

Learning and Becoming Through Art-Making: Relationships among Tools, Phenomena, People, and Communities in Shaping Youth Identity Development

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Abstract: The making of art creates possibilities for youth to simultaneously learn about what is being represented and develop their own identity in relation to the representation and how it is accepted or reacted to by others. Each paper will present a different case of students making art, how the process that they engaged in afforded different learning opportunities, and the outcomes of their participation.

Introduction

There is growing concern in the Learning Sciences about the ways in which formal education is cut off from reality. Schools, even classrooms that adopt inquiry methods and ambitious pedagogies, often abstract disciplinary content away from the contexts and purposes of that knowledge—to solve complex, real world problems that are relevant to today's youth *now and into projected futures*. One consequence of hermetically sealing off schooling from real life by teaching the disciplinary content in abstract ways, with the hope that the concepts can be connected to students' passions and purposes at some later time, is to alienate students from disciplinary learning. Further, this formal education approach flies in the face of contemporary theories that recognize learning as intimately tied up with developing a sense of self and community through meaningful participation in the practices of the communities of which they are becoming a part.

The making of art—whether the medium is sculpture, film, performance, visual graphics, or new media—creates possibilities for youth to simultaneously learn about what is being represented and develop their own identity in relation to the representation and how it is accepted or reacted to by others. In fact, it is not clear if these aspects are separable at all. We see developing one's identity at the core of what it means to learn, and constructing representations at the core of the process of becoming and re-envisioning oneself in relation to the world.

Why Focus on Art as a Means for Academic Identity Development?

Art is deeply personal, but at the same time is always a comment on the world as well. The genre of artistic expression that we focus on is the construction of *art with a message*. While any painting may evoke an emotion and reflect the artist's perspective on the world, we focus on cases where students are explicitly and consciously aware of creating art to critique, comment on, explore, convince others of a particular idea or create a narrative with a message embedded within the story. *Art with a message* provides an opportunity for students to start from where they are and what they know, but to direct their artwork outwards, towards an audience and a community concerned with the very subject the students are exploring. Thus, it provides youth a pathway for participation in a community that extends beyond the classroom and a pathway for the community to begin to interact with youth in ways that serve varied interests.

Additionally, *art with a message* provides a productive tension between individualistic expression and competent community participation that helps us as analysts to uncover some of the pathways and tools for identity development that remain invisible in other contexts. For example, Halverson (2013) points out that art is often treated as the ultimate personal expression, and yet there are historical conventions for art making that community members expect the artist or maker to follow or selectively break. This contradiction creates a dilemma for adults who wish to work with and develop youth identities as film-makers or artists. In Halverson's study the professional communities of film-makers that worked with youth, they resolved this contradiction in different ways—creating very different pathways for students as a result. In summary, art

making has some unique affordances to involve both students and community members in new and interesting ways as well as being a revealing context to explore identity development more generally.

Theoretical Framework

There are many different theories of identity and identity development. Each scholar in the symposium has adopted a theory of identity best suited to explaining their data and context, in-line with their own intellectual history. However, our presentations will be unified by our attention to practice-based theories of identity—discursive practices, tools of the trade, and roles within a community that people use to guide and understand participation (e.g. Nasir, 2002; Wortham, 2006). Further, the presentations will attempt to theorize the relationship between practice based identity and narrative identity—theories that focus on the stories we tell ourselves that create a stable narrative of who we are (Sfard & Prusak, 2005)—in new ways. Understanding practice-based identities provide us pragmatic ways to think about the opportunities to create new pathways to become someone and support the day-to-day work of identity development.

At a broad level identity development can be examined in terms of the ontological development of the subject in relation to the goals and tools of the community (Nasir, 2002). There are often established pathways for people to move along this trajectory. Existing community members play a vital role in inviting newcomers in, modeling the practices and tools, and helping the newcomers to understand and appropriate the values and purposes of the community. These invitations mark out the long term trajectory and the ways that more competent members work with newcomers to achieve smaller milestones of competent participation. Polman (2010) argues that these negotiations between adults and youth are analogous to Vygotsky's notion of the Zone of Proximal Development calling them Zones of Proximal Identity Development to highlight that the focus is on identity rather than conceptual understanding.

At a more fine grained level of detail, our collection of papers offers a coherent look at the diversity of ways that adults work with youth in these ZPIDs. Halverson's earlier work (2013) is particularly important here. Her work documented how four different afterschool programs structured youth's production of documentary films. Her analysis focused on the various professional filmmaking tools (e.g., pitches, scripts, artist statements etc.) that fundamentally shaped students participation and products. All of the papers in the symposium will highlight the tools that students were mentored in using and how the tools contributed to and helped shape their developing identities and learning.

