Supporting Focus on the Process of Learning, Rather Than the Product, in a STEAM Activity

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Abstract: This study explores how the design and facilitation of a STEAM activity during a professional development workshop supports a focus on learning through the process. How the activity was introduced and the whole group reflections – both mid-activity and at the conclusion of the activity - supported participants in making observations and focusing on the process, rather than the end product.

Introduction

Learners are often focused on the outcome or product of an activity, rather than the process of learning. The end goal is to get a correct answer or result on a lab or exam or to replicate an example artifact. A focus on the product or outcome is reinforced when learning is assessed through final answers and products. Focusing solely on products has been found to stifle learning, as it does not value learning that occurs during the process of working through an activity (LeJevic, 2013; Perignat & Katz-Buonincontro, 2019). However, many recognize that value should be placed on learning that occurs during the process of completing an activity, experiment, or project. For example, the *Next Generation Science Standards*, a set of standards used by many states in the United States, emphasize the development of science and engineering practices as an important aspect of learning science and engineering (National Research Council, 2013) and the *National Core Arts Standards* include a focus on creating art through processes such as conceptualizing, developing, and refining (National Core Arts Standards State Education Agency Directors of Arts Education, 2014). In this study, we begin to explore: How can the design and facilitation of an activity provide opportunities for learners to focus on the process, rather than the product?

Framework and methods

To address this question, we draw on the Tinkering Design Principles framework developed by Petrick et al. (2013), which positions tinkering and making as forms of legitimate peripheral participation in STEM and STEAM communities of practice. This framework emphasizes, among other aspects, facilitation through modeling STEAM practices, inviting learners to participate via multiple pathways, and prioritizing reflection. The present study uses this framework as a basis to investigate the ways in which such facilitation can support a focus on process, rather than product.

The context for this study is a two day, in-person STEAM (Science, Technology, Engineering, Art, Mathematics) professional development workshop. This study focuses on one of the activities that emphasizes science and art called Suminagashi, a process of paper marbling developed in Japan. Suminagashi inks are dropped into a bin of water, where they float, spread, or sink depending on the density of the ink, the application technique, and the surface tension of the water. The participants use the ink bottles, brushes of various sizes, and other objects to apply and manipulate the ink and create designs (Figure 1) which are then transferred from the surface of the water to various types of paper.

The data for this study consisted of video recordings of the Suminagashi activity from five different in-person workshop groups that were held in geographic locations across the United States. The participants included educators from a variety of institutions, including public library systems, science centers, art museums, and K-12 schools. We focused analysis of the data on the whole group reflection discussions of the activity. A facilitator introduced the activity by demonstrating the process of Suminagashi and then the participants had time to create Suminagashi prints. The facilitator led two whole group discussions – one in the middle of the activity and one at the end. The participants were paused during the middle of the activity to look at each others' prints, ask questions about techniques, discoveries, and choices, and encouraged to think about what they had tried out and observed while creating their prints. A similar discussion was held at the end of the activity to reflect on their learning during the activity. We transcribed the video and analyzed the transcripts using emergent coding (Strauss & Corbin, 1998), looking specifically at how participants talked about how the facilitation and design helped them focus on the process of doing the activity.

Findings and discussion

Overall, many participants noted the ways that both the design and the facilitation of the activity opened up opportunities to focus on the process. Specifically, participants noticed that activity was designed to focus on open-ended exploration, with the facilitator emphasizing that there was "no right way" to approach the activity and using language to position the activity as an "investigation" that relied on observation and other science and art practices. For example, one participant said, "I like that it started out more open ended though, just exploring, because it made me more, feel more free to just dive in" and another added that it "took the pressure off." One interpretation of these comments is that learners sometimes feel pressure to produce a particular kind of product, and the actions of the facilitator in removing the pressure off of focusing on a final product allowed participants to focus on exploring the process of Suminagashi. Another participant provided more detail about how the facilitation allowed her to focus on the process, saying:

> I think how she [facilitator] started with close observation. And giving us an opportunity to observe and ask questions. Which when we came to our tables, we continued to act in that way. Where if she'd set it up and said, okay, this is what Suminagashi is, you put some drops, and then you put your paper in and it makes a design. We would have come back and just done that. We wouldn't have come back and like, what's happening?

Here, the participants discuss the importance of how the activity was introduced and how they were encouraged to make observations and explore using different materials, rather than being told a specific way to do the activity. This encouraged them to try different approaches, make observations, and try again. How the activity was structured and facilitated supported participants' explorations in an open-ended way, rather than focusing on a specific end product.

This study reiterates the importance of the ways in which STEAM activities are facilitated. Calls for participating in authentically integrated STEAM involve drawing on a number of overlapping art and STEM practices. As legitimate peripheral participants, apprentices in STEAM learn the ways of being in practice through facilitator modeling, invitation, and guided reflection. Our study illustrates the importance of these facilitation strategies in opening up ways to focus on making and tinkering processes rather than products. Our results imply that facilitators should explicitly state norms, especially when they may be different than the norms of many learning spaces, and reinforce these norms throughout the activity. Group reflections, where participants have opportunities to observe and discuss what others have done, and then continue their own inquiry with broader insight from the group, are also useful for putting focus on the process, rather than the product.

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