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Crafting Human-material Collaborative Learning Processes and Technology Advances

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Abstract: Computer supported collaborative learning has a history of investigating learning processes between people and the technological materials that support them. Emergent posthumanist perspectives view technology as actively produced through routinized actions by humans and non-human materials. Applied to CSCL, this view would suggest that materials are active participants. The present inquiry explores materials that are historically connected to technology advancements–fiber crafts–to investigate material collaborative learning processes and the kind of learning they produce. Findings present material-collaborative learning processes that show crafters collaborate with materials to produce physical evidence of learning, i.e., craft-technology advances. This work has implications for theorizing and designing for collaborative learning, expanding who and what can be considered a participant.

Introduction

The field of computer-supported collaborative learning (CSCL) looks as collaboration as a process between people (i.e., pair, small group, whole classroom) often aided by computational materials (Stahl, 2013). Despite a rich array of theoretical approaches in CSCL, several underlying assumptions operate within the field, including that humans are the active participants in collaboration and that learning happens to humans. As a result, the CSCL technological materials have typically acted as mediators of collaborative processes and human learning (Yrjönsuuri et al., 2019). These theoretical assumptions treat CSCL materials as hierarchically inferior to people, potentially obscuring collaborative learning processes that the materials bring to learning.

Posthumanist perspectives (Barad, 2003) emerging in the learning sciences and CSCL are challenging assumptions of what is the active player in collaborative learning. Applied to CSCL, posthumanist perspectives decenter the human and suggest that collaborative learning processes may emerge from a human-material collaboration (Keune & Peppler, 2019). This is an important area to explore because posthumanist perspectives can address deficit notions and broaden what counts as learning (Mehto et al., 2020; Keune, 2020), potentially furthering the design of equitable learning environments. We consider fiber crafts a suitable context for this inquiry of posthumanist perspectives for CSCL because fiber crafts have a historical connection to computation (Essinger, 2004), make computational processes transparently performable (Keune, 2020), and are often performed collaboratively with others, for instance, through crafting circles. What remains unclear is what processes characterize a human-material collaboration and what may be identified as learning. Thus, we asked: *What collaborative learning processes do crafters reference when talking about engaging with materials while crafting? What learning is being produced during this collaboration?*

To answer the questions, we take a posthumanist stance that decenters the human to also positions materials as active contributors in collaboration to analyze 65 semi-structured interviews with adult crafters (e.g., knitters, quilters, sewers) and 397 photographs of crafters' projects through iterative thematic analysis. Findings present two themes that characterize the collaboration of crafter and craft materials: 1) *sensory collaboration,* where collaboration relies on the exchange of sensory information between crafters and materials through touch and sight and 2) *genealogical collaboration,* where expansion of the craft is made possible through collaboration that builds on past and present materials, and across different craft forms. Through the interview analyses, we observed that the craft technologies and techniques expanded and changed over time, presenting a material form of evidence of collaborative learning that neither belongs to the crafter nor the craft alone, but is a product of the shared engagement. This work has implications for theorizing collaborative learning processes and outcomes, expanding what can be considered a participant in collaborative learning.

Background

Physical and digital materials are often considered mediators for human learning (e.g., Yrjönsuuri et al., 2019; Stahl, 2013). Materials have been theorized as instruments that serve specific human learning objectives where materials turn into instruments based on context, practices, and the kind of knowledge that is intended to be gained (e.g., Ritella & Hakkarainen, 2012). Shared assumption center humans as main actor in collaborative learning and

materials as in-between humans. By contrast, more recent posthumanist perspectives call to decenter humans (Mehto et al., 2020). With histories in indigenous theories, physics, animal studies and beyond, posthumanist perspectives are concerned with inviting a range of voices into the inquiry of how materials work to produce human worlds (Kuby, 2017). These perspectives argue that non-humans can act on what manifests in the world (Mehto et al, 2020) and point to capture physical changes that are based on routine movements of people and materials (e.g., fiber crafts) and related to disciplinary domains as evidence of learning (Keune, 2020). Applied to CSCL, this questions what materials do in collaborative learning (Keune & Peppler, 2019).

An interesting question then is to explore what physical change happens through collaborative processes of people and materials. Fiber crafts are an interesting context for exploring this because they are historically linked to the fast-changing technological landscape (e.g., Essinger, 2004) and can be used to perform computational concepts (e.g., loops; Keune, 2020). While the discovery of new ideas and techniques can happen through direct experience with materials through trial and error (Gore, 2004), it remains unclear how crafters and craft may collaborate to inform new techniques and projects. Looking at crafting as collaborative technological practice from a posthumanist perspective presents a lens on collaborative learning that plays with established notions within collaborative learning, including processes, players, learning outcomes, and computation, and promises to see whether there is something that an additional set of theoretical tools could bring to the field.