Summary of Papers

Each paper will present a different case of students making art, how the process that they engaged in afforded different learning opportunities, and the outcomes of their participation. Polman and Graville Smith describe how the combination of aesthetic and information design in infographics authoring within an authentic data journalism internship contributes to identity development and learning. Bang, Warren and Rosebery describe their evolving research to design an artsience approach to learning focused on engaging underrepresented middle and high school youth in exploring and appropriating to their own expressive and communicative purposes practices of cultivating attention, making, critique and exhibition in relation to climate change and the human microbiome. Halverson outlines four frames that used within educational research to study of identity and details four corresponding design principals for art-making projects that help lead to the development of positive self. Enyedy et al. describe how producing an interactive mural became a site for learning about their neighborhood and urban planning concepts and becoming activists who wished to inform and persuade their community about urban planning decisions.

Format of the Session

The symposia will begin with short 10-minute talks by each presenter. If space permits, we would like to give the audience 15 minutes to explore more closely the artwork generated by the participants of the various projects. This would be structured like a museum walk or a poster session, where the audience could more closely examine cases of student work and ask questions of the presenters. We would then reconvene for a 10-minute commentary by our discussant Na'ilah Nasir. Estimating 5 minutes for transition time, this would leave approximately 20 minutes for moderated discussion among members of the symposium and with the audience.

Becoming Data Journalists: Developing Authoritative Self-Expression through Infographics Creation for Publishing

Joseph L. Polman, University of Colorado Boulder and Cynthia Graville Smith, Saint Louis University

"Infographics" are visually dense representations of data and information, which are increasingly relevant to mass media and social media communication. Infographics are used in both print and electronic media as a means of visualizing data and as a medium of organizing and communicating science information and arguments. A number of websites such as *Visual.ly* and *good.is* distribute infographics, and they are used in

established outlets like *The New York Times*, *The Guardian*, and *Wired*. Infographics are more than charts created from quantitative data for they involve qualitative or visual cues which their authors use to illustrate or differentiate ideas (Lankow, Ritchie, & Crooks, 2012; Smiciklas, 2012). As such, infographics are an art form with a message, combining information design with aesthetic design.

As part of a broader project on developing young adults' science literacy through collaborative infographics, this presentation will focus on how the combination of aesthetic and information design in infographics authoring within an authentic data journalism internship contributes to development and learning.

We take a sociocultural perspective on human action and learning, using the notions of mediated action (Wertsch, 1998) and identification (Wortham, 2006) over time to interpret development as a combination of trajectories of participation and identification (Polman, 2012). We are concerned with the verbal and representational discourse of participants, as evidencing changes in scientifically literate ways of thinking (Polman, Newman, Saul, and Farrar, under review). In addition, we are concerned with the zones of proximal identity development (Polman, 2010) created by hybrid activity spaces where brokering and boundary objects present opportunities for young people to engage with disciplinary content and practices of professional groups in ways that allow them to develop new identifications (Gutiérrez, 2008; Polman & Hope, under review; Star and Griesemer, 1989).

The context of this research study is a year-round out-of-school data journalism internship for high school aged youth sponsored by the Communication Department at Saint Louis University, with support from a National Science Foundation Cyberlearning grant. The internship program was established by Graville Smith in January 2013, and has included 6 to 10 youth through three cycles of infographic authoring. Youth participants are recruited from community programs and high schools in the region, with an emphasis on recruiting African-American and Latino students, as well as students with an interest in art (from a nearby arts-based charter school). For this presentation, we will focus on four teens: Areli, an African-American young woman who attends a private, all-girls Catholic school; Amy, a Latina who attends a public suburban school; Moriah, an African-American young woman who attended an urban public high school with competitive admissions, and now attends a 4-year state college; and Brian a European-American who attends an arts-based urban charter school.

Our methods are case studies focusing on the trajectories of identification and participation of these four youth in the data journalism internship. We focus on the discursive accomplishment of their making of infographics in the nascent data journalism community of practice. We conceptualize infographics as a genre of "art with a message," and relate authoring work to youth's development of authoritative voices expressing their ideas about science and its importance to the lives of potential readers, and to their development of identifications. All four of these participants entered the program with trajectories aimed at arts-related careers: Areli intended to pursue a career in animation by way of studies in computer science, Amy intended to pursue a career in animation in a context similar to Pixar, Moriah intended to pursue a career in graphic design (she is now majoring in that field at college), and Brian intended to pursue a career in the visual arts.

