

AERA 2018
Structured Poster Session

Session Title: Measuring Making: Methods, Tools, and Strategies for Capturing Learning, Participation, and Engagement in Maker Activities

Session Abstract: In this structured poster session, we explore the current field of maker assessments. As making continues to enter different educational spaces, scholars and practitioners have struggled to capture the quality of learning, participation, and engagement that takes place as a result. We bring together scholars looking at a diverse range of maker activities to address two queries: 1) What standards and measures of success do different maker educators and researchers employ? 2) What are the different strategies, tools, and methods that they use to capture these? By compiling and cataloging these new approaches, our goal is not only to develop an ongoing research agenda, but also to think more holistically about the value of making as an educational practice.

Session Summary: In recent years, making has become more established within formal and informal educational spaces (Peppler, Halverson, & Kafai, 2016a, 2016b). As this trend continues, it becomes important to consider what counts as success in the field, especially in terms of individual outcomes. In other words, what knowledge, skills, perspectives, or experiences do we want participants to gain from this type of activity, and how do we measure these? Answering this question becomes especially important considering the diversity of these activities - for as many programs as exist, there are as many different markers of success as well as tools and techniques that people use to capture these.

In this presentation, we present examples of different approaches and efforts to assess educational making, from youth-generated artifacts like portfolios (Fields et al.; Peppler et al.; Lui et al.), reflective journaling (DeLeima et al.) and artists statements/assessments (Halverson et al.; Anderson), to new tools and methods such as gesture sensing (Davis et al.), electrodermal activity sensors (Lee et al.) and screencasts (Mortensen et al.), to traditional research instruments being leveraged for new purposes (Maltese et al., Erete et al., Rosenbaum and Hartmann).

By bringing together these different perspectives, we aim to address several queries. First, what different outcomes are researchers and educators focused on capturing in terms of educational making? Some have described the role that making can play in promoting 'hard' skills or knowledge such as STEM content or hands-on production skills (e.g. Blikstein and Krannich, 2013; Quinn and Bell, 2013), while others have described interest in expanding students 'soft' skills or 'maker mindsets,' including increased self-efficacy or creative expression (e.g. Chu et al., 2015; Sadler et al., 2016). In bringing together and cataloging these diverse perspectives, our aim is to think more holistically about the value of making as an educational practice. Second, we look into different techniques and methods that different researchers have explored in capturing these different outcomes. Advocates for educational making have often described one advantage as moving away from blunt measures of assessment such

as standardized testing (Dougherty, 2013); however, once shifting away from these long accepted methods, what new tools and techniques can educators rely upon to capture gains in knowledge or learning? Furthermore, how can these act as ways to compare learning, participation or engagement across these different spaces?

We aim to address the following goals:

1. Elaborate on different standards and measures of success within different makerspaces and programs;
2. Present examples of different tools and techniques being developed by different educators and researchers to assess these standards/measures;
3. Discuss how to create systems for sharing and comparing these assessment tools and techniques across different communities and spaces ;
4. Discuss an ongoing research agenda for further examining these issues.

Structure:

Part 1 (around 10 min) – Introduction to session goals, brief description of each poster

Part 2 (around 60 min) – Free time for poster walk-throughs

Part 3 (around 20 min) – Discussant comments/conversation based emergent ideas and questions

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Measuring Debugging: How Late Elementary and Middle School Students Handle Broken Code

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The Maker movement often emphasizes its value in seeding productive orientations to failure, even by creating rewards within the community to valorize spectacular failures (Martin, 2015). However, there is not nearly enough research devoted to understanding how students fail, respond to failure in the moment, or push themselves to develop productive failure practices within makerspaces (see Ryoo, under review, for a comprehensive examination of this argument). In order to understand whether and how makerspaces cultivate productive orientations to failure, educational researchers need multi-dimensional measures of students' practices around and thoughts about failure. Drawing on a measurement framework that triangulates between student participation, artifacts, and reflection (Sandoval, 2012), our research team is conducting case studies of middle school students' experiences of learning how to debug computer code in an informal weekend/summer learning space. This research takes place within a two-week coding workshop (M-F, 9am-4pm) that attracts students (n=60) new to computer science. Undergraduate computer science majors (n=7) who participate in two weeks of professional development ahead of the summer workshop take on the role of lead instructor.

Our approach to measurement melds together a number of perspectives on how students orient to failure: (1) detailed micro-longitudinal interaction analyses of the resources students recruit when debugging code (*participation*); (2) the specific debugging goals students set for themselves in coding journals (*reflection*); (3) the assessments students make of the efficacy of their own debugging strategies in coding journals (*reflection*); (4) the stories students tell about their debugging routines during artifact-based interviews throughout the coding process (*reflection*); (5) analyses of the types of bugs students encounter in their code (*artifacts*); and (6) analyses of the artistic artifacts students create to express their experiences of failure (*reflection*). In addition, our instructors reference iteratively designed conjecture maps to assess the extent to which our learning design choices foster the above outcomes.

Altogether, the above measures capture whether students adapt their approach to debugging over time, how students reflect on their debugging practice, how students relate to archetypal depictions of failure, and whether our instructors see change in students' approaches to debugging. For each of these measures, we prioritize process over outcome by collecting each measure at least once every day for two weeks of a summer coding workshop, thus allowing for micro-longitudinal analyses. In addition, we value the interconnections between these measures as much as we value change within each. For example, we ask: (a) To what extent do the debugging goals students set for themselves in their coding journals become focal points of their debugging conversations with instructors; and more specifically, (b) How do our instructors actively cultivate transfer by stitching together students' journal reflections and debugging practices in their teaching?; and (c) How do the stories students tell about their debugging processes relate to the actual debugging routines they enact with their instructors?

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