Methods

This qualitative study included 65 adult crafters (20-73-years old) who were experienced in an average of three crafts (e.g., quilting, knitting, weaving). Crafters were recruited through online and offline crafting communities followed by snowball sampling. The majority of participants were female (n=60, 92%) and clustered around the Midwestern United States (n=38, 58%). Most crafters were white (n=57, 88%), four were Black (6%), three Asian (5%), and one did not share their racial identity (2%). Interviews were conducted at crafters' homes, studios, in public places, or through video conference.

Data sources

To investigate collaborative learning processes with materials, we analyzed 65 semi-structured interviews with experienced adult crafters that were conducted as part of an investigation into fiber craft for mathematics learning. Interviews were on average 59 minutes long and included questions related to 1) demographics, 2) connections between math and crafts, and 3) learning crafts. The interviews contributed to our understanding of the collaborative learning processes that crafters referenced as they reflected on their collaborative doing with the materials. The interviews also provided insights into the outcomes of such collaboration. To better understand what learning was produced as crafters and materials collaborated, data sources also included 397 photographs of crafters' projects. Of all, 21 crafters (32%) were comfortable sharing pictures of their crafts. The photographs contributed to visualizing the projects crafters mentioned and to reconstruct collaborative processes and outcomes.

Analytical techniques

To understand how crafters communicate collaborative processes with craft materials and how learning is produced, we engaged data that was collected based on humanist assumptions (i.e., interviews of people rather than material expressions) from a posthumanist point of view, assuming that materials take on an active role (Jackson & Mazzei, 2011). Thus, we first summarized any evidence that we could find in which crafters referenced collaborative engagement with materials, that is engagement in which it was unclear whether it was the crafter or the material that produced a project or a new technique. To ensure a shared understanding of what aspects to include in the summaries, Author 1 and 2 each created independent summaries of 13 interviews and then discussed them toward a shared summary. The shared understanding of the guided the writing of the remainder of the summaries. Then, Author 1 and 2 discussed the summaries in depth and iteratively coded them for emergent themes that captured how crafters talked about collaborating with materials. The themes included: 1) *sensory collaboration* with the sub-themes of *collaborating with textures* and *collaborating with visual elements* as well as 2) *genealogical collaboration* with the sub-themes of *collaborating with the past, collaborating with the present,* and *collaborating across craft forms.* We define and discuss the themes in depth in the findings section. To analyze the learning that is being produced during the material collaborative processes, we used the photographs to reconstruct the crafting processes that led to the production of new techniques and projects, evidence for the outcomes and learning that the craft experienced as it expanded itself.

Findings

Across the interviews, we identified two human-material collaborative learning processes: 1) *sensory collaboration*, which refers to how the people respond to the characteristics of materials through their senses and

the kind of characteristics that the material makes available to people and 2) *genealogical collaboration*, which refers to the expansion of a material practice, like craft, across past, present, and unrelated materials. Collectively, the themes contributed to understanding how crafters reference collaborative learning processes in discussing their engagement with materials and how learning takes place in such moments of collaboration. We discuss the themes and, in the interest of space, focus more closely on one example of genealogical collaboration.

Sensory collaboration

Sensory collaboration included two sub-themes. First, *collaborating with textures* captured how crafters used touch to respond to the tactile qualities of the materials while the materials made these tactile qualities feelable to the crafter. Across the data, 65% (n=37) of the interviews included collaborating with textures. For instance, crafters explained how textured yarn or fabric drove new techniques, projects, and shapes as materials produced particular effects. For example, a 34-year-old crafter said: "Wool fiber has barbs, so it catches on each other as they twist. Silk doesn't do that". The doing and catching of the textured matter was presented as an active contributor to how the project unfolded–a presentation not uncommon in the data.

Second, *collaborating with visual elements* referred to how the crafters used sight to respond to the visual qualities of the materials while the materials made these qualities available. Across the data, 37% (n=24) of the interviews included this theme. Examples involved aesthetics and decoration (e.g., color, general) as the driving force behind the production of new and widely circulating techniques. For instance, Diana, a 53-year-old quilter explained how the *scribbling* technique came about in collaboration among crafter and material: "Free-motion, you're actually (...) scribbling–that's the best way I can describe it–with your needle. (...) The trick is to do it in a way so that the stitches are even (...). If I were going over lines, back and forth, it would look kind of messy, but instead, I'm drawing patterns." This excerpt presents how the visual and decorative elements of the craft materials led to a new technique within quilting, one that could be named and pointed to.

Genealogical collaboration

Genealogical collaboration included three sub-themes that observed multiple lineages of technological development. First, *collaborating with the past* converted how crafters and materials engaged across generations of people and materials. Of all interviews, 22% included mentions that were coded with genealogical, including how working with heritage material made it possible to honor, connect to, and expand (family) history by physically exploring and expanding material markers of the past. The materials made it possible to engage with family members and events that had long passed and to continue them.

Figure 1. Die and diamond-shaped pieces of fabric (left), die cutter (right).

