'We Need It Loud!': Listening to Preschool Making from Mediated and Materialist Perspectives

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Introduction

Playdough, cookie cutters, battery packs, and electronic buzzers are scattered across a child-sized table in the preschool classroom. The children are poking electronic components into pliable clumps of playdough as they create electric circuits to power up the buzzers. The hum of children's voices rises in sync with the piercing drone of the buzzers. The volume rises and falls as children's bodies turn toward and away from the buzzers, and as more children begin to understand how to place the buzzers in their emerging designs. As more and more buzzers turn on, the sound sources of each individual component become increasingly blurred. One child, fascinated with the chaotic shrieking of multi-pitched buzzers, exclaims 'Beautiful music!' while others clap hands over their ears to mute the noise. In response, the facilitators begin to apply tape over the buzzers to dampen the sound, but the children immediately protest: 'We need it loud.'

Makerspaces like the activity station in this preschool classroom are springing up across school and out-of-school settings, emerging as sites for rich and active learning (Peppler et al., 2016). Makerspaces can range from shoebox kits with pipe cleaners, hot glue guns and light-emitting diodes (LEDs) to entire suites with virtual reality implementations, rows of 3D printers and laser cutters. Mixing low- and high-tech materials in making activities – such as the play dough, wire circuits and electronic buzzers in this chapter – opens a way for young children to produce and play as creative designers who explore responses to an evolving world that is not fixed or predictable (Resnick, 2017).

Making invites children to initiate and participate in creating new possibilities for themselves and others. The focus on exploratory tinkering in makerspaces shifts learning from orderly teacher-led achievement to accessible learner-driven exploration (Resnick & Rosenbaum, 2013; Vossoughi & Bevan, 2014). This transition shifts creative control from teacher to child, sometimes enabling chaotic or disruptive practices to emerge. In these moments, educators may seek to quickly restore order to ensure that all children are safe and have access to a range of design possibilities. However, proactive interventions may forestall learning and tame designs by restricting possibilities for exploring something new. In this chapter, we investigate untidy instances of emergence and cacophony in a preschool makerspace, examining a making activity to identify practices that encourage and sustain new possibilities. More specifically, we analyse sound, an understudied area in literacy learning and making, to better understand what happens when children play with technology-mediated sound-producing crafts. Aligning with recent work in multiliteracies, early childhood makerspaces, sound as multimodal and material composition (e.g. Serafini & Gee, 2017; Skerret, 2018; Thiel & Jones, 2017; Wargo, 2017; Wohlwend, 2017), we highlight the need for expanded ways to consider how sound, materials and meanings come together in art-making as well as ways to trace the emergence of art and the meanings children make with it.

Theoretical background

A multimodal lens looks at making as social practice that people use to shape materials in their social and cultural worlds. Here we might ask, 'How does a young designer read and wield the semiotic affordances of the material resources as they make?' This framing assumes agentic subjects who use physical aspects of materials to create designs and negotiate cultural worlds. A multimodal focus reveals barriers that prevent some children from accessing particular modes and cultural resources. However, does a human-centric focus that separates social and material, intent on manipulating modes and space, itself contribute to incorrigible disparities (Barad, 2003)? Could thinking differently about relations among humans and materials reveal ways to make learning more accessible and enable new ways of learning? In this chapter, we seek to challenge tacit assumptions in humanist notions of making, learning and development to more expansively consider early childhood learning. Instead of looking at individual learners on developmental trajectories, we consider the larger assemblage

(Deleuze & Guattari, 1987) – in this case, an entanglement of artefacts, practices and bodies – that produces design, play and experimentation. An early childhood makerspace is an ideal site to shift from attending to differences among individuals to look for connections within assemblages that squish together play dough, batteries, buzzers, fingers, colours and sound. Additionally, our focus on sound as a less-understood mode highlights unexpected possibilities for shared material productions (Skerrett, 2018; Wargo, 2017).

