



도토리묵 (Acorn Jelly) as an Actor to Connect Culture and Science

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Abstract: In response to research arguing for integrating culture into science education contexts, this analysis looks at how culture was an actor with agency in an elementary teacher professional development (PD) project. Drawing on actor network theory, we asked: How does culture as an actor exercise agency to shape an assemblage within elementary science PD activity? We focused on the Korean language and *도토리묵* (*dotori-muk*: Korean acorn jelly) as manifestations of Korean culture within our assemblage. Microgenetic analysis revealed three transitions where relationships between actors were re-assembled and translated into new learning trajectories. These transitions involved 1) the Korean language and 2) *도토리묵* exercising agency to influence the PD activity, and 3) Korean language and cultural practices influencing the teachers' and researchers' relationship to science. Findings provide insights for future research recognizing the agency and influence of culture on knowledge production.

Motivation

Research has shown how culture is an integral part of both scientific knowledge production and science learning (e.g., Bang et al., 2007). However, science as a discipline is traditionally conceptualized as narrow and static, establishing artificial binaries that separate science from culture and exclude students' cultural practices from science classrooms (e.g., Hudicourt-Barnes, 2003; Rosebery et al., 2010). This orientation results in a lack of culturally relevant learning experiences for students and constrains the types of science knowledge constructed in educational settings (e.g., Warren et al., 2020). Post-humanist approaches that consider the role of non-human and more-than-human actors in learning (Bellacasa, 2017) can help attend to this issue. Prior work on more-than-human actors has examined living beings within the context of the nature-culture divide (e.g., Bang et al., 2012). In this analysis, we seek to situate culture as an actor in its own right, viewing culture as encompassing how humans interact with each other and with the world around them. Recognizing that culture is often ill-defined (Hammond, 2014), we examine how culture (as represented by language and community practices) exercises agency and influences other actors, including science phenomena. This paper considers a group of actors (an assemblage) within an elementary science professional development (PD) community. We examined how an unfolding assemblage of researchers, teachers, and actors like culture re-arranged existing relationships, surfacing the influence of culture on science learning. We asked: how does culture as an actor exercising agency shape an assemblage within an elementary science PD activity?

Theoretical framework

Scholar Bruno Latour offered Actor Network Theory (ANT) as a new way to consider social relationships (2007). ANT reframes "social" not as a state or a static attribute of phenomena. Instead, ANT theorizes the social as a dynamic process that constantly (re)assembles connections between actors toward many different collective futures. These networks of connections among and between actors at any given time or place are called *assemblages*. With this reframing, Latour called for disciplines that study society (e.g., education) to "restudy what we are made of and extend the repertoire of ties and the number of associations way beyond the repertoire proposed" (p. 248). He argued that research should question phenomena that are positioned as commonplace or standard, and instead consider what types of actors and groups may influence these phenomena in the future. We propose culture as one actor that often goes unrecognized in studying the social in education. The current analysis aimed to question the well-established assemblage of classroom science in the United States: embedded in dominant, White, middle-class, English-speaking culture, one teacher has power over students as they learn science as a static discipline. In this established assemblage, students from monolingual English backgrounds tend

