Making Uncertainty Work: How Youth Manage Uncertainty to Shape Learning Trajectories in a School Makerspace

Colin G. Dixon, Lee Martin and Sagit Betser
cghdixon@ucdavis.edu, leemartin@ucdavis.edu, sbetser@ucdavis.edu
University of California, Davis

Abstract: In this paper, we use positional, conceptual, and epistemological dimensions of student framing to investigate how youth navigated open-ended work in a school-based maker club, and how opportunities to pursue personally consequential learning differed across participants. We identity four ways that uncertainty functioned in interaction.

Keywords: uncertainty, youth, making, learning ecology, agency, framing, collaboration

Introduction

Maker spaces are typified by fluidity of roles, products, audiences, and values (Sheridan et al., 2014). Such open ended, resource-rich spaces hold potential for generative and equitable learning (Bell, Van Horne, & Cheng, 2017), but also create challenges as students learn to navigate concerns of technological tools, varied resources, and the power and social dynamics present in all learning environments. Investigating how young people shaped their learning opportunities, we analyzed collaborative work on open-ended projects in a high school-based "maker club". We came to focus on how *moments of uncertainty* acted as pivot points that young people used to position themselves within their project group in order to access and build on existing areas of expertise.

Theoretical framework

To understand how young people navigated collaborative product design, we turn to framing theory, which allows for analysis across three dimensions: *positional*, *conceptual* and *epistemological* (Van de Sande & Greeno, 2012). Hand, Penuel, and Gutierrez (2012) propose framing theory as a tool for developing equity oriented educational designs, noting that "who gets to define what and when a frame is," is central to the distribution of power and opportunity. The question of who defines frames is especially relevant to making spaces, where familiar, school-like frames have been destabilized. Moments of uncertainty in collaborative work are a productive place for inquiry into this process and into how learning happens (Jordan & McDaniel, 2014).

Methods

This study was part of a larger design-based research project in which we co-developed a "maker club" that operated for 3 months at a public charter high school. We acted as participant observers, leading workshops and mentoring youth, while also recording audio and video data, collecting field notes, and debriefing with our research team and the partnering teachers. Fifteen youth, ages 14 to 16, participated in the maker club – 7 boys, 7 girls, and 1 gender non-conforming; 5 African-American, 3 Latinx, 3 White, and 4 multiracial. A focal group comprised three young women and one young man, and their project type and the problems (both technical and social) that arose were similar to those seen in other groups.

In this paper, we consider observation data from the third session of Maker Club, when students moved out of skill-building workshops and began work on their project ideas. We transcribed interaction from the full day (4.5 hours), then coded the transcript for framing at positional, epistemological and conceptual levels. We began to notice moments of uncertainty as key sites at which frames were asserted, contested, or reinforced. Using verbal and non-verbal markers of uncertainty, such as questions, hedges, and hypotheticals (Jordan & McDaniel, 2014), we re-analyzed the transcripts, identifying places in the day where uncertainty was raised. In analysis of thirteen key moments, we identified themes in how moments of uncertainty functioned in the framing work students were doing. We present four of these themes here.

Findings

Theme 1: Solidifying positions, purposes & power

At moments of uncertainty we saw participants attempting to frame roles and resources in ways that established authority or solidified relationships. For example, in one episode, two participants, Casey and B, sustained uncertainty around technical details – like the spelling of "laser" – in ways that allowed them to strengthen connection to each other and reinforce their roles as project leaders. This action simultaneously served to

position another participant, Deonne, as a social and technical outsider.

Theme 2: Pursuing areas or topics of interests

Simply *raising* areas of uncertainty provided a way for participants to pursue areas of interest by directing attention to desired features. For example, Deonne, asked a disproportionately high number of questions about aesthetics and engraving, the aspect of project work that aligned most closely with her expertise and learning goals for the maker club. Raising uncertainty about a feature allowed participants to make bids for responsibility of those features by framing their own expertise or interest.

Theme 3: Directing activity toward personal resources

Management of uncertainty played an important role in students' ability to bring outside resources – material, conceptual and cultural - to bear, such as when Casey suggested a re-design that would have allowed the group to work at her house, instead of the school. The move would have helped her access expertise in carpentry, as well as tools that she had at home. Rather than building personal connections into a project during initial ideation, moments of uncertainty across the project allowed participants to frame priorities and direct solution paths toward familiar toolsets that allowed them to participate centrally and knowledgeably.

Theme 4: Inviting new perspectives, resources, and positions

When participants resurfaced issues of uncertainty they had shut down or let drop, they shifted the resources, constraints, and epistemologies that could be brought to bear. Students left some issues unresolved only to re-engage when a shift in context directed attention toward new resources, or provided for a new perspective on old resources. For example, when Deonne asked about project dimensions, the group did not address the issue, with Isaiah claiming they were "just prototyping." When a mentor raised the same question shortly after, his authority and knowledge of tool limitations reframed the issue for the group. They began a process of measuring, sketching and debate, but Deonne shifted from the center of discussion to the margins.

Implications

Collaborating on open-ended work in the maker club was a process of negotiation and compromise; each project decision had aesthetic and structural implications, consequences for how each group member was positioned in subsequent work, and consequences for what and how each team member learned through discussion and construction. Uncertainty was pervasive and persistent, conceptually and relationally. Resolution was non-linear and often seemed secondary to learner purposes for participation. Learners had to tolerate ambiguity while selecting where and when to raise questions and concerns.

Moments of uncertainty created cracks in the organization of learning situations, opening room for student agency. Functioning like pivot points (Calabrese Barton, Tan, & Shin, 2016), these moments were places of flux where young people had opportunity to push on what kinds of resources and knowledge were brought to bear. Framing work accomplished with introduction of or response to uncertainty had strategic effect, providing opportunities to capitalize on and extend existing expertise and positions of some youth. Conversely, management of uncertainty also served to thwart project features and discussions to the detriment of some interests, purposes and practices. How young people manage uncertainty plays an important role in STEM trajectories, critical to whether or not they can leverage identities and build expertise across settings and time.

References

Bell, P., Van Horne, K., & Cheng, B. H. (2017). Special Issue: Designing Learning Environments for Equitable Disciplinary Identification. *Journal of the Learning Sciences, 26*(3), 367-375.

Calabrese Barton, A., Tan, E., & Shin, M. (2016). *Mobilities of Criticality: Space-Making, Identity and Agency in a Youth-Centered Makerspace* Paper presented at the Transforming Learning, Empowering Learners: The International Conference of the Learning Sciences (ICLS) 2016, Singapore.

Hand, V., Penuel, W. R., & Gutiérrez, K. D. (2012). (Re)Framing Educational Possibility: Attending to Power and Equity in Shaping Access to and within Learning Opportunities *H uman Development, 55*.

Jordan, M. E., & McDaniel, R. R., Jr. (2014). Managing Uncertainty During Collaborative Problem Solving in Elementary School Teams: The Role of Peer Influence in Robotics Engineering Activity. *Journal of the Learning Sciences, 23*(4).

Sheridan, K., Halverson, E., Litts, B. K., Brahms, L., Jacobs-Priebe, L., & Owens, T. (2014). Learning in the Making: A Comparative Case Study of Three Makerspaces. *Harvard Educational Review, 84*(4).

Van de Sande, C. C., & Greeno, J. G. (2012). Achieving Alignment of Perspectival Framings in Problem-Solving Discourse. *Journal of the Learning Sciences, 21*(1), 1-44.