

Making Identities: Understanding the Factors that Lead Young Adults to Identify with the Maker Movement

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Introduction

This research paper explores the factors that contributed to the formation of Maker identity in a population of young adults. Within the last fifteen years, numerous education reports have highlighted a collection of skills and competencies, such as practical ingenuity, collaborative problem-solving, design-based thinking, and self-directed learning, as necessary for the next generation of STEM professionals (Johnson et al., 2016; Moore et al., 2014; National Academy of Engineering, 2004). Many educators have identified these qualities in the activities and practices of the Maker Movement, a social phenomenon that combines the Do-It-Yourself ethos of the 1960s, the power of internet-based knowledge-sharing platforms, and the democratization of digital fabrication technologies. The upshot of this strong connection is an increasing interest in employing Making in educational contexts.

While most efforts to import elements of the Maker Movement into education have focused on specific tools, materials, and pedagogical strategies, little attention has been paid to the existing population of young adults who self-identify as Makers and who are often highlighted as exemplars of the movement's potential to revolutionize STEM education. In order to gain insight into the experiences of these individuals, we analyzed interviews from young adult participants in several national Maker Faires utilizing the conceptual lens of identity formation. Through a theory-driven qualitative analysis, we uncovered a number of factors that could help educators foster Maker cultures at their institutions and, by doing so, create the engineers, scientists, and STEM-literate citizens of the future.

The Maker Movement, Envisioned and Embodied

"Making is fundamental to what it means to be human."

-Mark Hatch, *The Maker Movement Manifesto* (2013)

In 2005, technologist and author Dale Dougherty founded the quarterly publication *Make:* magazine with seemingly modest ambitions. He likened it to *Popular Mechanics* "which had the attitude, if it's fun, why not do it?" and suggested that "such publications often helped people to start a new hobby and learn new skills" (Dougherty, 2012). Dougherty framed Making as a 21st-century update of craft-related techniques, which encompassed traditional activities like woodworking, sewing, and soldering (Martin, 2015), but also included computer-based activities such as coding, 3D-printing, and laser cutting. In the first issue of *Make:*, Dougherty framed the idea of Making in contrast to consumerism by saying, "more than mere consumers of technology, we are makers, adapting technology to our needs and integrating it into our lives" (McCracken, 2015).

In 2006, Dougherty launched Maker Faire, an outdoor festival that allowed Makers to display their projects, to socialize with Makers with different backgrounds, knowledge, and skills, and to act as a grassroots outreach mechanism for members of the public unfamiliar with the magazine (McCracken, 2015). While the first Maker Faire attracted 22,000 members of the public, the

2016 Bay Area Maker Faire saw an attendance of 150,000 and was among 190 other Maker Faires that took place in over 38 countries and that reached an estimated 1.45 million people (“Make a Maker Faire,” n.d.).

In parallel with the rapid growth of Maker Faires, hundreds of community workshops, often called makerspaces, hackerspaces, or Fab Labs (Lou & Peek, 2016) have been established. Although these spaces vary widely in the types of tools and machines they contain, who can access the equipment, and their business and operations models, they all emphasize the importance of the collaboration and socialization of Makers. While Makers utilized community spaces and festivals to connect in-person and share physical resources, the establishment of websites like Instructables and Thingiverse have allowed Makers to share ideas and collaborate on designs through the internet.

Dougherty and other leading voices in the Maker Movement have elaborated on the importance of Making as a cultural phenomenon, specifically noting its power to revolutionize economies, empower individuals, and increase technological innovations (Anderson, 2014; Thilmany, 2014). In addition, Dougherty and others have suggested that the principles of Making could be powerful mechanisms for change within the realm of education.

