CONSTRUCTIONISM IN THE CLASSROOM: THREE EXPERIMENTS IN DISRUPTING TECHNOCENTRISM

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Abstract
In this paper, I explore a question that is central to studying learning and technology: How can we support teachers to think beyond a technocentric view in the classroom? I argue that engaging teachers in experiences with constructionist approaches to learning can help teachers disrupt a technocentric approach. Drawing on reflections from five years of the ScratchEd project, I outline the elements of teacher support that I have designed and studied, which include an online community, face-to-face meetups, and an online workshop. I describe five tensions negotiated through this design work: the tensions between (1) tool and learning, (2) ahead-of-time and just-in-time, (3) individual and group, (4) expert and novice, and (5) actual and aspirational.

Keywords technocentrism, teachers, design experiments, professional development, ScratchEd

1. Technocentrism, revisited

In the mid-1980s, Seymour Papert wrote a position paper entitled *Computer Criticism vs. Technocentric Thinking*. A principal argument of the paper was that conversations about technology and learning too often begin and end with the technology itself, without acknowledging the complexity of the environment in which the technology is situated. Papert described this technology-limited view as *technocentrism*.

> Technocentrism refers to the tendency to give … centrality to a technical object—for example computers or Logo. This tendency shows up in questions like "What is THE effect of THE computer on cognitive development?" or "Does Logo work?" Of course such questions might be used innocently as shorthand for more complex assertions, so the diagnosis of technocentrism must be confirmed by careful examination of the arguments in which they are embedded. However, such turns of phrase often betray a tendency to think of "computers" and of "Logo" as agents that act directly on thinking and learning; they betray a tendency to reduce what are really the most important components of educational situations—people and cultures—to a secondary, facilitating role. [1, p. 23]

Thirty years later, very little has changed. In 2014, we are surrounded by tools and technologies for creating and making. But, when learners encounter this wide range of technologies in the classroom, their experiences are still too often centered on technology itself. The "learning" is focused on learning *about* the tool/technology or the effects of the tool/technology itself, rather than

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learning *with* or *through* the technology. The questions that are asked about impacts and outcomes strive to isolate the technology in question as the source of change. We still seem hopelessly stuck in a technocentric view.

Although technocentrist tendencies can be identified in nearly any area of learning in which technology is involved, I have been observing it for the past seven years primarily in the context of the Scratch programming language. My research has focused on studying and supporting the role of Scratch in various learning environments, particularly formal learning environments, such as K-12 classrooms—and it is this work that this paper is based upon. Drawing on reflections from five years of the ScratchEd project (including interviews with 30 teachers, observations from teacher professional development events, and activity from an online community of educators), I explore a central question: *How can we support teachers to think beyond a technocentric view in the classroom?* I argue that engaging teachers in experiences with constructionist approaches to learning can help teachers disrupt the technocentric approach.

The remainder of the paper is organized into four sections. In Part 2, *"Constructionism" in the classroom*, I provide a definition of constructionism as a set of classroom practices. In Part 3, *Three experiments in disrupting technocentrism*, I outline the elements of a model that I have been developing to support teacher learning, including an online community, participatory meetups, and an introductory workshop. In Part 4, *Lessons learned*, I discuss the tensions that I have negotiated through the process of developing the model and how the teachers with whom I work share those tensions as designers themselves. In Part 5, *Beyond technocentrism*, I conclude with an optimistic note about digital technologies and learning cultures.

2. "Constructionism" in the classroom

When working with teachers to help them think about technology in the service of learning, I often begin with an activity that encourages exploring the group's ideas about learning, independent of any technological considerations. For example, teachers might write a learning manifesto or sketch a vision of a learning environment. We use the artifacts to interrogate our assumptions and metaphors for learning. Do we imagine learners as sponges or as explorers? Do we talk about learners as being engaged in play or as being engaged in work? Do we describe learners in terms of their deficits or in terms of their abundances? We then discuss different theories of learning—behaviorism, cognitivism, constructivism, constructionism—and the alignment of the assumptions and metaphors about learning associated with these theories and those embodied in the artifacts we have just created.

Although constructivism is a term familiar to most teachers, constructionism is not—and I frequently share a favorite excerpt from Kafai and Resnick as definition.