Our preliminary findings include the following. The development of youth identifications was positively influenced by (1) the structuring of activity in the internship, (2) the authentic expressive practices, tools, and role as journalism practitioners taken on by youth; and (3) the status of data journalism with infographics as an emerging and shifting professional arena, and the specific youth internship as a nascent effort at participatory action research. Table 1 below shows the main stages of a graphic "project diagram" created by an adult staff member at the internship; the full graphic included specific actions and tools used at the various stages of an infographic design project. It shows how the chronological flow of activity is generally from top to bottom (ideation to data analysis to design) and from left to right (making choices, exploring and communicating), but arrows based on various contingencies lead to different stages non-linearly. Youth participants use the digital note-taking tool Evernote heavily, and identify what they are doing based on this framework.

Table 1: Stages of a graphic project

	Make Choices	Explore	Communicate
Ideas	Identify Idea	Research Idea	Pitch Idea
Data	Determine Data	Visualize Data	Present Data
Design	Draft Design	Modify Design	Submit Design

The activity framework above, with on the fly support from two adult supervisors, enables these youth to carry out a complex set of practices, all aimed at designing infographics which compellingly and clearly convey the youth's understanding of science that they see as relevant and interesting to their audience (youth readers of an online and print publication). Areli's infographic about zombie bees engaged her in communicating with a scientist doing emergent research in this arena, and she applied her skills as an illustrator to the task of

scientific illustration using the professional tool Adobe Illustrator, in order to create an eye-catching and information-rich diagram for readers (see Figure 1). Amy's infographic about when people really pay for tobacco use, in terms of incidence of mouth, lung, and esophagus cancer, challenged her to find a way to convey a large amount of data on diagnosis and mortality in a way that readers could understand quickly; she used a combination of Excel and Illustrator to visualize and organize representations. Moriah struggled to balance aesthetic and informational goals in her infographic on hair relaxers, which was exacerbated by the fact that she struggled to understand and therefore represent the complex whole-to-part magnification of a relaxed hair strand. Brian's infographic about tracing the evolution of the T. Rex to modern chickens challenged his self-positioning as a "dinosaur expert" and "great artist," when he struggled with the boundaries/gaps/depth of his knowledge to translate his lifelong interest in the topic into a coherent and concise representation of the emergent science topic.

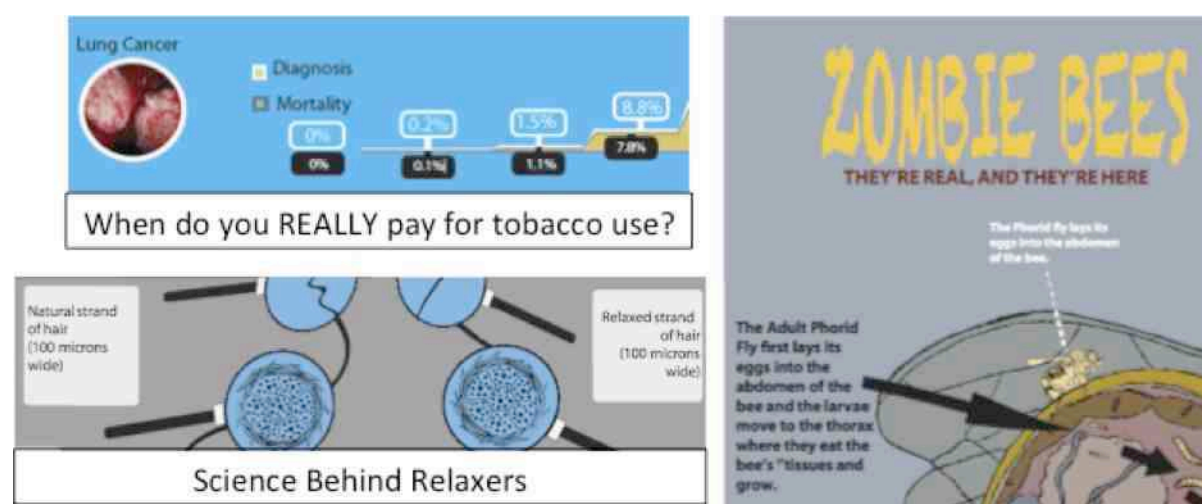


Figure 1. Detail from three science news infographics published by teen interns

These efforts benefitted from reference to authentic standards of good journalism, aimed at authoritatively conveying the current science, combined with support for aesthetic visual expression. Finally, the participants in this activity were readily able to engage in consideration of what it meant to position oneself in relation to possible selves, in part because data journalism in today's participatory, web-based media is such a moving target, and in part because their contributions to participatory action research had obvious affects on practices and tools in their own internship workplace.