We draw upon mediated discourse theory (Scollon, 2001; Wertsch, 1991) to see social actors' mediation of sound and materials in co-produced interactions reflected in their making practices with tools and their sociocultural purposes through modal and multimodal engagement. Next, to unpack the tangles of meanings, materials and bodies in children's designed artefacts, we explore a relational materialist orientation (Hultman & Lenz Taguchi, 2010) to literacy that ruptures definitions of development and learning, challenging the notion of texts as intentional representations and durable signs (Kuby & Rucker, 2016; Thiel, 2015). Central to relational materialism is Barad's (2003) emphasis on connections in intra-action: an interdependent collaboration among material and human actants that co-constitutes play, design and experimentation. Our goal is to track chaotic webs of intra-actions among makerspace assemblages and to recognize knowledge and learning as flows that are continuously emerging, clustering together and coming apart. This multicentred view of bodies, materials and spaces flattens power relations and troubles definitions of 'design' as a human manipulation of materials to create message-bearing artefacts, or definitions of 'play' as actors' dramatized and coordinated material reality that can be filmed, saved and shared. Instead, a focus on assemblage and flows moves away from outcomes and categorization to focus on entangled in-the-moment meanings as innovations and co-productions.

The research context and process

The vignette above is excerpted from a Design Playshop study (Wohlwend & Peppler, 2015; Wohlwend et al., 2016, 2017) in makerspaces in three classrooms (60 three- to five-year-old children, six teachers) at a preschool in the Midwestern United States. Children voluntarily joined small groups at an 'art table' – a stubby 3′ × 6′ all-purpose table next to a low shelf with art supplies – that constituted a temporary and impromptu makerspace in each classroom. During seven-hour-long sessions over a two-week period, we furnished each classroom

makerspace with a set of craft and electronic materials for children's exploratory play and making: tubs of play dough, small toys and Squishy Circuits play dough electronics kits (Johnson & Thomas, 2010). Squishy Circuits is an electronic tool kit consisting of a 6 volt DC battery pack, ten to fifteen LEDs, two buzzers, and a DC motor[1] that can be connected using play dough to create a working electrical circuit.

We video-recorded the making activity at each art table, positioning the camera at the children's eye level and focusing on their faces and hands. We recursively selected video data (Erickson, 2004), repeatedly viewing data to reach consensus about which major aspects constituted practices of design, play, collaboration and electronic production. We selected instances with buzzers for close analysis as key site of engagement (Scollon & Scollon, 2004), that is dense moments when assemblages produced amplification or contestation when practices, actors and materials converged, such as the tension between children's noisy designs and adult interventions to preserve quiet collaboration and successful electronic circuitry. We were especially drawn to material productions, such as the buzzers' sound production that captivated children yet disrupted adults as this pointed to places where the hierarchy between people and materials was ruptured and generated emergent possibilities and chaos.

In this chapter, we first examine art activity from a maker's perspective using multimodal microanalysis and mediated discourse theory (Scollon, 2001; Wertsch, 1991; Wohlwend, 2011a, b) that allows us to track designers' interactions with materials, the environment and one another. This multimodal focus analyses how children interact with buzzers and modes to fashion artefacts and how they manipulate modal affordances to craft designs that convey cultural meanings in peer and school cultures. Through this perspective, we can see social actors' purposes in which tools and objects are wielded to emphasize particular material properties, to develop children's design skills and to get tool users recognized as experts in the social fabric of peer playgroups. We annotated digital screenshots as analytic maps to sequence changes over time in modal arrays. This multimodal analysis helped us see how the children attached meaning to their projects and to track movement of shared attention, sensory discoveries and content knowledge around the table.