> [Constructionism] builds on the "constructivist" theories of Jean Piaget, asserting that knowledge is not simply transmitted from teacher to student, but actively constructed by the mind of the learner. Children don't get ideas; they make ideas. Moreover, constructionism suggests that learners are particularly likely to make new ideas when they are actively engaged in making some type of external artifact, … which they can reflect upon and share with others. [2, p. 1]

Of particular note for teachers, this definition suggests elements necessary for supporting constructionism in the classroom. The definition can be decomposed as a checklist for opportunities

to learn—how are learners invited to engage in *creating* (engaging in designing, making, constructing, across a range of materials and media), *personalizing* (grounding activities in an individual's and group's prior knowledge, questions, and passions), *sharing* (making connections with other learners as audience, collaborators, and coaches), and *reflecting* (engaging in metacognitive activities, thinking about one's own thinking)?

3. Three experiments in disrupting technocentrism

A definition of constructionism—even when accompanied by an elaboration of qualities of constructionist learning environments—is often (and unsurprisingly) insufficient for teachers to translate the *theory* of constructionism as educational philosophy to the *practice* of constructionism in designing learning experiences. I have been exploring the translation of theory to practice in the context of the Scratch programming language and online community (http://scratch.mit.edu), by studying and supporting teachers who include programming with Scratch as part of the learning experiences that they design.

Scratch, developed by members of the Lifelong Kindergarten research group at the MIT Media Lab, draws on the traditions of the Logo programming language and community for intellectual inspiration [3]. The intentions and aspirations for how Scratch might be employed in learning environments are grounded in Papert's vision for the types of relationships to expect and encourage between young people and computers.

> In most contemporary educational situations where children come into contact with computers the computer is used to put children through their paces, to provide exercises of an appropriate level of difficulty, to provide feedback, and to dispense information. The computer programming the child. In the LOGO environment the relationship is reversed: The child, even at preschool ages, is in control: The child programs the computer. [4, p. 19]

But a tool itself cannot dictate how it is used in a particular environment, despite the intentions or aspirations of the tool's designer [5]. In response, I have been developing a model to support teachers' understandings and explorations of constructionism. The model includes three primary elements—an online community, monthly face-to-face meetups, and an online workshop—and is rooted in a central assertion: teachers should have learning experiences that are comparable to their students' learning experiences. That is, if young learners flourish when there are opportunities to engage in creating, personalizing, sharing, and reflecting, then teachers will similarly flourish when they have comparable opportunities. This assertion has served as a guide, as a core design principle for the elements of my model for supporting teachers, elements whose histories and characteristics I will now describe in more detail.

3.1 ScratchEd Online Community

Although the Scratch online community has a large and active membership (with 3.1 million members and 5.3 million projects over seven years), it was not designed to support educators. It was designed for people who want to create and share projects, while educators are primarily concerned with helping *other* people create projects. Based on the expressed interest of K-12 teachers and motivated by the community of practice literature—a model in which teachers as learners have access to peers, shared goals, and resources [6], [7]—I developed the ScratchEd site for educators (http://scratch-ed.org).

Teachers interested in or already actively working with Scratch can use ScratchEd to share stories, exchange resources, ask and answer questions, and find other educators. In designing the ScratchEd site, I was inspired and influenced by others' work in online communities for educators, including Tapped In [8], KNOW [9], WIDE World [10], and Inquiry Learning Forum [11].

ScratchEd was publicly launched in August 2009. In the five years since its launch, more than 12,000 educators from around the world have joined the community, and have contributed more than 240 stories, 700 resources, and 4,400 discussion posts. Over the past year, the site has received an average of 112,500 page views from 23,000 unique visitors per month, predominantly from the United States. The site encourages participation and contributions from members; resources and stories that illustrate and support constructionist approaches are highlighted through curation.

3.2 Scratch Educator Meetups

The ScratchEd online community, although supporting teachers' needs for resources and connections, cannot provide constructionist *experiences*. I wanted to better support teachers in knowing what constructionist learning experiences might look like and feel like—a desire that led to the development of "meetups". The Scratch educator meetups derive from approaches to teacher learning that emphasize teacher agency (which places teacher thinking, ambitions, and actions at the center of the learning), rather than teacher training (which often frames the teacher-learner as passive in relation to the learning). The meetups have been inspired by participatory teacher learning models such as lesson study groups (e.g., [12]-[14]), professional learning networks (e.g., [15], [16]), and EdCamps (e.g., [17], [18]).