We will discuss the implications of this research and development for learning environments aiming to incorporate artistic and design cultures.

Expansive Meanings and Makings in ArtScience

Megan Bang, University of Washington, Beth Warren and Ann S. Rosebery Chèche, Konnen Center, TERC

Expansive Meanings and Makings in ArtScience (EMMAS) is a collaborative design research project focused on exploring the untapped potential of an artsience approach to learning and teaching for youth from communities historically underrepresented in science, including Native American, African American, Haitian American and Latino youth. In Seattle and Boston, two teams of learning scientists, educators, artists, and scientists are engaged in designing artsience inquiries for middle and high school youth in the domains of climate change and the human microbiome, both critically important in 21st c life. In these inquiries, participating youth directly investigate complex scientific phenomena, interpret related artistic and scientific visualizations, and develop creative responses for community engagement that integrate scientific and artistic concerns, materials and processes.

As an emerging creative movement, artsience takes many forms, all of which highlight the commonalities in thinking and making practices used by artists and scientists (Brown et al., 2011; Edwards, 2008; Heath, 1986; Jones & Galison, 1998; Root-Bernstein & Root-Bernstein, 1999; Siler, 1996). In this research, we conceptualize an artsience repertoire to include multifaceted practices of cultivating attention, making, critique and exhibition. These practices interestingly connect with those specified in NGSS but more interestingly expand them into open and varied forms of experimentation and expression that integrate across embodied and represented experience. Further, they place strong emphasis on coming to know phenomena deeply as an open process of relational understanding grounded in heterogeneity (Bakhtin, 1981) or multiplicity (Massey, 2005). Thus, as conceptualized in this project, an artsience repertoire involves youth and adults,

working together, in making and re-making relationships with phenomena, tools, materials, histories, and each other as a creative, emergent process of growth (Ingold, 2013; Nasir, 2012; Wenger, 1998). In this sense, we approach identity development as the ongoing generation and negotiation of relations within a multiplicity of possible trajectories—what Doreen Massey (2005) calls “a simultaneity of stories-so-far” (p. 12).

Broadly speaking, in EMMAS we are exploring the possibility that artsience inquiries—in their openness to boundary-crossing thinking, diverse ways of seeing, and hybrid modes of creative expression—will expand opportunities for youth from communities historically underrepresented in STEM to a) engage meaningfully in complex science and art, b) develop depth of understanding and craft in domains of significance to them and their communities, and c) erase boundaries between learning in school and thinking-acting in the larger community.

- In Seattle, Native youth, working with Red Eagle Soaring Native Youth Theater and with oceanographers and marine ecologists, are creating and performing an original play that aims at re-narrating relationships between the salmon life cycle and ocean processes beyond the dominant discourses of adaptation and mitigation in climate change.
- In Boston, students at Boston Arts Academy (a public high school) from diverse communities are working together with science and art teachers, Broad Institute microbiologists, and local artists (a data sculptor, a painter, a computational artist) to re-envision the human body ecologically as an assemblage of life forms living together—a microbiome—with major implications for health and disease.

In both sites, students’ art-making will undergo rounds of critique focused on forward-looking analysis of evolving work and work processes. Their work will be performed or exhibited in public spaces with the goal of engaged community learning and co-production of possible futures in relation to climate change, health and disease. In these ways, artsience practices potentially make available to youth multifaceted identities that cross boundaries of art and science, school and community, nature and culture.

EMMAS is in its initial design phase. Therefore, in this paper we will share preliminary analyses of artsience design activity at the two sites. We will focus on examining interactions between educators, artists and scientists as they a) engage in sustained, close looking at scientific and artistic sources in the domains of climate change and the human microbiome, and b) experiment with art-making practices in response to the sources. Through interaction analysis and discourse analysis of key events, we will address the following questions: What insights, tensions, and questions arise as the designers—educators, artists and scientists—collectively cultivate their attention to these sources? What kinds of relationships to sources and materials are generated and negotiated as they experiment with art-making? What commonalities and differences emerge between the two sites? How do these inform design possibilities for artsience inquiries in climate change and the human microbiome for youth?