We then take a relational materialist perspective (Hultman & Lenz Taguchi, 2010; Lenz Taguchi, 2010) to recognize change as active and ongoing material

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[1] The salt content of play dough makes it possible to replace typical metal wires with play dough as conductive material and part of an electronic circuit.

force. We tracked material doings and undoings of assemblages of maker practices, buzzer sounds, circuitry materials, children and adults. We focused on repetition and emergence as always/already-occurring flows in making to see how iterations of actions with materials produced both variations and ruptures that propelled possibilities. We consider ruptures as moments that entangle carefully separated components or undo an entanglement, accessing emergence and engaging possibilities for (re-)assemblage. As a heuristic to track sound through repetitive assemblage and reassemblage, we sought to parse the material interaction and repetitive movement of sound, similar to visual interaction and movement such as shared gaze and repetitions of colour and shape present in the video data. To amplify the material impact of sound and to represent it visually for analysis and publication in print formats, such as this chapter, we created visualizations of the buzzer sounds. Following a new media arts approach of transforming and pairing digital bits to materiality (Ishii & Ullmer, 1997), we used After Effects software animation tool to emphasize sound through a changing visual shape:

- the physical impact of the buzzers' volume by varying the size of the shape: larger size for increased volume
- the frequency of the buzzers' pitch by varying the speed and geometry of the shape: faster vibrating animation and more acute angles for higher frequencies
- the proximity of a sound source to people and circuitry tools by placing the shape on the video touching the originating buzzer.

The visualization of the volumes and frequency intentionally foregrounded sound, made its doing visible and paired it computationally with visuals, so it could not be muted from other parts that were moving in and out of art-making.

Findings

On our third day at the preschool makerspace, we introduced buzzers: small black boxes with red and black wires, which, when turned on, would squeak at different volumes and frequencies and vibrate and rattle on the table surface. Raising an eyebrow, Juan dangled a buzzer by its leads, repeatedly asking, 'What are these?' At the other end of the table, Adam replied, 'Buzzers', as an adult responded: 'Well, you're just going to have to play with them and find

out.' Juan shifted materials around, experimenting to find an alignment until suddenly a high-pitched electronic sound flooded the art table. The sound was extinguished just as quickly as it emerged, and all the children turned towards the source of the now-disappeared sound. Juan burst out laughing, and all other children joined in.

Adam was next to connect a buzzer, and immediately all eyes turned to him. He smiled, everyone laughed and the action pattern repeated. As more buzzers turned on, the buzzers' sounds melted into one another and it became increasingly difficult to differentiate their discrete sound sources. Pete and Sarah held their ears against their own buzzers to determine if the buzzer was working. Juan requested, 'Turn off yours, Adam,' and Adam plucked the loud buzzer from its play dough wiring. When Lisa's buzzer finally turned on, she squealed and rapidly wiggled her body, her movements echoing and amplifying the buzzer's vibration. Some children spread their arms wide open in response to the increasing noise; another shouted, 'When is it gonna stop? I don't know when.' The children responded to the clatter of sound through various strategies to amplify their individual buzzers. Suddenly, one very loud piercing buzzer dominated the soundscape. Juan bent and turned his ear towards it, seeking to decipher whether the new sound emerged from his project. With a broad smile, he loudly pronounced: 'Beautiful music. Let's make music.'

But just at this moment, the monitoring researcher/facilitators intervened. After identifying the extra-loud buzzer, one facilitator advised another to 'find some scotch tape and put it over the buzzer and make it softer,' while cautioning not to 'cover it up all the way' so that some sound could still be heard. With the sound softened, Juan also quieted but objected to adults' tampering with his project:

Juan: Why are you doing that?
Adult 1:   It makes it less loud.
Juan: We want it loud. We need it loud.
Adult 2:   If we make it really loud, you guys can't hear each other talk.

In this vignette, we were the intervening adults. As researchers and makerspace facilitators, we mediated the blaring of buzzers to fit the expectations for order and harmony in the preschool. In the subsequent analysis of these events, we present how our analysis helped us understand how children were exploring the material possibilities of their designerly intentions and sensory discoveries, and how this brought about a new understanding of materiality that pushed back on assumptions of art-making and schooling.

