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Navigating Standards-Based Making Practices in Elementary Classrooms

Purpose of the Study

The Maker movement, which aims to dissolve boundaries between disciplines to inspire inquiry-based thinking and problem-solving, has introduced new forms of interaction, innovation, and creative thinking to millions of people all throughout the world (Halverson & Sheridan, 2014). Although the majority of research into Making has focused on informal and out-of-school settings, research has suggested that embedding active, inquiry-based Maker activities into classroom settings could potentially change conceptualizations of learning and teaching (Schön, Ebner, & Kumar, 2014; Wohlbend, Peppler, Keune, & Thompson, 2017). However, despite the espousal of potential benefits for classroom integration of Making practices, research has yet to document how teachers and students navigate the tensions between traditional academic practices and the playful, imaginative, and collaborative design thinking that characterizes Making.

This proposal draws on results from the pilot year of a two-year, NSF-funded study. The project aimed to design, pilot, and integrate interdisciplinary, standards-based Maker kits into 12 elementary schools within a rural Southern school district. During the pilot, the kits, which included lesson plans linking all activities and materials (e.g., picture books, craft materials, tablets, 3D printers, circuits and other electronic materials) to ELA, science, math, and social studies standards, were integrated into 1st and 3rd grade classrooms. This paper describes findings from our study of teacher and students' interactions with standards-based Maker kits explicitly designed to address interdisciplinary standards. Our study was shaped by the following research

question: How do teachers and students utilize and navigate material, personal, and interactional resources when Making in the classroom environment?

Theoretical Framework

The Maker community encompasses “the growing number of people who are engaged in the creative production of artifacts in their daily lives and who find physical and digital forums to share their processes and products with others” (Halverson & Sheridan, 2014, p. 496). In classrooms, Making can also counter “many of the weaknesses of the traditional lecture-demonstration method, including the fragmentation of knowledge, student passivity, and the persistence of naïve beliefs” (Jackson, Dukerich, & Hestenes, 2008, p. 11). However, integrating Making into a classroom environment presents a complex set of challenges for both teachers and students: teachers and students must navigate often contrasting disciplinary norms and practices, in addition to new interactional relationships, identities, and purposes for Making.

This qualitative study situates teacher and students’ interactions with the Maker kits within the figured worlds (Holland, Lachicotte, Skinner, & Cain, 1998) of school and creative production. Building on the work of Bourdieu, Foucault, Leontiev, and Vygotsky, among others, Holland, Lachicotte, Skinner, and Cain (1998) define a figured world as a “socially produced and culturally constructed realm of interpretation in which a particular set of characters and actors are recognized, significance is assigned to certain acts, and particular outcomes are valued over others” (p. 52). It has proven to be a persistent theory for education researchers (Luttrell & Parker, 2001; Rubin, 2007) who have documented specific expectations, norms, and practices typically found within the figured world of school: (1) Classrooms are populated by teachers and students (often labeled as “smart,” “dumb,” “good,” or “bad”); (2) the

primary goal is to complete assignments and earn good grades; and (3) the most valued artifacts are unimodal, written, and “objective” (i.e., standardized tests).

As students and educators collaboratively construct and inhabit figured worlds, which “take shape within and give shape to the coproduction of activities, discourses, performances, and artifacts” (Holland et al., 1998, p. 51), certain activities and practices are valued and reinforced. However, means of expression, such as Making, can provide participants with opportunities to offer, take up, discard, and revise their identities in relation to new practices. For example, the figured world of creative production, such as that involved in Making, involves the remixing of content areas, genres, and cultural referents; moves between and among physical materials and composing tools; and the crafting of complex meaning (Vasudevan & Reilly, 2013). This study illustrates how teachers and students navigated multiple and hybrid contexts, histories, experiences, interactions, and resources for meaning-making within and across figured worlds.

Methods

Context and Participants

Our partner on DEMAND is a diverse, rural to suburban district in the Southern United States. Our pilot school, Creekside Elementary (all location and participant names are pseudonyms), serves a diverse population (59% White, 27% African American, 13% Hispanic, and 7% two or more races) of more than 800 students, 50% of whom receive free or reduced lunch. Two Creekside teachers, Ellen (1st grade) and Page (3rd grade), worked with the research team throughout the year to develop the Maker kits and to pilot three lessons designed for their grade-level and standards/topics that they identified as part of their curricula. Purposive sampling (Patton, 2002) was used to select the teachers based on three criteria: graduation from a shared

graduate-level specialized education program, an expressed interest in interdisciplinary teaching and learning, and a commitment to serving in a mentoring role throughout the next two years of the project.

Data Collection and Analysis

Methods for data collection assessed the effectiveness of DEMAND's design, development, and implementation processes using formative, summative, and knowledge-gaining measures. Primary sources of data used in this analysis included: video and audio recordings of Maker kit and classroom interactions; collection of artifacts from the implementation of Maker kit activities; teacher and student interviews; and surveys measuring teachers' beliefs regarding technology integration, Maker activities, and interdisciplinary instruction. The research team utilized stationary and mobile cameras, as well as audio recorders, to document students' and teachers' interactions with Maker activities. Additional data sources enabled the triangulation of data sources to ensure trustworthiness (Lincoln and Guba, 1985).