Cybermural: Becoming Artist Activists and Learning Urban Planning

Noel Enyedy, Jeff Burke, Fabian Wagnister, Amy Bolling, and Taylor Fitz-Gibbon, UCLA

Public spaces play an integral role in human life. To investigate how learning and becoming can be re-conceptualized to help youth become involved and informed citizens, we linked formal education to activism by locating learning and becoming in both an after school program and in the public spaces of the youth’s own neighborhoods. The students produced public art to comment on the past present and future of their neighborhood.

Given the goals of our project we developed a set of non-traditional learning objectives. Civic engagement can be seen to have a developmental trajectory that begins with awareness and personal responsibility, grows into participation, and culminates with a critical perspective and a set of practices to constructively engage in activism and our democratic process (Westheimer & Kahne, 2004). We see digitally enhanced public spaces as an opportunity to invite new members—in particular, youth—into existing community groups, sustain their interest and scaffold their participation, and support the development of a critical understanding of community issues and relate them to larger political and institutional arrangements.

Our model for promoting civic identity development, adopted from Learning Science work in youth activism (Kirshner, 2007) and digital media production (Halverson, 2008), centered on working with an existing community group that worked with 8 high school students in an afterschool program. To study the students’ learning and identity development, we used qualitative research methods including interviews and observations. For this presentation we will present the data from the interviews, which focused on students’ self-narratives of their own identities. Pre and post interviews were compared to explore students’ changed perceptions of self and issues impacting the community.

The CyberMural Authoring System and Process

The “cybermural” itself is a digital collage of photographs, drawings, and text produced by students that changes in response to an observer’s motion through a motion-based interaction camera system. However, from the standpoint of identity development and learning it is the authoring process, and not just the end-product, that is important. Below we outline the six phases of the authoring process where by students create art, understanding, and themselves in relation to their neighborhood.

1. **Students’ explore their community and their own prior knowledge.**
2. **Create media.** Students then create media assets (images, sound, etc.) that encapsulate some idea related to the broader themes that emerge from their exploration.
3. **Assign folksonomy keywords and weights.** The media that is gathered is uploaded in an online gallery by the students. The group revisits the conceptual discussions of step #1, and enumerates keywords (e.g., *gentrification*, *social connectedness*, *income*) that embody important concepts. Selected images are assigned tags that are “weighted” on a consistent scale (e.g., *income* on a scale of 1 to 100).

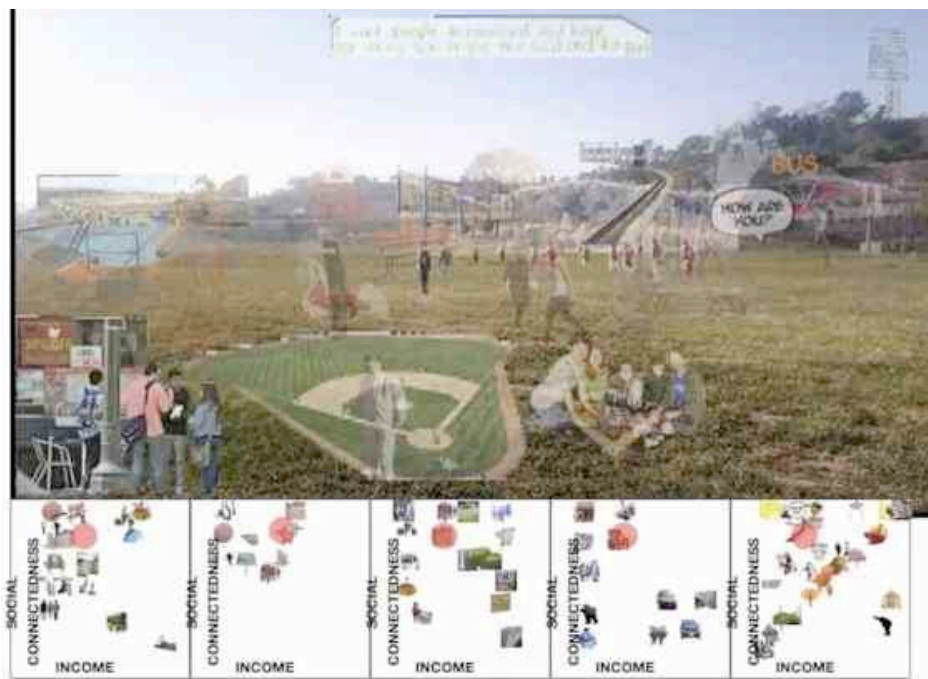


Figure 2. Building a scene from 5 different students ideograms

4. **Build “scenes” or “collections” from media.** To prepare an interactive mural, these tagged and coded media assets are now assembled into a traditional looking mural. However, the mural changes which images are displayed depending on the values of the concepts involved. For example in the mural depicted below the values are income 29 and social connectedness 82. As those values change the images such as the baseball diamond and swimming pool might disappear, while other images not present in this state appear for the first time.
5. **Map interaction to media responses via folksonomy concepts.** The concept values change based on how the audience member moves his body in front of the mural. For example, if an audience member got physically closer to the mural it might increase the “income” value, and thus change what images are displayed.