Interactions: Mediated action, interactions and multimodality

From a mediated discourse perspective, we can see children exploring the meaning potentials of modes and actions with play dough, LEDs and buzzers, as they create artefacts and entertain friends. While commercial play dough sets and LEDs allowed children to vary tactile and visual modes such as the shapes and colours of their doughy snakes and snowmen, the buzzers enabled experimentation with sound as an effect of a working circuit construction but also as a design element. When multiple buzzers went off at various pitches in this chaotic moment, children made sense of the cacophony of buzzing in different ways. Some children bent down and tilted an ear closer to their play dough projects to check if it were the source of the buzzing. Other children covered their ears with cupped hands, at first blocking the noise and then testing how volume could be manipulated by covering and uncovering their ears. Finally, Juan interpreted the buzzing as 'beautiful music', a move that immediately defined the multi-pitched sounds as a unified composition, appropriated the buzzer's sound production capability as a semiotic resource for creating a design, in this case music. The response of the children depended upon their individual purpose in their meaning-making with the sound. Figure 9.1 presents the children's sense-making through semiotic engagement with the buzzers and sound.

The adults at the table sought to mediate the buzzer action by covering buzzers with bits of tape to reduce vibration and quiet the buzzers but in ways that would still allow children's experimentation. In this case, our strategies were prompted by an interest in maintaining a more orderly learning environment where everyone could hear their own project, in enabling talk at the table and also in ensuring clear audio for later transcription. We also responded to the overall unruliness of the sound-intense activity in deference to school norms. But quiet buzzers conflicted with children's interest and excitement in exploration of the range of meaning, action and modal possibilities with buzzers and play dough. From a multimodal perspective, the adults' interactions backgrounded sound to privilege other modes while children's engagements foregrounded and directly engaged the design potential of sound – by moving body and object proximity, they explored sound amplification and insulation of sound and representations of pitch, volume and vibration.