Making in STEM Education

Only a few months before the release of the first edition of *Make:* magazine, the National Academy of Engineering published its landmark report *the Engineer of 2020*, which intended to help frame the challenges and contexts future engineers will face, as well as the personal attributes that could help them succeed. Some of the key characteristics noted were practical ingenuity, leadership capabilities, business management skills, resilience, flexibility, and agility, many of which correlate with qualities utilized in Maker practices. Since that time, additional calls from academic and governmental institutions for the development of similar qualities have reinforced the connection between Maker practices and STEM learning (Harvard Graduate School of Education, 2015, Office of Science and Technology Policy, 2016; Johnson et al., 2016; Moore et al., 2014)

Thus, hundreds of schools, museums, science centers, and libraries have taken up the standard of the Maker Movement. Education scholars have pointed out that Maker-based educational programs are rooted in the constructionist works of educational philosophers like John Dewey and Seymour Papert (Martin, 2015), and are also related to emerging pedagogies that promote grit (Duckworth, Peterson, Matthews, & Kelly, 2007) and growth-mindset development (Yeager & Dweck, 2012). These synergies have worked in favor of integrating Making into education, especially given the movement’s loyal supporters and positive brand image (Bean & Rosner, 2014). Yet, that image has often been strongly linked with the material elements of the culture, like 3D-printers, power tools, and Arduino microcontrollers, along with the idea of a dedicated makerspace for conducting Maker activities. This has led many institutions to take their first steps towards Making by making large investments in equipment, facility renovation, and even new construction.

At the heart of these efforts is the question: how do we optimally incorporate aspects of the Maker Movement into our schools, museums, libraries, and extracurricular institutions? By moving immediately to the materials and tools or considering Making as part of a more traditional curricular program, we believe that educators may be missing the most important piece of the movement—the Makers themselves.

Making Makers

In this vein, we took a different perspective than previous researchers and began by considering the person-centered nature of Making. While processes of design, collaboration, and iteration are thought of as important elements of Making, as are technical skills like drilling, sanding, and 3D-modeling, the movement is essentially about people. Even in the very nomenclature of the movement, Makers are emphasized over the disembodied act of “Making”. When describing Makers, other categories of identities are often invoked such as designers, scientists, engineers, entrepreneurs, and inventors.

Instead of starting with physical materials or pedagogical strategies, we started with the end goal in mind: the formation of a Maker. If the aim of education is to form people who have certain skills, knowledge, and attitudes, then it would be useful to gain a deeper understanding of the young adults who already embrace them.

The concept of identity has been explored extensively within the larger social science and educational research communities as well as in engineering education (Kaplan & Flum, 2012; McLean & Pratt, 2006; Tonso, 2006). In looking for a place to gain a foothold in assessing Maker identity, we chose to utilize Gee’s conceptual framework for identity (Gee, 2000), as it was educationally-oriented and based on a socially-constructed conception of identity. It also made sense given that the Maker Movement meshes well with what Gee calls the Affinity-identity, which is derived from the shared experiences of those taking part in an interest-driven specific practice. At the same time, Gee points out that identity labels, such as Maker, can be seen through a variety of lenses, often simultaneously. In considering the possibility that Maker identity may have other dimensions, we hope to provide new insights about what draws young adults into Making.

In addition to Affinity-identity, Gee describes three other identity categories: Nature-identity, which is attributed to innate qualities that are presumed to be unchangeable, Institutional-identity, which flows from the roles and responsibilities associated with a specific position with an institution, and Discourse-identity, which relates to characteristics that derive from interactions with others (See Fig. 1). Describing a person as a “tall, intelligent professor who plays basketball” provides simple examples of all four identities types. Yet, it may be the case that each of these identities overlaps or relates, such as height and playing basketball. It was these connections and intersections that often brought to light the most interesting findings in our study.

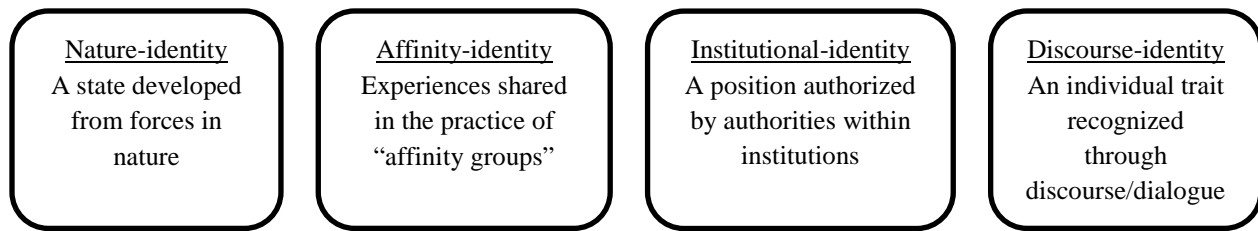


Fig. 1 Original Analytical Framework for Identity (Gee, 2000)

Research Questions

RQ1: How do Young Makers describe the factors and experiences that led them to adopt a Maker identity?