Figure 3. Constructing scenes for five student folksonomies

6. **Present the mural.** The final phase of the project involves students presenting their mural to the public and explain what they intend the mural to show.

We began this project with a Community of Practice (CoP) perspective. We expected the mural project would be an entry point into community of practice — a site of learning and action in which people come together around a joint enterprise and in the process develop a common, historically constituted repertoire of activities, set of stories, and way of speaking and acting (Wenger, 1998). However, we came to see our project more as an example of expansive learning (Engeström & Sannino, 2010), where students themselves contested the activity, and used the mural and the authoring process to develop a new hybrid practice that redefined the nature and purpose of their activity in the afterschool program and in their neighborhood.

Identity, Art-making, and the Design of Learning Environments

Erica Rosenfeld Halverson, University of Wisconsin-Madison

In this paper, I wrestle with the myriad constructions of “identity” that exist in education research, describe how these constructions have been used in the design of learning environments, and unpack what we can learn about identity and design through studies of art-making. There are four primary frames that are leveraged with respect to the study of identity within educational contexts:

- Identity as a *psychological construct* that describes individuals’ internal, lifelong sensemaking process;
- Identity as understood within the context of the *sociological processes* of our everyday lives;
- Identity as defined by a series of *social categories* that help individuals and communities to identify individuals and the cultural contexts to which they ascribe;
- Identity as constructed in and through *the narratives that people tell* formally, informally, and over the course of their lives.

While these frames are not mutually exclusive, each one offers a window into how we use identity in educational research, especially as we design interventions, curricula, and community settings that attend explicitly to issues of identity in learning.

Identity as Psychological Construct

Here, I am referring to the psychological tradition popularized by Erikson (1968) that frames identity as an internal mechanism by which we make sense of ourselves and how we fit into the world around us. This mechanism exists regardless of context, time, and interaction, but is activated by times of “crisis” when individuals experience a disconnect between their internal sensemaking and their actions in the world. Educational psychologists have favored this frame for identity and measure successful and unsuccessful development using validated measures (Marcia, 1994). Examples of designs that reflect a psychological stance on identity and development include Bers’ (2001) *identity construction environments* and Stern’s (2008) review of teens’ use of personal social media for identity development. I have considered the role of art-making in the study of psychological identity and I have found that the process of creating, adapting, and sharing original art facilitates psychological processes including exploring possible selves and creating a viable social identity (Halverson, 2005, 2009).

Identity within Sociological Processes.

The sociological frame for understanding identity competes with the psychological, theorizing identity as constructed in the social world through interaction (Mead, 1934). From a sociological perspective there is no

identity absent presentation; identity is historically rooted but constructed anew in every interaction. Most progressive educators resonate with a more sociological view of identity and study identity-in-action using frames including individuals' "figured worlds" (Holland & Lachicotte, 2007) or the "identity kits" that are constructed through discourse (e.g. Gee, 1989). Much of the work on communities of practice as learning environments draws on sociological understandings of identity to design spaces that afford the construction and presentation of identities-in-practice (Wenger, 1998). It is perhaps obvious that the sharing or performance of original art in the context of learning environment offers opportunities for the construction of sociologically-situated identities (Halverson, 2005). Less apparent but equally as powerful is the role that the adaptation of work for public performance plays in young peoples' socio-cognitive understanding of how representation creates (and is created by) identity (Halverson, 2010a, 2010b).