Intra-actions: Doing and undoing art-world-making

Across all rooms, the camera and external microphone became a distortive component of the entanglements that revealed our preconceived framing from
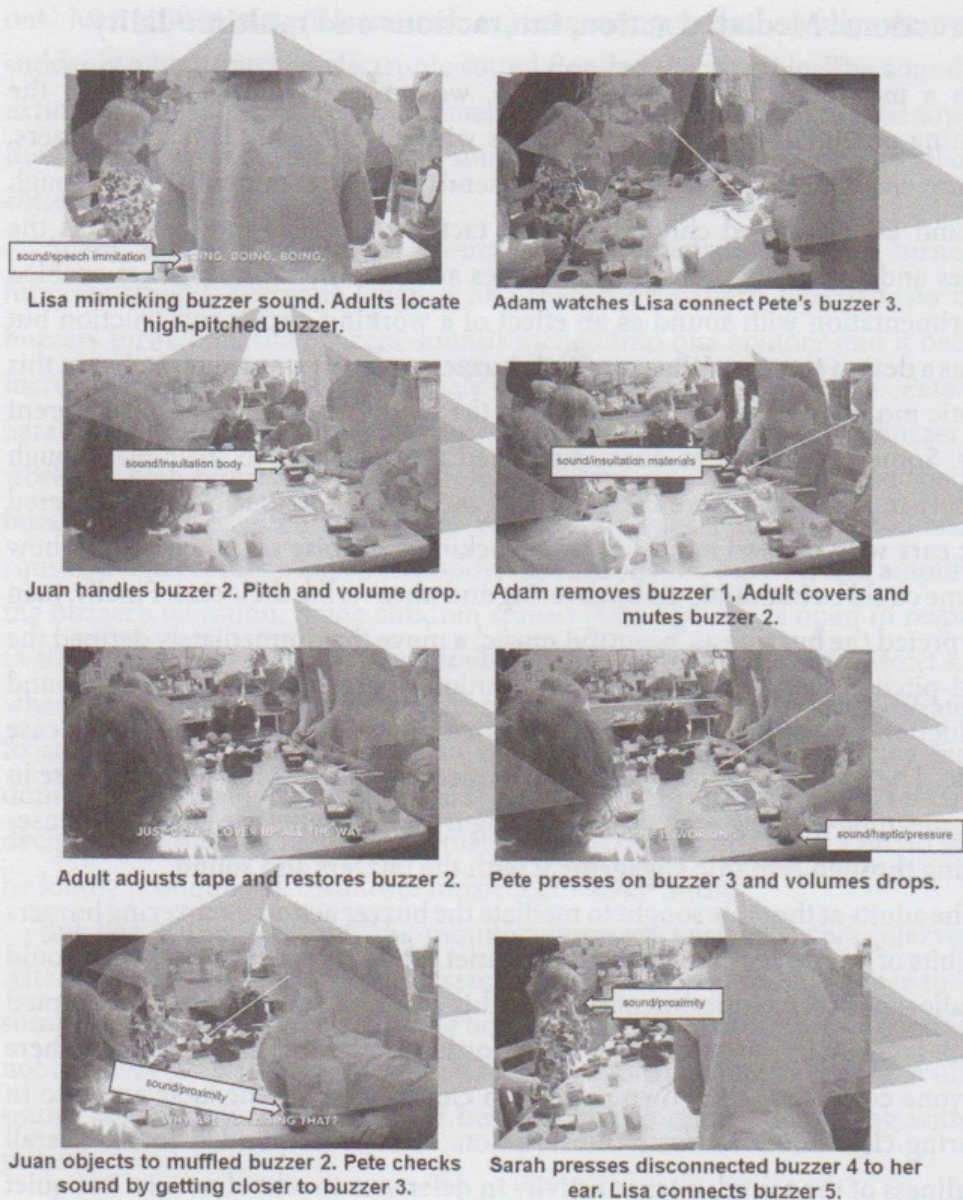
Figure 9.1 Illustration of sense-making with buzzers and maintenance of modal possibilities.

a humanist perspective. Through our positioning of camera lenses, we had attended to people (rather than materials), the table (rather than the table-in-context and its relationships) and changeover time (rather than moments of ruptures that revealed how things were held in place). The distortive presence of the recording devices became salient when children moved the external microphone and created feedback noise. This rupture foregrounded our manipulation of data and turned the research gaze back on us as researchers and our analytic choices through research tools. This drew our attention to more closely listen to the possibilities of buzzers.

Buzzer entanglements consisted of intra-actions that in this case were feeble and transitory doings that could be undone just as quickly as they were established. When wires, play dough, battery packs and children's hands aligned, buzzers droned on. When any of these assemblage parts slipped out of position, the play dough circuits were cut and the sound was severed. Moments when buzzing emerged stood out as filled with entanglements of unintentional configurations while moments when buzzing ceased were catalysts for intentional retracings as children worked to reinstate particular configurations or recombine elements anew through fresh explorations.

Repetition amplified sound as children sought to maintain buzzing and bring it about recurrently. In the flow of continued doing and sounding, new buzzers started up and contributed to the noise concert that transformed the physicality of the art table. Many buzzers sounded at the same time yet at different volumes and frequencies, and the source of any one buzzing noise melted into the rest. This auditory amalgamation created a piercing tonal cacophony that overwhelmed some practices and pulled others forward. The children stopped trying to trace the sound sources and bent towards the cacophony. The emergence of being among the material repercussions of joint human and material production was also the emergence of a sound-governed space not comprehensible from a humanist perspective. However, the camera lens and video analysis made visible how intra-actions of human and non-human playmates together changed the art table composition and its environment through their negotiated intra-actions in the production of ubiquitous buzzing sounds. In the fleeting moments when buzzer noise emerged and was muted by tape and bodies, the art table space took on a new materiality through the doing and undoing of droning buzzers, illustrated in Figure 9.2.