Quantitative data, such as survey responses, were assessed via t-test, which allowed us to examine central tendencies. Video and audio recordings were microanalyzed using the multimodal discourse analysis (MMDA) approach, which assumes that social interactions necessarily rely on forms of communication beyond language (Kress & van Leeuwen, 2001; Norris, 2004). This approach allowed researchers to understand how standards-based Maker activities were defined and negotiated by participants.

Findings

Findings are organized into two sections that illustrate how students and teachers navigated the figured worlds of school and Making as they engaged with the interdisciplinary, standards-based kits. In order to highlight the interactional and representational tensions inherent

when students and teachers engage with Making in the classroom, examples are drawn from the use of a Maker kit in Page's 3rd grade class, which began with students' reading and discussion of a book about the Swamp Fox, a local Revolutionary War figure. Using a light bulb, copper tape, a battery, and an overlaid message, students were then asked to compose a secret message to communicate information to fellow patriots without the British knowing.

Making Circuits: Engagement in Transdisciplinary Design Thinking

Initial interviews with students teachers revealed a need for additional projects and curricular initiatives that incorporated key STEM and design thinking skills. When we questioned Claire, a 1st grade student, about any experiments she had ever done, she replied, "I don't know what that is." Likewise, Kim, a 3rd grade student, noted that in second grade, "her class did some experiments, but not a lot," her favorite science project was "making slime." Ellen and Page also noted that they spent less than two hours total per week on science and social studies topics due to standardized testing pressures and limited time for any content area other than English Language Arts and math.

The Maker kits introduced new opportunities for participation in collaborative creative production, transdisciplinary design thinking, and experimentation. As the following exchange between Alice and Calvin reveals, circuit spy message creation required students to navigate multiple disciplinary (ELA, science, social studies, and engineering) practices, as well as experimentation and design thinking.

Alice: So, that didn't work. This one goes on the long side and this goes on the short side.

Calvin: They can't touch.

Alice: Ok. So, it doesn't feel like there's really tape on this.

Calvin: So, like this? What's that for? Fold here. (holds copper tape out for Alice).

Alice: Is it working?

Calvin: Look, it's glowing.

Alice: It's glowing. It shows the other spies where the weapons are!

Calvin: Maybe we should add a symbol on the map to hide where it is, like the Swamp Fox.

“I Don’t Want to Mess This Up”: Scaffolding Failure to Support Making

In the figured world of school, students are not often given the opportunity to fail in a safe space, much less encouraged to fail in order to advance a project. However, during open-ended Making projects, especially in situations of open-ended projects, there is a high likelihood that students will experience failure. Kurti, Kurti, and Fleming (2014) even discuss “failure” as one of the guiding principles of makerspaces and “simply the first or second or third step toward success” (p. 10). In the following exchange, Adam and Ezekiel experience failure as they create their message.

Adam: It’s hard to do this.

Ezekiel: Just go in here and grab it, I don’t want to mess this up.

Ezekiel: So, the British are here. Where’s the other one?

Adam: This right here, this could be where they are.

Ezekiel: Look at this, it looks so terrible. I can’t fit the tape in for the circuit.

Adam: I think we have to start over.

Page (walking over to boys): Oh my goodness, this looks great.

Ezekiel: It looks terrible. Am I doing it right?

Researcher: So, did you do one and you're doing one? So, you have your idea down. It doesn't have to be done, because this is just your draft, right? But it looks like you have a good idea. Should we try the next step?

Adam: *Is that okay?*

Researcher: Of course! So, what we're going to do is this, you're going to use this as a template to help you. It's called copper tape, so it's going to help the electricity move on the page.

Adam: So, the copper is the thing that helps it light up?

Adam's questioning of the researcher ("Is that okay?") as he is encouraged to see the initial message as a draft represents a shift from more traditional schooled interactions to a collaborative navigation of failure and discord. Although Adam didn't feel successful in the initial crafting of the message, seeing his draft as a step in the process, rather than a product that needed to be perfected, supported him in creating his spy message circuit. This suggests that in order to support students to challenge, negotiate, and discard ideas in the process of Making, pedagogical and interactional models need to account for the value of failure and discord over efficiency and ease.

Significance

Through an in-depth analysis of students' interactions and responses to the kits, this study traces the material, personal, and interactional resources that students bring to Making and describe how students learned to navigate new interactional roles across figured worlds. Our findings demonstrate that students' interactions with standards-based Maker kits offered new opportunities for participating in transdisciplinary design thinking and for legitimizing practices valued in informal and formal literacy settings (Author, 2017; Buchholz, Shovel, Peppler, & Wohlwend, 2014).

Our work offers significant implications for researchers and educators interested in designing Maker activities and the implementation of learning activities that blur the boundaries between in-school and out-of-school learning spaces. First, this study responds to the call for additional research focused on connections among Making, standards, assessments, and interactions to understand the role of Making in formal academic institutions (Halverson & Sheridan, 2014; Oliver, 2016). Further, for researchers interested in connect informal and formal learning spaces, this work raises important considerations for the practices and interactional roles that students and teachers must navigate while Making. Finally, for teachers and teacher educators interested in Making in academic settings, this study suggests ways to scaffold and support students as they engage in new forms of collaborative creation and interaction.

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