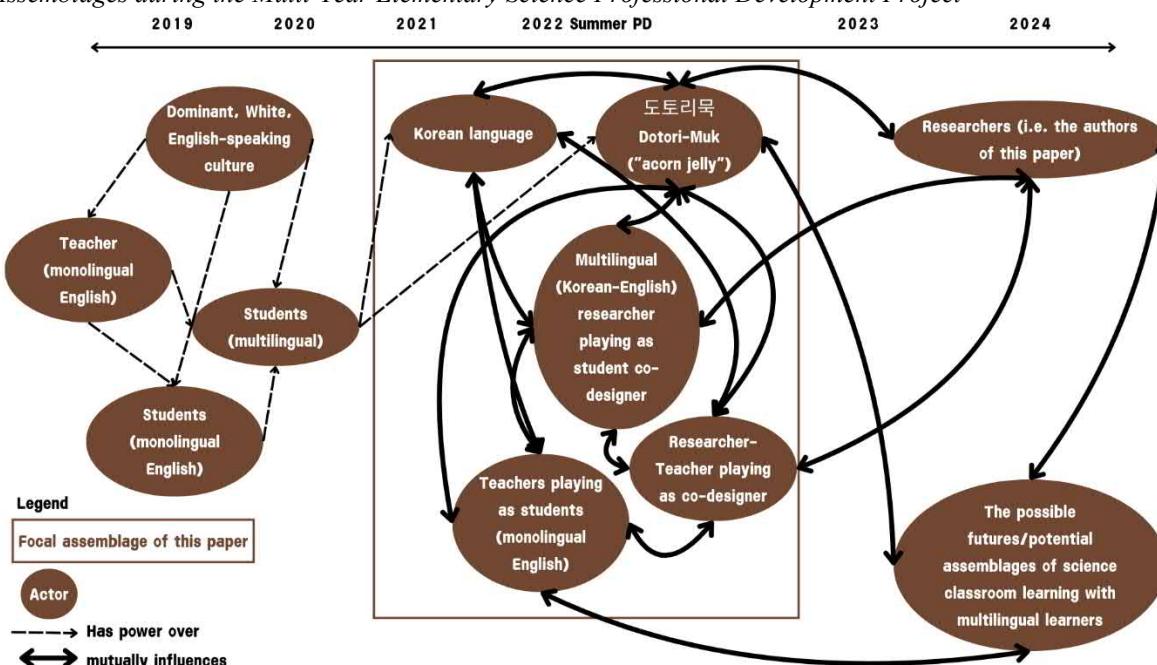
to hold higher status or have more power as they often have more opportunities to participate than multilingual learners (see left side of Figure 1; Chang-Bacon, 2022).

This paper focuses on two theoretical concepts within Actor Network Theory: *transitions* and *translations*. We define *transitions* as events that indicate a (re)assembling of connections that make an existing or new actor's relationship to the collective activity more apparent. For example, while scholars have argued that culture has always been intertwined with science (e.g., Bang et al., 2007; Bang et al., 2012), it is only more recently that culture's agency in science learning activities has been made more visible (e.g., Bang & Marin, 2015). A *translation* refers to the actors within an assemblage making sense of this new type of relationship or new connection to another actor. We argue that transitions and translations are important moments in the learning trajectory of the collective activity. Transitions and translations show us the process by which more expansive ways of knowing (Warren et al., 2020) are welcomed into classroom science.

Applying the ANT framework to our context, Figure 1 visualizes the transitions of the assemblage of teachers, researchers, and actors in our multi-year professional development (PD) project. The left side depicts a traditional assemblage and power dynamics: actors having one-directional power over other actors (i.e., dominant, White, English-speaking culture enacting influence over teachers who exert influence over students; monolingual speakers exerting power over multilingual speakers). Moving from this traditional assemblage, this study focuses on a new assemblage within the brown box in the center of the figure. Many of the former traditional relationships have been re-assembled as mutually influential (see legend in the bottom left corner). New actors like the Korean language and *도토리묵* (pronounced like “dotori muk” or translated loosely to English as “acorn jelly”) that are not typically acknowledged in traditional science classroom assemblages are also present. To honor the idea that assemblages are not static, the right side of Figure 1 also shows future directions that are made possible: teachers in their classrooms may take up the PD activity we describe below in very different ways than the activity in our focal assemblage. For instance, teachers might choose an anchoring phenomenon other than the acorns and oak trees we explored in our assemblage, co-design lessons with students who speak languages other than the Korean modeled here, represent different cultural practices, and make different scientific connections.

Figure 1

Assemblages during the Multi-Year Elementary Science Professional Development Project



Context and methods

The data for this analysis come from a multi-year design-based research project (Bell, 2004; Brown, 1992; Hoadley et al., 2002; Sandoval & Bell, 2004) focused on elementary science teachers using representations to support student sensemaking. Early in the project's first year, teachers requested resources to support multilingual learners in their classrooms. The research team designed and iterated tools and activities to meet this need (see Daniel et al., 2023). The current analysis looked at the fourth iteration of an activity designed to help teachers think about supporting multilingual learners. The activity took place during a week-long summer workshop in