The monthly meetups began in Cambridge, Massachusetts in December 2010, as a way for educators interested in Scratch to connect with their peers, support each other's learning about working with Scratch in a classroom setting, and share their experiences. The meetups are three hours in duration, take place on Saturday mornings, and are structured in three parts. Part one involves networking and introductions, in which people get to know each other or (depending on the number of repeat attendees) get caught up. Part two consists of self-organized breakout sessions. The group, which ranges in size from 10 to 50 people, collectively negotiates different tracks of learning, focus, and activity, and then breaks out into smaller groups to pursue those interests. Part three, which occurs over lunch, involves reporting out from the breakout groups, sharing experiences in a Show & Tell format, and general group updates and announcements.

3.3 Creative Computing Online Workshop

ScratchEd meetups are geographically constrained, accessible only to those in and around Boston. In response, with support from Google's CS4HS program and motivated by curiosity to explore large-scale online learning environments as sites of constructionist learning experiences, I led the development of the Creative Computing Online Workshop (CCOW), an open online learning experience. The workshop was built using Google's Course Builder platform, which provided the infrastructure for building an online course.

CCOW (http://creative-computing.appspot.com) was organized as an experience for teachers to learn about Scratch, both as a tool and as an approach to learning. CCOW was hosted for six weeks, from June 3 until July 12, 2013. Approximately 2,100 people from all around the world enrolled in

the workshop, with 51% of those enrolled indicating that they intended to participate beyond "just browsing".

During the workshop, participants engaged in a variety of activities. They created Scratch projects, working with the latest version of Scratch (Scratch 2.0)—from focused debugging challenges to more open-ended design explorations. They maintained online design journals that served as a record of and reflection on their participation throughout the workshop. They defined and pursued independent learning projects, such as designing curriculum, hosting workshops for kids, and exploring the connections between programming and art. They interacted with workshop colleagues through comments on design journals and discussions in the course's online forums. Over the six weeks of the workshop, CCOW participants watched workshop videos 24,000 times, created 4,700 Scratch projects, wrote 3,500 discussion posts, and shared 180 final projects.

4. Lessons learned

Having worked on the development of a model to support teachers' explorations and experiences with constructionist approaches in the classroom for the past five years, I am often asked, "What lessons have you learned from your work?" I have come to appreciate that my experiences and understandings are more aptly described as "tensions negotiated" than as "lessons learned". The tensions I attempt to negotiate in creating learning environments for teachers often mirror the tensions that teachers have communicated (through the online community, the meetups, and the online workshop) about their experiences of creating learning environments for their students. Here, I describe five of the most pressing tensions, illustrated with examples from my perspective with teacher learning and from teachers' perspectives with student learning.

What I hope will be striking to the reader of this list of tensions is that most are not about the particular tool or technology being used within learning environments. Rather, these tensions focus primarily on consideration of the people, activities, and interactions within learning environments. I return to Papert's *Computer Criticism vs. Technocentric Thinking* for a reminder to privilege culture over computer.

> The context for human development is always a culture, never an isolated technology. In the presence of computers, cultures might change and with them people's ways of learning and thinking. But if you want to understand (or influence) the change, you have to center your attention on the culture—not on the computer. [1, p. 23]

4.1 Tension between tool and learning

In the spirit of disrupting technocentrism, all three aspects of the ScratchEd model for supporting teachers prioritize pedagogical knowledge over content knowledge. That is, the online community, the meetups, and the online workshop emphasize thinking about constructionist approaches to learning over thinking about the mechanics of Scratch as tool or thinking about particular computer science concepts. We eschew direct instruction, for example, about Scratch's user interface or about particular computer science concepts in favor of exploration and peer learning. But for some teachers, this can lead to a lack of comfort and confidence with the "content", which discourages them from using Scratch with their students. There is a balance between supporting knowing about the tool and supporting knowing how to engage in creative design activities, using the computer for personal expression and problem solving. Teachers struggle with this tension in their classrooms as

well, with some students asking to be told how to "do" particular assignments, focusing on the mechanics of product rather than the process of learning.