The new materiality produced musicians who recognized the high-pitched sounds as 'beautiful music' as well as music critics who asked 'When is it gonna stop?' Bodies intra-acted differently with the sound-producing mechanisms: the physical change at the art table prompted bending torsos into the flow of sound or covering ears to mute the sound. Art-making – in this case, the shaping of an unexpected and unruly large physical force – was in the children's actions, the alignment of circuitry parts, the sound production and the multiple relationships among components.

The emergence of art-making was fragile and subjected to a privileging of speech, materialized through taping over buzzers to enable talk and transcription. The action of muffling buzzers worked to undo the togetherness of human/non-human assemblages and to uphold personal boundaries of individuality.
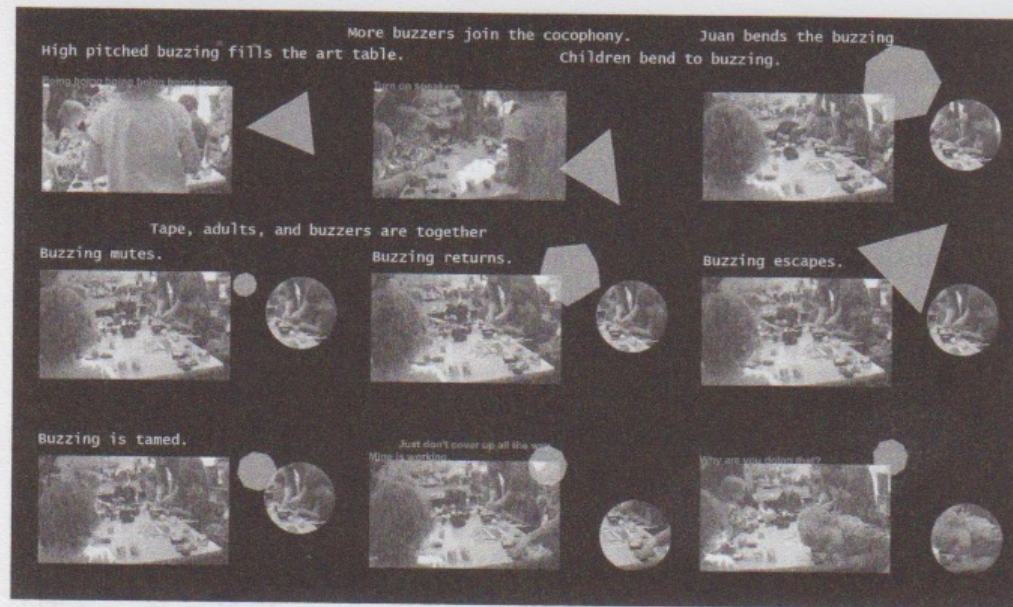
Figure 9.2 After Effects screenshots flattened for print to show the visualization of audio materiality.

Tension among doing and undoing shaped and was shaped by the socio-material relationships among buzzers and children as well as the physical art-making and world-making possibilities that emerged from these relationships. For example, when a child altered a buzzer's pitch by wiggling the battery pack and analogized converged buzzers to music, the child-noise entanglement was undone by damping the buzzers to maintain audible boundaries for individual children. In this way, the action of taping ruptured the amplified multi-buzzer sound but also produced pushback from the children-buzzers-noise assemblage (e.g. complaints of 'what are you doing?'; buzzing that vibrated through the tape). Taping action not only muffled the physical buzzing but also closed off some child-sound and art-world possibilities while opening others. Adults in these shape-shifting encounters also contributed as actants through doings and undoings that underscored the force of world-making of the child-buzzer-art.

Discussion and implications

The mediated perspective uncovered designerly exploration of the buzzers, including imitation, insulation, pressure and proximity, by the children and adults driven by social intentions and expressive meaning-making. From a mediated perspective, we found that visualization of sound helped us compare

the ways that children (and adults) explored manipulation of sound as a mode and as a design element through exploration of sound insulation and sound vibration with their bodies and materials.

