poiesis] ‘creation, production’) to describe the recursive process by which a system produces and maintains itself by creating its own parts. In the words of Weber and Varela (2002), “[f]orm, then, is not just an abstract goal in a genetic program, but a material task to fulfill from moment to moment” (p. 117). Biological forms crystallize the active role of the organism in its morphogenesis and its species’ evolution in the long term. While genes set the parameters for development, the actual form of each living being emerges from ongoing *sense-making* of the environment through situated and embodied action (Weber and Varela, 2002). Thompson and Stapleton (2009) add that sense-making involves not just cognition but also emotion because, in making sense of its surroundings in relation to its current bodily state, the organism determines their value or relevance in the degree it feels attracted or repelled. In the words of Fuchs and Koch (2014), emotion emerges “from the circular interaction between affective qualities or affordances in the environment and the subject’s bodily resonance,” which suggest a correspondence between motion and emotion (p. 1).

In anthropology, ecological materialism brings these ideas together to discern the relations between making and growing. Ingold (2013) argues for an understanding of creativity not divorced from the material unfolding of the living world. Like other creatures, he observes, humans gather materials from a world already going on and redirect material flows in anticipation of what may emerge. Ingold and Hallam (2016) observe that the designs of both natural and human worlds are the outcomes of skilled response to a mutually responsive material environment; skilled makers know their materials and work *along* them to keep creation going; likewise, thriving organisms know their medium to keep life or self-creation going. Notably, what is fabricated does not escape the flows of life—artifacts do not transcend nature by the imprint of culture—but remain as material gatherings prone to dissolution, corrosion, wear, and breakdown (Ingold, 2013).

The concept of pluriverse creativity assembles these ideas to enable the possibility of multispecies and multimattered creativity as a form of embodied dialogue. We wonder what forms of sustainable and fertile living result when flattening hierarchies and allowing creativity to emerge from the enmeshment between living beings, materials, technologies, and humans. Pluriverse creativity aims to hold a dialectic and didactic space to consider multiple ways of being and their idiosyncratic ways of moving the world towards novel togetherness.

## Methodology and research design

Building on the theoretical framework, we designed an implementation to support pluriverse creativity. We invited middle-school students to build creative relationships with the living world and each other through hands-on biomaking with fungi. An online invitation called youth to join a different story of the environmental crisis: ‘Sometimes, climate change can feel overwhelming. Especially if you are young and surrounded by adults who think *you* are the future and need to find solutions to literally save the planet! What if rather than trying to fix it, we join the creative and regenerative power of the earth?’

We recruited twelve participants, seven girls and five boys, aged 11-12 from two public schools in a heavily developed American city. Students did not have previous experience with biomaking and had little exposure to outdoor landscapes beyond urban parks and playgrounds. Divided into two groups, we met after school for three hours a day, once a week for a six-week period. In total, participants dedicated 18 hours to the workshop. The activities were evenly distributed into two settings: A local urban park and a maker lab on a university campus. At the park, students could wander independently within 6.5 acres of woods labeled as wild but relatively managed. The makerspace was adapted as a biomaking lab that more closely resembled an apothecary. It mixed technological tools and gadgets with all sorts of gathered materials displayed in jars and boxes labeled as fungi food, biomaterial ingredients, stones, twigs, dried mushrooms, etc. By bringing elements from the park into the lab and vice versa, we wanted to intentionally blur the boundaries between indoor and outdoor settings. The aim was to introduce a persistent presence of more-than-human elements and entities—such as fungi, mosquitoes, trees, worms, logs, moths, spiders, and even bacteria and mold—into the making process.