4.2 Tension between ahead-of-time and just-in-time

In constructionist learning environments, learners are invited to take ownership of and responsibility for learning goals, instead of primarily following the ambitions and direction of others. But in order to achieve their goals, learners require access to resources to support the pursuit of their pathways. In response, designers need to make resources available that are appropriately-accessible (both in format and complexity) and appropriately-timed for the learner. Appropriate timing involves resources that are shared in advance or ahead-of-time, anticipating and guiding learner needs, and resources that are shared spontaneously or just-in-time, responding to learner needs. In the ScratchEd online community, for example, ahead-of-time support is available in the form of landing pages for beginners and just-in-time support is available through asynchronous discussion forums. In classrooms, ahead-of-time support can be made available by having a library of print materials to access, while just-in-time support can be achieved through peer coaching.

4.3 Tension between individual and group

Learning is not an individual process—learners can benefit from being connected with others [19]-[21]. These connections can take different forms, with others potentially serving key roles as advisors (e.g., providing advice for challenges), as collaborators (e.g., jointly pursuing a learning goal), as audience (e.g., showing appreciation for creative work), and/or as advisees (e.g., someone with whom to share one's understanding). Individuals unfamiliar with social learning, however, may resist these opportunities, seeing them as not aligned with or even antithetical to one's own interests and goals. For the designer of learning environments, cultivating connections between learners and others involves (at least) two components: (1) helping learners identify potential connections (i.e., matchmaking), and (2) supporting positive interactions within those connections (i.e., respectful, productive, and mutually beneficial). Designers can introduce structures that support connection-making processes (e.g., introducing learners to those who have compatible and complementary interests, or grouping learners with those who have divergent interests as a way to broaden learners' perspectives). In the Scratch educator meetups, for example, a portion of each meetup is dedicated to networking and collaborative schedule-making, to accommodate a wide range of interests and to support connections.

4.4 Tension between expert and novice

Closely related to the tension between the individual and the group is the tension between individuals within a group as they take on roles of "expert" and "novice". Our work has involved teachers with a range of backgrounds—teachers who have extensive classroom experience to those who are just starting their practice, teachers who have long-adopted constructionist practices to those with more didactic or teacher-centric approaches, and teachers who have extensive experience with computer science and Scratch to those who self-describe as terrified by computers. Across these dimensions, there are multiple notions, then, of who is an "expert" and who is a "novice". But while it can be beneficial to have participants with a broad variety of expertise, relying too extensively on the expertise of participants can be problematic. First, in participatory models of learning, those with greater expertise or confidence can be denied opportunities to extend their own learning. For example, in the Creative Computing Online Workshop, teachers with greater Scratch experience were regularly contacted for support in design activities, leaving them

with less time to pursue their own work. Second, expertise in one aspect of practice does not imply expertise across all aspects of practice. Those cast as "experts" may unintentionally encourage "incongruent adaptations" [22] or "lethal mutations" [23] of constructionist practices. Accordingly, designers should consider how to disrupt conventional notions of expertise and invite broad participation.

4.5 Tension between actual and aspirational

In many ways, constructionist learning experiences are fundamentally at odds with the lived reality of K-12 education. The lack of resources, lack of time, lack of administrative support, lack of meaningful metrics for assessment and evaluation, and even a lack of interest from learners, can all contribute to an (at times) overwhelming sense of challenge. A tension exists for designers, then, between the actual and the aspirational, what designers determine is feasible given current constraints and what designers might imagine for the future(s) of learning. Inherent to the role of a designer is to offer a sense the potential and of the possible, to share what learning could be like. This stance often conflicts with barriers perceived or imagined by learners, and will involve sincerely engaging with concerns—the collection of "but…" statements, such as "I'd like to do that, but…", "That seems so interesting, but…", "I see how you could do that, but…".

5. Beyond technocentrism

Although I often experience frustration and pessimism when I see how computers and digital technologies are introduced and employed in learning environments, I also have reason for great optimism. Some of my optimism stems from new opportunities, such as advances in network technologies, which incite the imagination with new conceptions of learning cultures. But much of my optimism stems from the exchanges that I have seen among educators within the sphere of Scratch activities. Through the ScratchEd online community, the meetups, and the online workshop, I have studied and appreciated how teachers negotiate the tensions and complexities of designing constructionist learning environments, engaging in careful observation and interrogation of the activities, people, resources, and roles within the learning environments they help shape as designers. It is within this complexity that learning can flourish, beyond technocentrism.

