Making It Social: Considering the Purpose of Literacy to Support Participation in Making and Engineering

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About: Hello people of the internet and makers. My name is Naeem, and I am an engineer and maker myself. I am currently a Fab Steward at the South End Tech Center in Boston. I mostly make everything and anything I can think of and will be posting some instractables of my future projects for all to see. Feel free to leave comments and build requests.

Joined: May 22, 2011

Website: Naeem Wilson

Interests: Laser Cutting, Anime, Videogames, Emgineering, Vynil Sticker Making, 3D Printing, Teaching, Anything Nerdy.

Age : 18

Gender : male

So wrote Naeem (fourth author), a senior in high school, in his "about me" section on Instructables (www.instructables.com), a do-it-yourself online community in which members post instructions for projects they have made and respond to projects others have made. Naeem works as a lab steward and youth teacher at a community-oriented fab lab (fabrication laboratory). Fab labs are a type of makerspace in which people share tools and ideas while working on projects of their own interest and collaborating with others. The fab lab where Naeem works has digital fabrication tools such as 3-D printers and laser and vinyl cutters in addition to electronics and crafts materials. As a lab steward, Naeem helps youths and adults learn how to use available tools and develop and explore ideas as they use different kinds of tools.

In this column, we explore how one of Naeem's posts on the Instructables website is a type of

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engineering practice, reflecting relationships between digital literacies and social and intellectual practices of making. Makerspaces are becoming increasingly popular because they support learning activities driven by personal interest. More specifically, they promote participants' exploration of the relationships among digital, electronic, and physical worlds. Although making is interdisciplinary, it shares many characteristics with engineering as a discipline. Both making and engineering require people to scope and frame problems, make informed design decisions, use evidence and knowledge from other domains such as science and mathematics, and create or modify objects.

Making leverages many of the tools of engineering, but it also centers attention on characteristics of artistic practice, such as aesthetics and playfulness, that are typically less emphasized in traditional conceptions of engineering. Hence, making is not constrained by descriptions of engineering practice that heavily emphasize technical design (Trevelyan 2010). Rather, we argue that making potentially presents a more expansive and inclusive way of describing engineering practice because it allows for a greater range of practices that are socially and workplace oriented. The potential of making to be more expansive and inclusive is important because women, African Americans, Latinos, and Native Americans have not had equal access to high-quality opportunities to learn or enter the field of engineering (National Science Board, 2014). Therefore, we position making as a practice that stretches the boundaries of engineering.

Making is not limited to digital technologies (see Chachra, 2015). However, as a type of engineering practice, it can include many digitally based literacies relevant to the discipline of engineering: searching online and through personal networks for information, using digital fabrication software such as computer-aided design programs or vector-based drawing tools, writing computer programming code, creating interactive digital/physical objects, communicating with others through social media or e-mail, sharing work, and participating in online forums and communities.

One of the digitally based literacies in making is the composition of multimodal how-tos that are posted and shared online. We explore the ways in which Naeem's how-to post drew on and reinforced practices from his making in his particular makerspace. That is, he participated in literacies central to making and engineering: sharing design constraints, decisions, and results with others in the community from his fabrication of a particular object.

Yet, Naeem's post reflected his own ways of engaging these practices. We argue that this instantiation is a result of his participation as a lab steward and youth teacher in a community makerspace that stresses openness, access, and community. We highlight the particular ways that Naeem decided to share with the community, because they draw on values of access and inclusion—values that are necessary to broaden participation in engineering fields. We also suggest that his practices can serve as resources for designing inclusive and expansive learning activities and environments across formal and informal spaces.

Social and Intellectual Practices in Making
How to Make a Book Cover With Living Hinges

Naeem has posted two self-made projects on the Instructables website. The one we focus on in this column is a one-piece laser-cut wooden book cover with a living hinge (see Figure 2). A living hinge is composed of one continuous piece of material rather than two or three interacting parts, such as in a door hinge. In the two months that the project has been online, it has received over 4,100 page views and over 100 favorites. Naeem's work, and the way he shared it, has clearly caught the attention of the makers that frequent the Instructables online community.

Naeem's multimodal digital composition in an online community reflects his facility with digitally based literacies within social and intellectual practices in making (see Figure 3). His post helps illustrate the relationships between his instantiation of digitally based literacies and the social and intellectual practices

Figure 2
Naeem's Wooden Book Cover

Figure 3
Step 1 in Naeem's Wooden Book Cover Post on the Instructables Website (www.instructables.com)

So recently my friend has gotten me a notebook with a cover that wasn't as appealing to me. Instead of being a jerk and getting a new book, I decided to create a new book cover for the book. After thinking about various book covers, I decided that the best course of action would be to make a book cover out of wood.