The central non-human participant of the workshop was fungal mycelium. In previous work, we have detailed the properties that make fungi a suitable organism to facilitate interspecies creativity (Correa & Holbert, 2021). Mycelium is a multicellular organism that grows as a white meshwork of threadlike tissues. It lives

underground or beneath decaying wood or leaves. Under certain conditions, it produces the fruiting body we know as mushrooms. It can be cultivated relatively easily by inoculating a carbon-rich substrate (e.g., woodchips, grains, cardboard, etc.) and providing certain temperature and humidity conditions. Broadly speaking, building with mycelium involves leveraging the organism's capacity to fuse pieces of organic matter by allowing the organism to grow through a substrate inside of a mold which is subsequently released after several days of growth.

Workshop activities were facilitated by two or three facilitators (first, third, and fourth authors) and documented by one or two research assistants. All workshop sessions were audio and video recorded through a rich tapestry of equipment, each with its own affordances and constraints. We used 360-degree cameras to record group activities in the park and lab and chest-mounted action cameras for students' solo work at the park. Action cameras allowed a (relatively) less invasive capture of participants' intimate work (remote from the researchers) at the park and aimed at capturing their embodied sense-making. We held two group interviews and had individual walking conversational interviews. We also took media videos and photographs of the maker activities, drawings, and in-process creations. The first and fourth authors also took observational notes about participants' behavior and the fluctuating state of the park and its creatures.

As design-based research, the workshop's aim was to both be informed and inform our theoretical and practical understanding of making as a multispecies and multimattered practice. Iterative cycles between theoretical and practical development are characteristic of design-based research (Wang & Hannafin, 2005). We designed a program that reimagined biomaking to afford mindful interspecies creativity. By implementing and analyzing the program in two iterations (with the two different groups), the aim was to refine existent theory and incrementally advance practical applications of creativity beyond humans in education.

To leverage pluriverse creativity, we centered the body as an interface between human and non-human participants. Drawing from Chappell's (2018) notion of creativity as embodied dialogue, we framed making as a *dialogue without words* by which multiple entities and elements can gather to make something together. Learners were invited to practice different ways of establishing wordless conversations with other bodies. This involved tuning into non-human ways of being in the world and responding through making while also attending to other beings' ways of making. Some design decisions we took to support dialogue without words were:

- Listening to other non-human bodies: We asked students to find a personal place in the park they felt drawn to while exploring the area. We let students move freely around the park and be moved emotionally and physically by other bodies. We facilitated activities to heighten students' reception of the movement of the forest in order to build awareness of other creatures' ways of perceiving the world.
- Allowing non-human bodies to have the first word: Instead of asking students to problem-solve, ideate, and project ideas on materials, we framed making as a response to a living world that is already going on. Specifically, we asked them to focus on one specific feature of their personal place—a crack in the soil, the twisted way of a trunk, the sound of leaves—as a starting point for making.
- Responding through making: After allowing enough space and time for something to call students' attention, we invited them to use clay and later mycelium to respond to the specific feature—by extending it, disrupting it, or repeating it—just as they would do in a conversation with a friend.
- Listening to their human bodies: Rather than providing recipes or techniques, as is often the case in biomaking, we leveraged students' intuition and sense-making to guide the creative dialogue. For example, instead of telling students exactly how much water mycelium needs, we invited them to recall their experiences of seeing mycelium growing in moist places in the park. This was facilitated with the prompt *what do you feel?* (Rather than *what do you think?*).
- Assembling bodily rhythms: Human and non-human bodies transform matter at different paces; while students are able to build a mold and fill it with an inoculated substrate in a couple of hours, mycelium can take three to five days to completely colonize the substrate and be ready to unmold. As facilitators, we had to coordinate activities accordingly to allow human and non-human parts to express themselves fully while being open to integrating unpredictable human and non-human responses.
- Allowing non-human bodies to have the last word: Instead of dehydrating the resulting mycelium pieces for students to take them home, we brought them alive to the park, where they were shared with families and friends on the last day of the workshop. We chose to work with a strand that was endemic to the area and beneficial to the forest ecology so that the organism could continue to live beyond the duration of the workshop and grow publicly at the park as a statement of interspecies possibility.