The materialist perspective, on the other hand, illustrated that a design focus manifested intentions to artificially maintain a one-buzzer/one-child approach to art-making that were ruptured when many buzzers went off simultaneously so that sound sources could not be singled out and buzzers could not be untangled. This convergence required more and more effort to maintain separation among projects in the face of an emerging and overwhelming force at the art table. The materialist perspective prompted analysis of the larger world-making phenomenon that was emerging at the table and how the art-making assemblage was undone and redone by attempts to separate the assemblage into modes, projects and components moving towards individual completion goals. The material analysis illuminates how less-privileged components and ways of doing and being and making the world were silenced.

Our explorations also point to methodological implications for research that examines processes of translating material states when seeking to identify material forces that act as world-making mechanisms for and with children. The analysis with the video editor After Effects enacted an assemblage of researchers, material instruments and theory that ruptured our humanist foundation for theorizing learning. When we flattened digital audio onto the visual data channel, the audio could not be muted by a stroke of a button of the tangible computer interface; this facilitated the sense that the audio materiality was overlaying, covering and disrupting the visual centrality of humans. Visually and auditorily, the instruments of 'data collection and analysis' converged and reconfigured our educational theorizing. The translation of data across senses reveals our perceptual assumptions at the human-computer interaction level and invites us to question sensory privilege in early childhood classrooms. In educational research, there is a need for consistent interrogation of representation and manipulation of data across senses (not only across instruments) to better identify traces of material forces. Digital media arts practices of translating sensory input to other sensory outputs can help further develop these methodological threads, especially when smartphone applications support augmenting camera views with spatio-visual sound interactions. These applications make it easier to collect and translate data across senses.

The research has implications for the design of learning experiences for children. The making of something new that continually breaks down previously established assumptions, like the buzzing materiality at the art table, resonates with art that seeks to unsettle and produce new ways of being in the

world. When we attend to these potentials, instructional limitations morph into listening to relationships that material/child assemblages express together. The chapter highlights the need to provision classrooms with materials that invite exploration and ruptures of predominant practices and that expect the emergence of unexpected material entanglements. It carves out a space for preserving exploratory spaces with opportunities for children to be messy. Rather than mediating towards predetermined goals and outcomes, we encourage listening to the repetitions that are always/already variations and the trajectories that lead learners into new spaces. Zooming out further, this work suggests that keeping classrooms and learning spaces artificially stable is problematic as the worlds that children make and grow up in are neither stable nor predictable.

References

Barad, K. (2003). Posthumanist performativity: Toward an understanding of how matter comes to matter. *Signs: Journal of Women in Culture and Society, 28*(3), 801–831.

Deleuze, G., & Guattari, F. (1987). *A thousand plateaus* (Brian Massumi, Trans.). Minneapolis, MN: The University of Minnesota Press.

Erickson, F. (2004). Demystifying data construction and analysis. *Anthropology & Education Quarterly, 35*(4), 486–493.

Hultman, K., & Lenz Taguchi, H. (2010). Challenging anthropocentric analysis of visual data: A relational materialist methodological approach to educational research. *International Journal of Qualitative Studies in Education, 23*(5), 525–542.

Ishii, H., & Ullmer, B. (1997, March). Tangible bits: Towards seamless interfaces between people, bits and atoms. In *Proceedings of the ACM SIGCHI Conference on Human factors in computing systems* (pp. 234–241). ACM.

Johnson, S., & Thomas, A. P. (2010, April). Squishy circuits: A tangible medium for electronics education. In *CHI'10 Extended Abstracts on Human Factors in Computing Systems* (pp. 4099–4104). ACM.

Kress, G. (2003). *Literacy in the new media age*. New York, NY: Psychology Press.

Kuby, C. R., & Rucker, T. G. (2016). *Go be a writer!: Expanding the curricular boundaries of literacy learning with children*. New York, NY: Teachers College Press.