Materials needed:
- 1/8 inch sheet plywood
- old notebook (could buy new, but who wants to spend money?)
- glue (preferably craft glue)
- laser cutter
-computer (for the design and cutting)
-heat gun

cultivated in maker environments. We briefly highlight three of these relationships: problem solving by making objects in the world, engaging selves (appealing to affective dimensions that support others' risk-taking), and distributing expertise (acting as part of a knowledge ecosystem to which others also contribute).

Problem Solving Through Making

As a self-identified maker, Naeem solved many problems by making. In the case of his Instructables post, he responded to a tension in his life by creating an object in the world that satisfied that tension, "So recently my friend has gotten me a notebook with a cover that wasn't as appealing to me. Instead of being a jerk and getting a new book, I decided to create a new book cover for the book" (see Figure 3). His idea to create a new cover was brought on by a real-world problem and was also supported by his past involvement in making. He first encountered living hinges two years prior, and he was only now using the technique for a new purpose. As in engineering, Naeem worked from a tension to identify a problem, frame it, and leverage his engineering ingenuity to repurpose existing designs. In making the book cover, his digital participation and disciplinary literacy skills allowed him to recall the prior experience with these hinges and then create and use designs with drawing software to make the laser-cut object.

After he made the actual object, he shared his experience with the Instructables community. As instructions go, the words and images that he used to explain the project were not very detailed. There are other Instructables posts that include every step of every process. However, Naeem's post reflected where his design was in development at the time, not necessarily his final iteration. He explicitly stated in the post that he would add more detail later. Although his instructions were not finished, he opted to post anyway, and he attracted the attention of thousands of viewers.

Making, through the culture of rapid prototyping, challenges notions of when something is ready to be published. By posting early in his process, Naeem could have an audience, gather ideas from comments—as he did—and work on future iterations. Composing the post and sharing it became part of his problem-solving process for making a better book cover. He simultaneously posted to share himself, seek recognition of his work, and learn.

Engaging Selves

In our studies, we have found that a central aspect of making for makers is sharing what they know with their communities (Gravel, Tucker-Raymond, Kohberger, & Browne, 2015). Sharing is also central to Naeem's practice. Although there were book covers that other people had made and other examples of living hinges on the Instructables website, he posted his project because no one had put the two together quite like he had. He had unique knowledge to share. Within his disciplinary practice, Naeem had created new knowledge about engineering book covers. He shared his work as a way to inspire and invite others to participate and make. When asked why he chose to create the post as he did, he said,

> It was partly because I didn't want people to shy away from a cool project using a lot of words. That's a lot of text, and that's good if you're going step by step, but I just want to get the idea out there of, Hey, I made a wood-covered book. I guess it's just more of the idea of not just all the steps.... Since it was a work in progress, I left it at saying, "I'm going to have more. I just haven't got to it yet."

Naeem was strategic about wanting to elicit an affective response to "a cool project." He wanted to expose his viewers to the idea of living hinges within a book cover instead of possibly intimidating them with a detailed, text-heavy, step-by-step description. His post was a way to share his new knowledge and invite others in the community to take a risk and make something as well.

We believe that Naeem's role as a teacher in the fab lab contributed to the way he composed his Instructables how-to. His job in the fab lab is to engage anyone who comes in, to get them excited, as he is, about making things. It is an integral part of his making because making and teaching happen side by side in the fab lab. Through his post, he attempted to get others excited about his idea by "put[ting] it out there." Thus, Naeem's composition was not a demonstration of all that he knew about the subject, as is required so often in schools, but was socially oriented, sharing knowl-

edge with an audience even though it might not be in final form. He posted to engage and inspire others in addition to getting feedback from them, an inspiration that in turn spurred his own making. His approach to composition also reflected the ethos of open access to knowledge, tools, and expertise that making communities share in general.

Distributing Expertise

Through his post, Naeem engaged in sharing in a way that implicitly acknowledged the distributed nature of knowledge and expertise in maker communities. His text did not exist as a stand-alone how-to. Other webpages on Instructables showed how to make other kinds of living hinges, and Naeem showed how to make a living hinge for a book cover. His post existed not only as part of an ecosystem of how-tos but also as part of a network of social relationships. It was a text among similar texts, some of which were complementary to his. For example, one reader who responded to his post pointed out that there was another maker who had a really good post about gluing book covers to the pages.