Identity in Social Categories

While identity as sociological process refers to the *how* of identity, we also think of identity in educational research in terms of the *apriori* social categories we assign to individuals (and that individuals assign themselves) as markers of identity. Social identity categories include race, ethnicity, gender, and social class (e.g. Kao, 2000; Phinney & Ong, 2007) but can also refer to "clique" categories defined by social group identification (Eckert, 1989). As research that evaluates individuals based on their categorical affiliation, this frame for identity is often constraining and deficit-based. However, design-based research that aims to debunk social categorization as a valid measure of positive identity development has proven a powerful method to overcome identity as stereotype (see, for example, Fleetwood, 2005; Lee, Spencer, & Harpalani, 2003; Nasir & Hand, 2008). Art-making experiences offer particular opportunities to "detypify" social categories through specific representational choices. In fact, youth art-makers often express and explore identity at the intersection among representational modes (Halverson, 2010b). It is important to remember that in art-making processes, representational choices are purposeful and that the designed learning environment serves to help youth make these choices and to reflect on them as a core part of what it means to understand the relationship between identity and art.

Identity as Narrative

Narratives as constituting and constitutive of identities can be found across psychological, sociological, and social categories' perspectives on identity in education. Learning environments from Alcoholics Anonymous (Cain, 1991) to the math classroom (Sfard & Prusak, 2005) draw on the narrativization of experience as crucial to learners' positive identity construction and affiliation. Art-making is a natural match for narrative conceptions of identity – it is easy to see how if we think about identity as instantiated in narrative why creating art is necessary for young peoples' development. I have found that for young people who feel marginalized from mainstream institutions, narrative opportunities to create, adapt, and express identity are crucial to the development of positive conceptions of self (e.g. Halverson, 2005, 2010a, 2010b).

Design Implications for Art-making and Identity

Regardless of which frame for considering identity we bring to bear in the design of learning environments, it is clear that art-making supports the development of positive self, especially for young people who regularly experience marginalization. For learning environments that value art-making, I consider the following principles for design:

- Draw on local community conceptions of identity as the basis for design; art-making supports both individualistic and collectivistic ways of thinking about identity;
- Engage learners in cycles of creating, representing, and sharing art so that learners can experience what each component of the cycle affords. Public sharing is especially important and is often left out of the design of learning experiences because they are difficult to organize and manage;
- Provide many opportunities for critique, feedback, and reflection. It is in these moments that young people come to articulate the relationship between their understanding of identity and how art-making supports identity construction and representation;
- Evaluate learning as both process and product, looking for the development of metarepresentational competence, an understanding of when to draw on which tools for what purposes in the expression of ideas about self (Halverson, 2013).

It is my hope that these design principles spark conversations around art-making learning environments but also help the learning sciences to think about identity as a theoretical construct more broadly in research.

References

Bakhtin, M. (1981). *The dialogic imagination*. Austin: Texas University Press.