2022 where teachers divided into small groups to explore problems of practice related to science teaching. Our focal assemblage experienced a lesson facilitated by Sarah (Author 1), playing the role of a Korean-speaking newcomer student, and Bethany (Author 2), playing the role of a science teacher. In the lesson, Sarah taught the group about *도토리묵* (*dotori-muk*, or Korean acorn jelly). Sarah spoke entirely in Korean and both Sarah and Bethany used lesson materials and each other to mediate Sarah's meanings for the group. The lesson connected to a broader Ambitious Science Teaching unit (Windschitl et al., 2018) the PD group had been exploring about acorns and the lifecycle of an oak tree to answer the questions, "Where do oak trees come from?" and "Who needs trees?". The assemblage we consider here included human actors (six in-service elementary teachers, two research team members, and the authors as facilitators) and actors that are not typically viewed as having agency (e.g., shared prior experiences, lesson materials, teaching frameworks, language, cultural practices, acorn jelly). In our analysis, we focused on Korean culture as an actor in the assemblage. Recognizing the vastness of culture as a construct, we sought to go beyond "surface" representations of culture (Hammond, 2014). We understood the Korean language as a form of deep culture that mediates how individuals move through and interact with their world and one actor with agency in our assemblage. We also recognized *도토리묵* (*dotori-muk* or Korean acorn jelly) as a manifestation of Korean culture. In understanding *도토리묵* as an actor, we included the product itself, its history, the process by which it is made, and cultural practices surrounding its use, such as eating it as *반찬* (*banchan* or a side dish).

We used a microgenetic method (Chinn & Sherin, 2014) to analyze our video data, which captured a rich learning process. We made frequent observations, and Bethany and Sarah completed fine-grained analysis of in-the-moment transitions toward collective learning. Together, we identified and discussed transitions in learning trajectories and noticed what co-occurred with the transitions, making arguments about culture's influence on learning trajectories. Many moments evidenced the influence of culture as an agent in the assemblage. We highlight three that exemplify how culture's influence was significant and novel to the assemblage.

Findings

In line with Actor Network Theory (Latour, 2007), we identified many transitions that occurred in our assemblage. Here we describe three transitions that served as key translations for our learning trajectories and analyze how representations of culture enacted agency in ways that influenced the trajectories of our assemblage. The first transition occurred early in the activity and was significant because our focal representations of culture (the Korean language and *도토리묵*) were introduced as actors. In a prior PD activity, Sarah had introduced *도토리묵* by recording on the whole group summary chart that her "family loves eating acorn jelly" and that she thought it was "made from ground up acorns." Sarah's move to introduce *도토리묵* as an actor within the broader PD network allowed Bethany to re-introduce *도토리묵* as an actor in this assemblage. She did this by connecting the actors of the summary chart, *도토리묵*, and Sarah. Bethany stated, "I got curious. That's a really interesting connection. I wonder if we can do something to have Sarah help us understand a little bit more about acorn jelly." These discursive moves positioned *도토리묵* as an actor with the agency to influence the subsequent activity of the assemblage, making visible for the teachers in the assemblage how it might be possible for them to also give agency to cultural representations in their own classroom assemblages.

A second key transition introduced the Korean language and an actor within the assemblage. As the activity began, Bethany invited Sarah to share her expertise to "help us think about [*도토리묵*] a little bit." Sarah responded by moving toward Bethany and holding up a picture of *도토리묵*. Sarah then tentatively said "친구들 안녕하세요 [hello, friends]" and waved, followed by a bow. Sarah continued speaking in Korean to share about *도토리묵* and her recent personal experience eating *도토리묵*. As Sarah spoke in Korean, Bethany helped interpret her story into English. Bethany and the teachers in the group collectively worked to understand Korean's agency by guessing and asking Sarah questions to confirm their understanding of her experience. Because the human actors did not speak Korean, they relied on other non-human actors to understand Sarah. These non-human actors included pictures of *도토리묵*, gestures (e.g., Sarah miming "eat"), and cultural practices like the practice of eating *도토리묵* as a traditional side dish and the practice of bowing during an introduction. The non-human actors exercised agency in ways that allowed human actors in the assemblage to translate relationships to facilitate communication. Furthermore, Sarah made space for Korean as an actor in the assemblage to exercise greater agency than it otherwise would have in our English-dominant PD space or than it has generally in science classrooms in the United States. The transition of Korean exercising greater agency in this space shifted the learning trajectory, renegotiating relationships between the human actors of the teachers and researchers and non-human actors. These first two transitions explored the relationship and networking between human actors and the actors of Korean language and cultural practices. The transitions pointed the human actors in the assemblage (Sarah, Bethany, the teachers) to recognize the agency that language and cultural practices already have and enact in multilingual science classrooms, even if that agency is oppressed or goes unrecognized in many spaces.