In making, it is expected that knowledge is distributed among many people. Makers are interdependent because they need and expect others' expertise just as they know that they should contribute their own. Naeem implicitly trusted that his readers would leverage the distributed knowledge of the community and that they would find the information they needed about living hinges. His contribution helped sustain a community that relies on exchanging knowledge and providing social support to achieve each member's goals.

Implications for Promoting Digital Literacies for Disciplinary Learning

In this column, we focused on Naeem's post to highlight how his engagement in the social and intellectual practices of making was integrated into his deployment of digital literacies. They included his own personal making within a social fabrication space and his teaching experience, which helped others get involved and excited about making.

We agree with Manderino and Castek (2016) that "inquiry learning and problem solving…[should] be foregrounded in instruction so disciplinary and digital literacies are…tools that help individuals' attempts to solve intellectual and real-world problems" (p. 81). We suggest extending this idea from individuals to groups working together. Making literacies are socially orient-

ed, which stands in contrast to the ways that individual achievement is rewarded in schools.

Surveys of those working in higher education have cited school climate and perceived lack of support as primary reasons for why students of color do not follow through with undergraduate engineering degrees (National Academy of Engineering, 2014). For instance, a workshop and report from the National Academy of Engineering and the American Society for Engineering Education indicated that there can be an unsupportive culture at the institution and, at the same time, few learning communities to improve retention in undergraduate engineering programs (National Academy of Engineering, 2014). At the same time, students of color who participate in learning activities with others have a greater rate of persistence to degree completion than those who do not (Chang, Sharkness, Hurtado, & Newman, 2014). Naeem's post highlights the relationship-building nature of making that may broaden participation in object building, inherent to both making and engineering. This relationship-building nature of making is oriented toward creating and sustaining a supportive learning community, which has been shown to be a resource for long-term engagement.

The case of Naeem's project and Instructables post suggests a set of considerations for designing social spaces to promote the development of digital literacies in making as a type of engineering practice: addressing or featuring problems generated by students, developing young people's networks of expertise, promoting the interconnectedness of texts, and attending to social and affective dimensions of literacy engagement, including play and risk-positive presentation. These design considerations value and promote open access to information for communities to work together. By doing so, they can help youths develop agency by enacting their literacies to seek information, share knowledge, and teach others. This approach to disciplinary literacy requires a community-oriented environment that treats individual learning as part of the greater, interconnected whole. We argue that these considerations can help expand disciplinary literacy practices so they consider social relationships as integral to learning. Digitally based literacies, from this perspective, can be simultaneously transformative for individuals, communities, and disciplines.

NOTES

recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation. The Autodesk screenshots are reprinted courtesy of Instructables and Autodesk.

REFERENCES

Chachra, D. (2015, January 23). Why I am not a maker. *The Atlantic*. Retrieved from www.theatlantic.com/technology/archive/2015/01/why-i-am-not-a-maker/384767

Chang, M.J., Sharkness, J., Hurtado, S., & Newman, C.B. (2014). What matters in college for retaining aspiring scientists and engineers from underrepresented racial groups. *Journal of Research in Science Teaching*, *51*(5), 555–580. doi:10.1002/tea.21146

Gravel, B.E., Tucker-Raymond, E., Kohberger, K., & Browne, K. (2015). Literacy practices of experienced makers: Tools for navigating and understanding landscapes of possibilities. In *Proceedings of FabLearn 2015: Digital fabrication in education*. Palo Alto, CA: Stanford University Press. Retrieved from fablearn.stanford.edu/2015/wp-content/uploads/2015/10/FL2015-ResearchPanel-GravelTuckerRaymondKohbergerBrowne.pdf

Manderino, M., & Castek, J. (2016). Digital literacies for disciplinary learning: A call to action. *Journal of Adolescent & Adult Literacy*, *60*(1), 79–81.

National Academy of Engineering. (2014). *Surmounting the barriers: Ethnic diversity in engineering education: Summary of a workshop*. Washington, DC: National Academies Press.

National Science Board. (2014). *Science and engineering indicators 2014* (NSB 14-01). Arlington, VA: National Science Foundation.

Trevelyan, J. (2010). Reconstructing engineering from practice. *Engineering Studies*, 2(3), 175–195. doi:10.1080/19378629.2010.520135
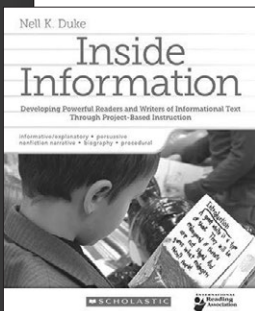
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