Second, *collaborating with the present* captured how the integration of current technologies and techniques informed the becoming of craft and crafter as the crafter, by virtue of using the new technique, and the new technologies, by virtue of blending with the craft, collaboratively advanced what was possible with craft. Of the interviews, 52% (n=34) included this theme. One example was the integration of a sewing machine with quilting, where the machine produced possibilities for quilting to become more rapid and for new techniques to flourish, including machine appliqué. Where the craft expanded to become a machine integrated technique, the crafters became gift-givers, creative producers, and, in some cases, published authors.

Third, *collaborating across craft forms* captured collaboration of crafters with materials that were not initially part of the craft as well as how the original craft materials accepted these materials to produce new techniques expanding the craft. Of the interviews, 38% (n=25) included this theme, including integrating electronics into traditional fiber craft, dyeing fabric with non-traditional materials, painting fabric and printing photographs on fabric. For example, Jenna, a 61-year-old quilter, described that she had not used her die cutter (Figure 1) for a long time before it "called out to her" for cutting fabric. Die cutters are intended for paper crafts. In quilting, they speed up cutting fabric shapes that can be sewn together. Jenna and the die cutter worked together to produce the shapes. The crafter applied pressure, by turning the handle. The die was open to be used with

different materials, including fabric, and the fabric accepted to be cut. This physically expanded the craft of quilting, growing lineages into paper crafts, as well as possibilities for new crafting techniques and designs.

Discussion and implications

This study showed human-material collaborative processes in which materials take on active roles. Learning outcomes–the physical expansion of the (craft) technologies of/in production–were contingent on the crafter *and* the craft materials. This was evidenced through physical technological development but did not belong to the human or the material. *Sensory collaboration* highlights surfaces in collaborative learning technologies and took serious aspects of human-material doing that would typically be considered secondary or unnecessary for learning (e.g., decorating). *Genealogical collaboration* made it possible to see an expansion of craft as a result of collaboration across craft forms and time. Although similarities are present to design in use, in which the purpose of materials can shift over time and with use (Ritella & Hakkarainen, 2012), the posthumanist lens highlighted the becoming of the craft and the crafter as physical evidence of learning through collaborative.

We cannot affirmatively say whether it was the crafter's insight or the materials presence that produced the expansion of the craft. In and of itself, this calls into question whether we can explain the repurposing of tools solely as human purpose. The study showed that the technology of quilting as much as the crafters developed over time. The study has implications for collaborative learning, presenting early evidence to consider including human-material collaborations as a form of collaboration. By seeing human-material collaboration as a driver of technological development and this development as evidence of human learning, a broader understanding of what counts as collaborative learning becomes possible. This is important because our study suggests that considering human-material collaborations make it possible to value practices and sensitivities that are otherwise at risk of being dismissed as secondary (e.g., decoration, feeling the material). For research this means closely attending to which materials to design with and what human-material processes are at play when capturing collaborative learning. More work is needed to consider collaborating with materials beyond adult crafts.

References

Keune, A. (2020). Fabric-based computing – (Re)examining the materiality of computer science learning through fiber crafts. [Doctoral dissertation, Indiana University]. ProQuest Dissertations Publishing.

Keune, A. & Peppler, K. (2019). Child-material computing: Material collaboration in fiber crafts. In Proceedings of *CSCL 2019*. Lyon, France: ISLS.

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.

Essinger, J. (2004). *Jacquard's web: How a hand-loom led to the birth of the information age.* Oxford University Press.

Gore, N. (2004). Craft and innovation: Serious play and the direct experience of the real. *Journal of Architectural Education*, 58(1), 39-44

Jackson, A. Y., & Mazzei, L. (2011). T*hinking with theory in qualitative research: Viewing data across multiple perspectives.* Routledge.

Kuby, C. R. (2017). Why a paradigm shift of 'more than human ontologies' is needed: Putting to work poststructural and posthuman theories in writers' studio. *International Journal of Qualitative Studies in Education*, 30(9), 877-896.

Mehto, V., Riikonen, S., Hakkarainen, K., Kangas, K., & Seitamaa-Hakkarainen, P. (2020). Epistemic roles of materiality within a collaborative invention project at a secondary school. *British Journal of Educational Technology.*

Ritella, G., & Hakkarainen, K. (2012). Instrumental genesis in technology-mediated learning: From double stimulation to expansive knowledge practices. i 7(2), 239-258.

Stahl, G. (2013). Theories of cognition in collaborative learning. In C. Hmelo-Silver, A. O'Donnell, C. Chan & C. Chinn (Eds.), *International Handbook of Collaborative Learning.* (pp. 74-90). Taylor & Francis.

Yrjönsuuri, V., Kangas, K., Hakkarainen, K., & Seitamaa-Hakkarainen, P. (2019). The roles of material prototyping in collaborative design process at an elementary school. *Design and Technology Education: An International Journal,* 24(2), 141-162.

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