Guided by Tsing's "arts of noticing" (2015, p. 37), the analysis gave attention to multispecies relations often ignored or bypassed in traditional qualitative research. Tsing asks us to "look around rather than ahead" (p. 22) to make room for possibilities in "latent commons" (p. 135). We attempted to look at entities and matter

around students as much as we looked at them and tried to make sense of events through the theoretical framework. Whereas process philosophy drew our attention to material transformations occurring between bodies, embodied cognition led us to interpret the behavior of organisms without anthropomorphizing by considering their role in driving material flows and their diverse forms of making sense of the world. These insights were assembled through multispecies storytelling (Tsing, 2015), which uses lively writing strategies (see also Blaise & Hamm, 2019; Goebel, 2022) to convey immersion in a multispecies world.

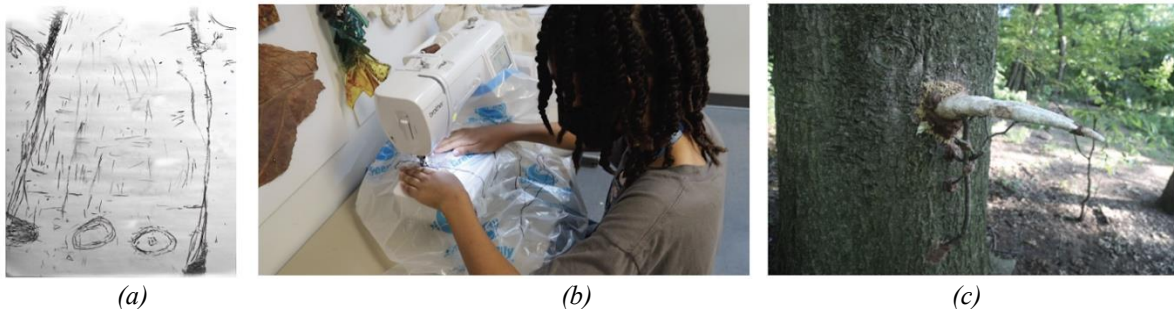
## Findings: Dialogues without words

### First dialogue

The slender red oak and its ancestors had felt human dwellings grow heavy over their roots. Yet, the tree knows the river keeps flowing nearby; every autumn, it counts on its breeze to spread leaves over its acorns and protect them from the coming snow. After the winter, bright green buds are slowly uncoiling from the tree's bare branches. A pack of young and noisy humans pass next to its trunk layered in warm clothes and carrying heavy backpacks [as described in notes]. The oak was there when one of them decisively walked towards it, sat over its roots, and pressed his back against a cavity on its bark that 'felt like somebody sat there before' [as shared in group interview]. The roughness of the northern side of the trunk captures his attention [as captured by action camera]. He never looks up at the branches or peers around the trunk but focuses on the crevices and foldings of its darker side. He is particularly drawn to a circular mark the size of a fist [noted in individual interview, student's drawing (Figure 1a), and captured by action camera]. When prompted about how the bark came to be that way, he points to the mark: 'there used to be a branch over here ... hmmm maybe I can make another branch for it.'

#### Figure 1

*Student's drawing of the tree and the circular marks on its bark (a), sewing bags to make a branch-shaped mold (b), and the 'prosthetic branch' installed on the tree with the support of clay and twigs (c)*



