

## Materials and Participants: A Dialogical Relationship

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**Abstract:** Materials play an important role in learning. Humans actors use materials in particular ways depending on the context and materials also can shape how human actors use materials. This study explores the dialogical relationship between the participants and materials in suminagashi, a Japanese paper marbling activity. We found that materials that are traditionally thought of as art materials, such as paintbrushes, are used to support practices often considered science practices, such as experimentation.

### Introduction

Scholars have long recognized how materials play a role in learning and that they shape learning experiences in important ways (Gibson, 1977). For example, certain materials are often associated with particular disciplines and practices. A paintbrush can be thought of as a tool used in painting and visual arts, while a microscope may be linked to science and science experiments for closely examining specimen. In previous work, we found that 4-7th grade girls saw specialized materials of science being used for almost predetermined ends, limiting the types of activities or practices that the girls engaged in with those materials (Tsurusaki et al., 2017). Fields such as design studies have pushed conceptualizations of the role of materials to explore the active role they play in shaping the learning context and experience. In other words, there is a dialogical relationship between materials and the designer (Schön, 1992) and material agency is contextual, emergent, and contingent (Tholander, Normark, & Rossitto, 2012). Furthermore, both humans and materials possess agency (Shotter, 2006). We build on the idea that materials and designers are in a dialogical relationship by investigating materiality in STEAM activities with adults. We explore the question: *What is the dialogical relationship between the participants and materials in a STEAM activity?*

### Theoretical framework and methods

The meanings that material objects take on are situated within the contexts, narratives, and purposes of their use. Harré (2002) argues that material objects take on different meanings depending on the context of their narratives. For example, a needle may have meanings related to sewing, navigating, or removing a splinter depending on the context. Nasir and Cooks (2009) examine the importance of the role of material resources in learning the practices of a discipline, in this case, how athletes use material resources in the sport of track. Humphries and Smith (2014) argue that material objects "...[are] complex, vibrant and interactive agents capable of influencing and shaping the human experience" (p. 482). How material resources are used shape learning experiences.

While some may examine the use of materials in their final form, such as how a paintbrush or microscope is used (e.g., Harré, 2002; Nasir and Cooks, 2009, Humphries and Smith, 2013), some materials can also change form and the reflexive nature of the materials can impact learning in different ways. Ingold (2011) argues that materials are not fixed, but rather their meaning is made as they are used. It is in the process of creating or making that we draw out the potential of materials through our interactions and relations with them (Ingold, 2013). Therefore, it is our experiences and connections to the materials themselves from which we can draw meaning.

The context for this study was a two day, in-person STEAM professional development program for informal educators in the Northwest U.S. We analyzed the interactions of participants and materials in an activity called suminagashi, a process of paper marbling developed in Japan. Suminagashi inks were dropped into a bin of water, where they floated or sank depending on how the ink was added to the water, the surface tension of the water, and the density of the ink (Figure 1).



**Figure 1.** Participants dropping suminagashi ink into water bin (left) and paper marbling prints (right)

The participants used the ink bottles, various sizes of brushes, and other objects to apply and manipulate the ink and create designs. Once ink was added to the water, the participants used various types of paper to transfer the ink from the water bin to the paper. Two participants shared one set of materials, which included a water bin, suminagashi inks, brushes, and paper. We videotaped the activity and transcribed the video for dialogue and actions. We used interaction analysis (Jordan and Henderson, 1995) to explore the dialogical relationship between the participants and the materials.

## Major findings

What could traditionally be considered art materials, such as paint brushes and inks, are used in this activity to support experimenting and observation, which while they are practices in both art and science, are traditionally considered science practices. We found that examining the dialogical relationship between material and human actors can help us understand how a STEAM activity can support integrative thinking across science and art.

For example, Martha and Leah experimented with the inks and how they behaved in water. They observed that the yellow ink spread out when dropped into the water. Martha suggested that they try a different color ink, green with the same brush, and found that it did not spread like the yellow ink. They shared their observations and hypotheses about whether the brush or some property of the ink caused the different spreading. This episode shows the dialogical relationship between materials, people, and practices. As the materials reacted, the participants responded by experimenting with materials (e.g., trying different colors, brushes) to further explore the materials.

As they continued exploring, they experimented with different sized brushes, using brushes when they were wet or dry (“I think it has worked better when the brush is wet already”), different colors of ink, and placing the paper into the water in different orientations (e.g., dipping it under the surface, placing it on top of the surface, etc.). As they made observations about both how they were using the materials and how the materials were interacting with each other, they explored different ways of using the materials.

## Conclusions and implications

As Ingold (2011) argues, materials do not have objective uses apart from the purposes to which they are being put to use. There is a dialogical relationship between materials and participants who engage with materials. The materials shape how participants engage with them in a dialogical relationship. We argue that it is essential to consider the role that materials play, as agentic players, in participant learning and how learning environments are structured to allow for “reflective conversations” (Schon, 2012).

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