The third transition considers how Korean language and cultural practices as actors exercised agency to support interactions that sustained science learning. This third translation re-arranged actors' relationships to their own bodies and embodiment as influencing the assemblage's learning trajectory. As the assemblage unfolded, teachers as human actors learned more about 도토리묵 through the participation of new actors: a video on foraging for acorns to make 도토리묵; a recipe video of making 도토리묵; cards to sequence the process of making 도토리묵. These additional actors helped interpret the agentic moves of Korean language and cultural practices related to 도토리묵 that drove the assemblage's learning trajectory. Toward the end of the activity, 도토리묵 took on a new role, becoming not only an actor as a cultural representation, but also an actor in the process of science learning. Building on the networked knowledge the assemblage had constructed, Sarah continued to speak in Korean and guided the teachers as human actors to take on roles representing more-than-human actors (e.g., heat, water, motion) as they embodied the process of making 도토리묵. In this final transition, Korean language and cultural practices as represented by 도토리묵 enacted agency in directing the human actors to move in ways that reflected the steps involved in the practice of making 도토리묵. Together, these three transitions showed how human actors' relationships to non-human actors (e.g., cultural practices, language, embodiment) were re-arranged to translate traditional ways of relating to science as acultural and static into a new relationship to science as a dynamic discipline embedded in culture.

Discussion and implications

By focusing on three transitions and translations of relationships within a specific assemblage, this paper offers insights into how the learning trajectories of this collective were influenced by non-dominant culture and non-human actors. The first example focused on how non-human actors influenced the researchers to co-design an activity that centers oak trees, acorns, and how 도토리묵 is made. The second example showed how culture exercised agency over the activity by introducing Korean language as an actor that re-mediated the teachers and researchers' relationships to each other and to the phenomenon being studied—도토리묵 is not just a neutral object of investigation, but an important memory from many Korean children's experiences eating 반찬 (*banchan*) with their families. The third transition exemplified how both 도토리묵 and Korean language as actors shaped the learning activity to introduce embodiment as a tool for expanding teachers' and researchers' understanding of how multilingual learners make sense of scientific phenomena (i.e., states of matter).

This analysis offers theoretical and methodological implications for the Learning Sciences. First, the findings show how transitions within an assemblage expand current definitions of what is considered social. They provide insights into teacher professional learning practices by considering how assemblages translate and make sense of new relationships with actors that have traditionally been marginalized (in this case, multilingual learners, the Korean language, and Korean cultural practices). These translations of new social relations shape the learning trajectories of the assemblage. For instance, a traditional science classroom assemblage may have led to narrow, consensus-seeking visions of science (Pierson et al., 2023), in contrast with this new assemblage that allows for heterogeneous, multiple ways of knowing (Pierson et al., 2023; Warren et al., 2020).

Second, this paper provides a novel application of microgenetic methods. By leveraging post-humanist views such as assemblage theory, our analysis shows how microgenetic methods offer insights into claims at the micro level, and can also help us analyze how macro-level influences like culture are actors in local assemblages. Sarah and Bethany as actors in the space exercised agency within the assemblage to open up possibilities for culture as an actor to influence the assemblage. Other actors in our assemblage (e.g., the teachers, PD frameworks, shared representations of group thinking) were influenced by culture in different ways.

We conclude with a call for Learning Sciences researchers to continue acknowledging the agency and influence of culture and non-human beings on social activity. Science educators should go beyond simply leveraging cultural practices to support canonical science understandings. Instead, we can strive to recognize science as already inherently embedded in cultural practices. By recognizing the agency and influence of culture in its many forms, we introduce opportunities for multiple ways of knowing with actors that are traditionally marginalized. This reframing of science learning through actor network theory pushes on disciplinary boundaries of what counts as scientific knowledge and gives examples of more expansive ways of producing knowledge. These expansive learning trajectories create more equitable opportunities for students from diverse cultural backgrounds to bring expertise into science learning activities that is recognized as part of social assemblages.

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Acknowledgments

This analysis was part of a larger study funded by the James S. McDonnell Foundation (grant #220020521).