### Second dialogue

Mycelium threads unfolding and branching outwards through an intricate world of hardwood chips, exploring all crevices, filling every corner, breaking down everything on their path until reaching an inscrutable plastic membrane that refuses to break down. Moving sugars and oxygen through a tangled body and releasing carbon dioxide until the air around feels stale and thin. Suddenly, a stream of fresh and dry air wraps the newly formed body of mycelium. Using scissors, the kid carefully begins to tear apart the plastic mold and release what he called 'the prosthetic branch.' He had made the branch-shaped mold at the lab by sewing together two layers of compostable plastic bags (Figure 1b). Later he had filled the mold with loose hardwood chips inoculated with mycelium so it could grow in that shape. Three days later, the kid is back at the tree [captured by action camera], sitting cross-legged on the ground, finally opening the mold: 'I feel like a mad scientist, buah ha ha.' Yet, his human hands do not seem to know how to harness the odd body of mycelium. Not knowing how much pressure it can handle, the mycelium branch breaks once 'crap!' and twice 'creep!' The dismembered mycelium branch lays in front of him next to a block of clay that seems to suggest a way forward. He grabs a chunk of clay and connects the broken pieces back: 'clay is so heavy...I hope mycelium can grow through clay...cause if it can't then this part never grows again...I hope you can grow through clay dude.'

### Third dialogue

Despite the kid's efforts, the clay refuses to hold the broken mycelium branch together, 'don't die on me,' he whispers. As he tries to save his mycelium branch, other creatures come by [captured by his action camera]. A white moth finds on his fingers a good place to land but, after realizing they are moving, launches off to the ground

only to be chased after. ‘Do you wanna die?’ asked the kid while firmly holding the scissors. The moth tries to open its white wings to fly away, but they are broken and useless. The boy grabs a stick from the ground whispering, ‘yes you do, yes you do.’ The white moth attempts a final jump before disappearing under the stick. ‘The dude was done.’ Soon after, a mosquito finds the boy’s warm skin while he was wrestling with the clay. ‘Aaaaghh bugs, nature,’ claimed the boy with a contemptuous tone that was immediately followed by a new exclamation in a high-pitched voice: ‘I love nature, but I just don’t like bugs [...] when I have a kid he is going to be partly made of glass.’ Finally, a second boy arrives to the tree screaming and running from a hive of bees that does not seem interested in him [as captured by his action camera]; breathing heavily, he exclaims: ‘am I the only one scared of all these animals?’ A brown squirrel passing by hears the kid’s heavy steps and freezes staring at him. ‘Aaaahhh! There is a squirrel! The squirrel is looking at me!’

#### Fourth dialogue

The harsh bark of the tree refuses the clay and the prosthetic branch altogether. Six tangled human arms wrestle with the branch and clay against gravity. Together, all bodies—hands, tree trunk, clay, mycelium branch, and sticks—finally suspend the prosthetic branch in a delicate and almost impossible balance (Figure 1c). A human group of friends and relatives gather around the tree and look puzzled at the branch. Holding a pencil in his hand, the boy shares proudly about the prosthetic branch and his hopes for it: ‘it’ll stay on here and mushrooms will grow. It can be like a patio for squirrels [...] if we get lucky this might actually grow into the tree so it can stay there without the clay.’ His voice spreads through the forest and a thick layer of fully-grown leaves dresses the canopy, cycling matter, crafting atmosphere, and giving breath to all bodies under its shadow.

#### Discussion: Making sense of creativity in the pluriverse

Dialogues without words are lively, messy, and prone to misunderstandings, contradictions, and discomfort. Instead of bringing students back to pure nature ecologies that no longer exist or asking them to dream distant techno-utopian futures, we choose with Haraway (2016) to “stay with the trouble” and give space for learners to craft ways forward from the midst of our hybrid, odd, messy, and unraveling pluriverse worlds.

The first dialogue positions maker activities within a larger hybrid ecology. Not a wild and innocent landscape but a place of resistance; a seemingly wild but managed patch of woods in a city of manicured parks and playgrounds. The dialogue was initiated by the encounter between the kid’s back and the tree’s bark pressing against each other and, later on, by the circular mark that captured his attention. His reading of the mark as a trace of a fallen branch suggests an incipient understanding of the tree not as a finished and static object but as an unfolding body. Giving living beings the chance – space and time – for learners to notice them and giving learners cognitive tools for noticing is a necessary first step to acknowledging creativity in the world. It is worth considering how this incipient noticing could have been nurtured further, through prompts or discussion, for the student to consider something as still as a tree as an unfolding creature that is in movement within itself despite its solid appearance. Subtly, this was suggested by the practice of making itself through which the student entered into conversation and joined the tree on its becoming.