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References

[1] S. Papert, "Information technology and education: Computer criticism vs. technocentric thinking," *Educational Researcher,* vol. 16, pp. 22-30, January 1, 1987.
[2] Y. Kafai and M. Resnick, Eds., *Constructionism in practice: Designing, thinking, and learning in a digital world*. New Jersey: Lawrence Erlbaum, 1996.
[3] K. Brennan, "Learning computing through creating and connecting," *Computer*, vol. 46, pp. 52-59, 2013. doi:10.1109/MC.2013.229
[4] S. Papert, *Mindstorms: Children, computers, and powerful ideas*. New York, NY: Basic Books, 1980.

[5] M. Scardamalia and C. Bereiter, “Higher levels of agency for children in knowledge building: A challenge for the design of new knowledge media,” *Journal of the Learning Sciences,* vol. 1, pp. 37-68, 1991.
[6] E. Wenger, *Communities of practice: Learning, meaning, and identity*. Cambridge: Cambridge University Press, 1998.
[7] S. A. Barab, M. Barnett, and K. Squire, “Developing an empirical account of a community of practice: Characterizing the essential tensions,” *Journal of the Learning Sciences,* vol. 11, pp. 489-542, 2002.
[8] U. Farooq, P. Schank, A. Harris, J. Fusco, and M. Schlager, "Sustaining a community computing infrastructure for online teacher professional development: A case study of designing Tapped In," *Computer Supported Cooperative Work (CSCW),* vol. 16, pp. 397-429, 2007.
[9] S. Brunvand, B. Fishman, and R. Marx, “Moving professional development online: Meeting the needs and expectations of all teachers,” in *Research on alternative and non-traditional education*, J. R. Dangel and E. Guyton, Eds., Oxford, UK: Association of Teacher Educators, 2005, pp. 205-232.
[10] M. S. Wiske, D. N. Perkins, and D. E. Spicer, "Piaget goes digital: Negotiating accommodation of practice to principles," in *Online professional development for teachers*, C. Dede, Ed., Cambridge, MA: Harvard Education Press, 2006, pp. 49-67.
[11] S. A. Barab, J. G. MaKinster, and R. Scheckler, "Designing system dualities: Characterizing a web-supported professional development community," *The Information Society,* vol. 19, pp. 237-256, 2003.
[12] B. Doig and S. Groves, “Japanese lesson study: Teacher professional development through communities of inquiry,” *Mathematics Teacher Education & Development,* vol. 13, 2011.
[13] M. L. Fernandez, “Investigating how and what prospective teachers learn through microteaching lesson study,” *Teaching and Teacher Education,* vol. 26, pp. 351-362, 2010.
[14] T. Watanabe, “Learning from Japanese lesson study,” *Educational leadership,* vol. 59, pp. 36-39, 2002.
[15] E. Alderton, E. Brunsell, and D. Bariexca, “The end of isolation,” *Journal of Online Learning and Teaching,* vol. 7, pp. 1-14, 2011.
[16] F. Fulton, H. Doerr, and T. Britton, “STEM teachers in professional learning communities: A knowledge synthesis,” *National Commission on Teaching and America’s Future,* 2010.
[17] M. Boule, *Mob rule learning: camps, unconferences, and trashing the talking head*. Medford, NJ: Information Today, 2011.
[18] K. N. Swanson and A. Leanness, “Edcamp: A qualitative exploration,” 2012. Available at http://edcamp.org/wp-content/uploads/2012/07/Edcamp_Whitepaper_Final.pdf
[19] J. S. Brown, A. Collins, and P. Duguid, “Situated cognition and the culture of learning,” *Educational researcher,* vol. 18, pp. 32-42, 1989.
[20] J. Lave and E. Wenger, *Situated learning: Legitimate peripheral participation*. New York, NY: Cambridge University Press, 1991.
[21] B. Rogoff, “Developing understanding of the idea of communities of learners,” *Mind, culture, and activity,* vol. 1, pp. 209-229, 1994.
[22] H. T. Lin and B. Fishman, “Scaffolding teacher adaptation by making design intent explicit,” in *Proceedings of the 9th international conference on Computer supported collaborative learning-Volume 2*, 2009, pp. 159-161.
[23] A. L. Brown and J. C. Campione, “Psychological theory and the design of innovative learning environments: On procedures, principles and systems,” in *Innovations in learning: New environments for education*, L. Schauble and R. Glaser, Eds., Hillsdale, NJ: Lawrence Erlbaum, 1996, pp. 234-265.