- Bers, M. U. (2001). Identity construction environments: Developing personal and moral values through the design of a virtual city. *Journal of the Learning Sciences*, 10(4), 365-415.
- Brown, A., Snellson, K., Root-Bernstein, R. & Siler, T. (2011). An ArtScience Manifesto. *Leonardo Journal of Art, Science, Technology*, June 2011.
- Cain, C. (1991). Personal stories: Identity acquisition and self-understanding in Alcoholics Anonymous. *Ethos*, 19(2), 210-253.
- Eckert, P. (1989). *Jocks and burnouts: Social categories and identity in the high school* (Chapter 1, pp. 1-24). New York: TC Press.
- Edwards, D. (2008). *Artscience: Creativity in the post-Google generation*. Cambridge, MA: Harvard University Press.
- Engeström, Y., and Sannino, A. (2010). Studies of expansive learning: Foundations, findings and future challenges. *Educational Research Review* 5.1 1-24.
- Erikson, E. (1968). *Identity: Youth and crisis* (Prologue, Chapter 3, Chapter 6). New York: WW Norton & Co.
- Fleetwood, N. R. (2005). Authenticating practices: Producing realness, performing youth. In S. Maira and E. Soep (Eds.), *Youthscapes: The popular, the national, the global* (pp. 155-172). Philadelphia, PA: University of Pennsylvania Press.
- Halverson, E. R. (2005). InsideOut: Facilitating gay youth identity development through a performance-based youth organization. *Identity: An International Journal of Theory & Research*, 5(1), 67-90.
- Halverson, E. R. (2010a). Film as identity exploration: A multimodal analysis of youth-produced films. *Teachers College Record*, 112(9), 2352-2378.
- Halverson, E. R. (2010b). Detyfication as identity development: The dramaturgical process and LGBTQ youth. *Journal of Adolescent Research*, 25(5), 635-668.
- Halverson, E. R. (2013). Digital art-making as a representational process. *The Journal of the Learning Sciences*, 22(1), 121-162.
- Heath, S.B. (1986). Good science or bad art? Or both? In D. Baker, J. Clay and C. Fox (Eds.), *Challenging ways of knowing: In English, mathematics and science*, pp. 13-18. London: The Falmer Press.
- Holland, D. & Lachicotte, W. (2007). Vygotsky, Mead, and the new sociocultural studies of identity. In H. Daniels, M. Cole, & J. Wertsch (Eds.), *The Cambridge companion to Vygotsky*. London: Cambridge.
- Ingold, T. (2013). *Making: Anthropology, archaeology, art and architecture*. New York: Routledge.
- Jones, C. & Galison, P. (Eds.). (1998). *Picturing science, producing art*. New York: Routledge.
- Kao, G. (2000). Group images and possible selves among adolescents: Linking stereotypes to expectations by race and ethnicity. *Sociological Forum*, 15(3), 407-430.
- Kirshner, B. (Ed.). (2007). Special issue: Youth activism as a context for learning and development. *American Behavioral Scientist*, 51(3).
- Lankow, J., Ritchie, J., & Crooks, R. (2012). *Infographics: The power of visual storytelling*. Hoboken: NJ: John Wiley & Sons, Inc.
- Lee, C. D., Spencer, M. B., & Harpalani, V. (2003). "Every shut eye ain't sleep": Studying how people live culturally. *Educational Researcher*, 32(5), 6-13.
- Marcia, J. E. (1994). The empirical study of ego identity. In H. A. Bosma, T. L. Graafsma, H. D. Grotevant, & D. J. Delevita (Eds.), *Identity and development: An interdisciplinary approach* (pp. 67-80). Thousand Oaks, CA: Sage.
- Massey, D. (2005). *For space*. Los Angeles: Sage.
- Mead, G. H. (1934). *Mind, self, and society* (Part III, pp. 135-200). Chicago: University of Chicago Press.
- Nasir, N. (2002). Identity, goals, and learning: Mathematics in cultural practice. *Mathematical thinking and learning* 4.2-3 213-247.
- Nasir, N.S. (2012). *Racialized identities: Race and achievement among African American youth*. Stanford: Stanford University Press.
- Nasir, N. & Hand, V. (2008). From the court to the classroom: Opportunities for engagement, learning, and identity in basketball and classroom mathematics. *Journal of the Learning Sciences*, 17, 143-179.
- Phinney, J. S. & Ong, A. D. (2007). Conceptualization and measurement of ethnic identity: Current status and future directions. *Journal of Counseling Psychology*, 54(3), 271-281.
- Polman, J. L. (2010). The zone of proximal identity development in apprenticeship learning. *Revista de Educación*, 353(September-December), 129-155.
- Polman, J. L. (2012). Trajectories of participation and identification in learning communities involving disciplinary practices. In D. Yun Dai (Ed.), *Design research on learning and thinking in educational settings: Enhancing intellectual growth and functioning* (pp. 225-242). New York: Routledge.
- Polman, J. L., and Hope, J. (under review). Science news stories as boundary objects affecting engagement with science.
- Polman, J. L., Newman, A., Saul, E. W., & Farrar, C. (under review). *Adapting practices of science journalism to foster science literacy*.

- Root-Bernstein, R.S. & Root-Bernstein, M. (1999). *Sparks of genius*. Boston: Houghton-Mifflin Company.
- Sfard, A. & Prusak, A. (2005). Telling identities: In search of an analytic tool for investigating learning as a culturally shaped activity. *Educational Researcher*, 34(4), 14-22.
- Siler, T. (1996). *Think like a genius*. New York: Bantam Books.
- Smiciklas, M. (2012). *The Power of Infographics: Using Pictures to Communicate and Connect with Your Audiences*. Indianapolis, IN: Que Publishing.
- Star, S. L. & Griesemer, J. R. (1989). Institutional ecology, 'translations,' and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology. *Social Studies of Science*, 19(3), 387-420.
- Stern, S. (2008). Producing sites, exploring identities: Youth online authorship. In D. Buckingham (Ed.), *Youth, identity, and digital media* (pp. 95-117). Cambridge, MA: MIT Press.
- Wertsch, J. V. (1998). *Mind as action*. New York: Oxford University Press.
- Wenger, E. (1998). *Communities of practice: Learning, meaning and identity*. Cambridge: Cambridge University Press.
- Westheimer, Joel, and Joseph Kahne. (2004). What kind of citizen? The politics of educating for democracy. *American educational research journal* 41.2: 237-269.
- Wortham, S. (2006). *Learning identity: The joint emergence of social identification and academic learning*. New York: Cambridge University Press.

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