RQ2: How can an identity framework help educators more effectively leverage the values and practices of the Maker Movement in formal learning environments?

Research Design and Methods

Utilizing Gee’s identity framework as a conceptual starting point, we conducted a theory-driven thematic analysis (Boyatzis, 1998) of semi-structured interviews with self-identified Young Makers. The intention in starting with an *a priori* theory was to provide an initial foothold for starting the discussion of Making as an identity. Through a constant comparative process (Glaser, 1965), Gee’s original theory was amended and expanded to account for Maker-specific identity types observed in the conversations.

The data utilized for this research was gathered as part of a larger NSF-funded study of approximately 84 Makers who displayed their works at flagship Maker Faires in the United States . Makers were asked to take part in semi-structured artifact elicitation interviews and were then contacted via email to participate in deeper critical incident interviews (Flanagan, 1954; Klein, Calderwood, & Macgregor, 1989).

The methods utilized here are an extension of previous work done by Lande and Jordan in exploring the learning outcomes and educational pathways of Makers (2014, 2016). While data for the original study was gathered to maximize variation in the sample, for this investigation 11 critical incident interviews of Young Makers (ages 12-21) were chosen based on a purposive sampling strategy (Creswell, 2015) as a subset of the original group. Critical incident questions are aimed at uncovering the participant’s feelings, thoughts, and rationale associated with personally-meaningful events and decisions. Examples of questions utilized in the protocol are “*How did you become a Maker?*”, “*How have your experiences in school prepared you for the Making you are doing now?*”, and “*What role does community play in your experience as a Maker?*”.

All interviews utilized for this study were conducted via telephone or Internet-based teleconferencing software. Parental or guardian consent was obtained for all minors participating in the study, and minors were also provided with assent information. Participant data was

collected through audio recordings, transcribed utilizing an online transcription service, and then anonymized through pseudonym assignment.

Findings/Themes

The resulting themes highlight key factors that led to the formation of Young Maker identities in the participants. While Gee's initial identity categories were applied as *a priori* codes, additional categories emerged from the data. These emergent identity types are bolded in this section and an amended framework is presented in more detail in the following section.

Meaningful Personal Connections

Discussions about meaningful relationships were a common starting point when Young Makers described the development of their interest in Making. While comments about the roles of friends and family initially seemed to fit under the category of Discourse-identity, it became evident that this label was not descriptive of the Young Makers' experiences. Most instances of early Making occurred, not because they forged socially-imbued personal qualities, but due to the fact that a Young Maker was personally invested in a particular relationship. In many instances, these were parental relationships; in others, they were peers or teachers. From these examples, the **Relational-identity** category emerged as a key addition to the initial framework.

My grandpa taught me woodworking from a pretty young age. I started when I was like seven, doing a lot of basic stuff. Learning how to use tools safely, mostly, but I kind of got that realization. This was like post-Lego kind of, like can actually build functional things out of wood. It was like, "Oh wow, that's awesome."

-Alex

When speaking about Relational-identity, the primary motivation for Making was either purely based on the existence of the relationship (e.g. "My mom likes to do woodwork, so I helped.") or due to a more explicit external motivation from the other individual (e.g. "My dad needs a new bowl, so I will make him one.") In some cases, the relationship was with a more experienced Maker, though other times it is with a novice or someone who is not involved with Making, but simply encourages the Young Maker's interest.

Whenever I used to do a science fair project as a child, my father would be there supervising and giving me tips on some of the projects that I ever messed up, because even though he was an artist, he was still this curious child at heart, so he would always be like, "Oh, I wonder should we put in that liquid, like see what happens." He would always be with me in the kitchen doing that.