Lenz Taguchi, H. (2010). Rethinking pedagogical practices in early childhood education: A multidimensional approach to learning and inclusion. In N. Yelland (Ed.), *Contemporary perspectives on early childhood education* (pp. 14–32). New York, NY: Open University Press.

Peppler, K., Halverson, E., & Kafai, Y. B. (Eds.). (2016). *Makeology: Makerspaces as learning environments* (Vol. 1). New York, NY: Routledge.

Resnick, M. (2017). *Lifelong kindergarten: Cultivating creativity through projects, passion, peers, and play*. Cambridge, MA: MIT Press.

Resnick, M., & Rosenbaum, E. (2013). Designing for tinkerability. In M. Honey, & D. E. Kanter (Eds.), *Design, make, play: Growing the next generation of STEM innovators* (pp. 163–181). New York, NY: Routledge.

Scollon, R. (2001). *Mediated discourse: The nexus of practice*. London: Routledge.

Scollon, R., & Scollon, S. W. (2004). *Nexus analysis: Discourse and the emerging internet*. New York, NY: Routledge.

Serafini, F., & Gee, E. R. (Eds.). (2017). *Remixing multiliteracies: Theory and practice from New London to new times*. New York, NY: Teachers College Press.

Skerrett, A. (2018). Learning music literacies across transnational school settings. *Journal of Literacy Research, 50*(1), 31–51. doi:10.1177/1086296X17753502.

Thiel, J. J. (2015). Vibrant matter: The intra-active role of objects in the construction of young children's literacies. Literacy Research: Theory, *Method, and Practice, 64*(1), 112–131.

Thiel, J. J., & Jones, S. (2017). The literacies of things: Reconfiguring the material-discursive production of race and class in an informal learning centre. *Journal of Early Childhood Literacy, 17*(3), 315–335.

Vossoughi, S., & Bevan, B. (2014). Making and tinkering: A review of the literature. *Academy of Sciences*. Retrieved from: http://www.informalscience.org/making-and-tinkering-review-literature.

Wargo, J. M. (2017). Rhythmic rituals and emergent listening: Intra-activity, sonic sounds and digital composing with young children. *Journal of Early Childhood Literacy, 17*(3), 392–408.

Wertsch, J. V. (1991). *Voices of the mind: A sociocultural approach to mediated action*. Cambridge, MA: Harvard University Press.

Wohlwend, K., & Peppler, K. (2015). All rigor and no play is no way to improve learning. *Phi Delta Kappan, 96*(8), 22–26.

Wohlwend, K., Keune, A., & Peppler, K. (2016). Design playshop: Preschoolers making, playing, and learning with Squishy Circuits. In K. Peppler, E. Halverson, & Y. Kafai (Eds.), *Makeology: Makerspaces as learning environments*, (Vol. 1, pp. 83–96). New York, NY: Routledge.

Wohlwend, K. E. (2011a). Mapping modes in children's play and design: An action-oriented approach to critical multimodal analysis. In R. Rogers (Ed.), *An introduction to critical discourse analysis in education* (2nd ed., pp. 242–266). Mahwah, NJ: Lawrence Erlbaum.

Wohlwend, K. E. (2011b). *Playing their way into literacies: Reading, writing, and belonging in the early childhood classroom*. New York, NY: Teachers College Press.

Wohlwend, K. E. (2017). The expression of multiliteracies and multimodalities in play. In E. F. Serafini, & E. R. Gee (Eds.), *Remixing multiliteracies: Theory and practice from New London to new times* (pp. 162–174). New York, NY: Teachers College Press.

Wohlwend, K. E., Peppler, K. A., Keune, A., & Thompson, N. (2017). Making sense and nonsense: Comparing mediated discourse and agential realist approaches to materiality in a preschool makerspace. *Journal of Early Childhood Literacy, 17*(3), 444–462.