The second dialogue presents a series of embodied conversations that gave rise to the ‘prosthetic branch.’ The actual form of the branch emerged from the relational engagement of mycelium growing outwards through the wood chips and against the surrounding plastic mold. The mold’s shape, in turn, emerged from the dialogue between the sewing machine, the boy, and the plastic bags. Later on, at the park, the student, the mold, and the branch wrestled with mutually responding forces until the final shape was released. In the process, his unskilled bodily movements, not knowing the body of mycelium well enough, broke its delicate fibers apart. When looking for a way forward, the student demonstrated both thinking like the organism and thinking through clay in an embodied manner. The myceliated substrate, which is as light as styrofoam, contrasted with the weight of the clay. When holding the clay in his hands, the question of mycelium’s ability to grow through clay emerged from his embodied understanding of density and his past experiences growing mycelium at the lab.

The third dialogue shows how the students’ presence in the forest was not without friction. Despite our efforts to build awareness of their bodies and other fragile non-human bodies around them, they inadvertently and, at times, intentionally smashed seedlings, made trails, and displaced or killed critters. When learning occurs outdoors, Pacini-Ketchabaw (2013) suggests important questions: “Who lives and who dies with children’s visits to the forest? What worlds are created? What futures are generated and regenerated in these visits?” (p. 356). The boy’s care for mycelium contrasted with his reaction toward other creatures that interrupted his work. Non-human bodies moved the students’ bodies—emotionally and physically—and awakened visceral reactions that they attempted to tame rationally, perhaps given the presence of the chest camera. In these intimate yet uncomfortable encounters, human-nature boundaries dissipated, allowing for what Taylor and Pacini-Ketchabaw (2015) describe as the “mutual vulnerability” inherent to everyday interspecies encounters. Being observed by piercing non-

human eyes, feeling the fragile body of a moth breaking down, becoming porous and edible for mosquitoes, having a skin that is not ‘made of glass.’

Finally, the fourth dialogue illustrates the student’s emerging understanding of making within a larger scheme of multispecies events. For him, the branch is not finished; mushrooms will grow, squirrels will play, and mycelium may even continue to grow toward the tree. An understanding of making in continuity with the ongoing transformations of the earth facilitates a mindful consideration of its implications. Creativity in the pluriverse demands responsibility for the “creatures” (Whitehead, 1978) that we make and the traces we leave behind. Thinking of making as growing offers paths to re-weave human threads into the fabric of life.

The presented dialogues without words describe how a multiplicity of beings accommodate to each other in their discordant ways of being. Every-body—children, facilitators, mycelium, clay, bugs—was doing its own thing, immersed in embodied sense-making. Yet, when intentionally assembled, collective sense-making can bring forth novel togetherness. As primary steps in the path of re-thinking making in the pluriverse, we highlight the importance of giving space for learners and other beings to notice each other and discern shared participation in the creative reconfiguration of the earth. Whereas this research focused on biomaking, its principles extend towards all making practices considering the active participation of materials and technologies in the collective making and remaking of the earth.

## Conclusion

We explored the pluriverse creativities as a space to study making as an embodied process by which a multiplicity of entities and elements give rise to the forms and features of the world. By recognizing the intricate ways natural and artificial forces build and grow upon each other, we aim to advance understandings of making in which humans are not in a position of management and control but instead immersed in a complex socio-ecological world in ongoing material reconfiguration. This way, rather than trying to save the planet through making, we invite makers to join the earth in its creative dynamics and regenerative capacity. Recognizing the challenges ahead, we look forward to new paths in maker education where students and other beings can learn from each other through productive differences, create collective sense-making, and move towards novel togetherness.

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