-Diana

Instances of Discourse-identity emerged in circumstances where Young Makers framed their own personal characteristics in terms of their interactions with other individuals, both inside and outside of Maker communities. In both cases, Young Makers displayed what Gee termed "bids" for social recognition as Makers, though emphasizing different facets of this identity. When in a context including other Makers, some comments focused on competing in robotics competitions

or displaying their work at Maker Faire. Young Makers described discourse within Maker communities as providing feelings of acceptance and support as they gained skills and knowledge.

When you're starting out, it's really important that there's a supportive community that's willing to teach and explain and also share, to share ideas, resources, stuff like that. Then once you get really into it, you're really immersed in the community and the community has to be something that you're comfortable being identified with...

-Emma

In contexts that were comprised of non-Makers, Young Makers expressed sentiments like pride, not only based on their work, but based on their knowledge of certain tools or technical skills, which their peers may not have.

I don't know if you watch Doctor Who but I made a few Doctor Who-inspired pendants as my first prints... My friends were like, "Oh my God can I have some? They're so cool. That's so awesome." I was like, "yeah".

-Ella

Deep Engagement with Material

As noted above, Young Makers discussed identity associations specifically tied to their interactions within both Maker and non-Maker communities. Given that Gee's framework was structured around social relationships, another major modification came when recognizing that Young Makers' also developed relationships with the tools, materials, and other equipment that they utilize for their projects.

I made a huge coffee table and I thought that that was pretty difficult and because I think it was really big, I had to go in before school, stay after school, spend all my free time in the woodshop working on that, and then that was ... That one just took a lot of time and so this one was smaller and it took a lot of patience because I was re-doing the same thing over and over again.

-Vanessa

Gee's framework seeded the notion that Makers engage in "discourses" in which certain personal characteristics, like patience, resilience, and achievement emerge through interactions with other people. In these interviews, we noted a parallel phenomenon occurring through interactions with inanimate objects. These observations led to the creation of the **Material Discourse identity** category. As in Vanessa's situation above, Young Makers can foster self-images of being persistent and hardworking with no immediate reference to an authority figure or any other individual. In other cases, as in Blake's below, Young Makers attach significance to the item, as a symbol of their journey and their passion.

I actually keep this, this was my first Arduino, on the bulletin board next to my desk as a reminder to how and why I started.

-Blake

Sentiments like these overlap significantly with identity categories that focus on the individual's passion for certain practices within the Maker community or, as we determined, relied on a preference with no recalled origin.

Social Exploration of Interests

The power of Maker Faires to bring together like-minded and passionate individuals was evident in many stories. As noted by several Young Makers, these festivals are sources of ideas and inspiration for future projects; they also provide an opportunity for Makers to have their own interests reinforced and shared in a positive environment. The several instances in which Young Makers cite Maker Faires as central to their becoming Makers provide ample support for the appropriateness of the Affinity-identity category.

My objective is to get people to know how to learn more at the Maker Faires and what's it do when you're there too. People might be like 'oh, it's just a place to look around and see what people have made', but I want people to have the idea going to the Maker Faire is not just that. It's a place that you can find people to help you do what they're doing.

-Aaron

The **Preferential-identity** emerged in many of the stories told by Young Makers and was denoted by Young Makers' statements that offered unexplained interests or predispositions. This identity category remained one of the least penetrable parts of understanding Maker identity. In analytic memos made during the coding process, the phrase "black box" was often noted by the authors as describing instances when Young Makers have stated that they "Always loved X." or that "They have been doing X forever." From their perspective, there was no reason for their interest—they just "were".

"I think I've honestly always been a Maker. Even though at a young age it was probably silly little things that I would build in the kitchen, or playing with Legos, or something like that, because I've always liked to fiddle with things, break things, take apart things. I would take apart a lot of the things around the house, much to my mother's chagrin."

-Diana

The Preferential-identity could be classified as a subset of the Nature-identity, given that Young Makers see themselves as being innately interested in specific topics, though it also seems connected with the notion of Affinity-identities, which are tied to the social practices of people with similar interests. In the modified framework, the authors have depicted it as bridging between these two overarching categories.

Discussion

Gee's analytical identity framework was a useful starting point for understanding basic elements of the Young Makers' formative experiences in their journey into Making. Yet the four initial identity categories, which were employed in the first coding scheme, eventually needed to be augmented and modified. The use of negative case analysis (Corbin & Strauss, 2008; Gilgun, 2005) was crucial in allowing the data to reshape the original theory such that it adequately captured the factors that contributed to Young Maker identity formation (bolded terms are additions; dashed boundaries represent new or modified categories).

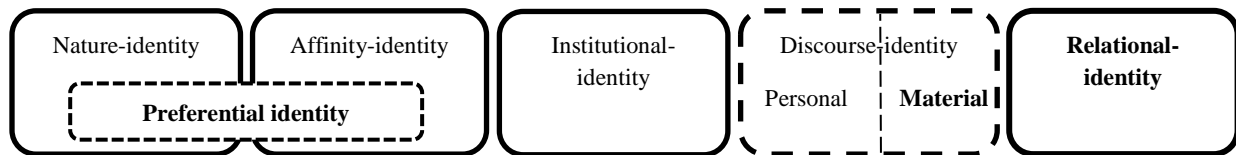


Fig. 2 Modified Analytical Framework for Maker Identity

The findings presented above suggest that further examination of Young Maker identity could provide insights into the psychosocial process of “becoming” a Maker as well as a tool for helping educational institutions refocus their efforts on creating opportunities for students to develop their Maker identities.

Towards a Process Theory of Maker Identity Formation

As an initial study of Maker Identity with a small sample size, we believe that further investigations should not only address the refinement of the categories developed, but a greater understanding of their relationship to each other. During coding and analysis, there were some hints that certain identity types, such as Relational-identity and Preferential-identity were present earlier in a Young Maker's life before others, like Material Discourse-identity and Affinity-identity. Uncovering a process of Maker Identity formation would provide fruitful ground to explore in future studies.

Applications for Educators

The results of this study highlight some of the potential ways in which education-based Makerspace might be useful in cultivating authentic Maker identities. While several of the Young Makers interviewed had access to certain tools and materials, none of them emphasized the need for large facilities or expensive equipment. This suggests that costly investments in makerspaces may not be necessary to encourage the formation of a Young Maker. Conversely, the presence of mentors or encouraging friends and family in the lives of Young Makers suggest that there is latent value in the existing relationship students have with teachers and peers. While leveraging these relationships is commonplace in clubs and sports settings, cultivating and harnessing them in the classroom may prove to be a useful strategy for motivating students when encountering new experiences or learning new skills. For those students who come to school with an innate interest in specific topics, giving them designated times in class to explore their

interests with other students could be transformative. By intentionally fostering the creation of Maker-inspired “learning ecologies”, or specific contexts that afford for learning opportunities (Barron, 2006; Lande & Jordan, 2014a), educators may be able to tap into the self-directed learning that naturally occurs at Maker Faires and makerspaces (Larson, Lande, & Jordan, 2016). These recommendations, while simple to offer, run against many institutional norms, goals, and policies present in public education, especially at the middle and high school levels.

It is worth noting that Institutional-identity was only identified in one instance, in which a Young Maker attended a school that systematically introduced students to skills and tools that are associated with the Maker Movement. The lack of Young Makers who came from these kinds of environments suggests that further study might be beneficial in specific schools who have already institutionalized Making and conduct a comparative qualitative study between non-student Makers and student Makers.

Conclusion

Through this investigation, we have attempted to shed light on some of the key elements of Maker Identity with the hope that it might provide perspective for educators attempting to implement Maker-based programs. While the conclusions produced by a study of this size and scope cannot be generalized to a larger population, the young adults we interviewed suggested that connections with supportive friends and family, deep engagement with tools and materials, and chances to pursue one’s interests are key ingredients for developing authentic Makers. By fostering Maker Identity, we may be able to prepare the next generation’s STEM-savvy citizens to be ready for the complex and unknown challenges and opportunities the future holds.

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