

Collaborative Agency in Youth Online Creative Production in Scratch

Yasmin KAFAI, Deborah FIELDS, William BURKE

^a*Graduate School of Education, University of Pennsylvania, United States*
kafai@upenn.edu

Abstract: Much attention has focused on the successes of creative collaboration in online communities yet little is known about how members organize participation and collaboration at such sites. In this paper, we analyze different dimensions of collaborative agency by youth who locally self-organized in groups and participated in a collaborative design challenge in the Scratch online programming community. We report on youths' fluid roles in groups, their contributions in terms of feedback, and their awareness of participation in relation to the online community. In the discussion we address what we learned about new forms of collaboration, equity issues, and implications for the design of tasks which better support collective learning.

Keywords: Collaboration, online community, programming, social networks

1. Introduction

Most education research to date has focused on understanding collaborations in small groups. Thousands of research studies have mapped out different dimensions that impact successful and equitable participation in collaboration including the nature of various group arrangements such as reciprocal teaching or jigsaw techniques, interactions with members of different gender, race, ability, and experience, and causes for success and failures of group work [17]. By contrast, the research on understanding collaborations in large groups is fairly nascent: the engagement in social networking sites [9] and participation in multiplayer gaming communities [6] and virtual worlds [10] are all pointing towards considerable changes in how youth are learning to interact with each other, the number of participants being one crucial difference, the nature of collaborative tasks and interactions another.

A small but growing body of research is focusing on the success of online creative collaboration in massive communities, with Wikipedia and Linux as the leading examples [2]. It has been proposed that these forms of large-scale online collaborations hold particular promise for student learning and creativity [20]. The focus of our paper is to understand better what it means to learn to participate and contribute effectively in these large-scale communities, to develop and foster a sense of belonging, and to design for online creative collaboration [11]. We are calling this particular ability to interact with and contribute to large groups, *collaborative agency*, in order to highlight dimensions that would apply to collaboration in massive communities where participation is voluntary, size of groups vary, and members often have different expertise and might not know each other. While some have argued against adopting these models of collaboration for school communities [8], our goal is to investigate how design activities that connect local students with massive online communities can become a fertile ground for supporting and developing collaborative agency.

Here we present the findings of a collaborative design challenge that we launched in a programming community called Scratch.mit.edu in early 2011. With over 850,000 members and over 1.8 million projects, Scratch is by far the largest youth online programming community. Our research focused on a local workshop with 21 youth that self-organized in six groups of different sizes to contribute to a collaborative design challenge in the larger Scratch community. Over a ten-week time period we captured students' interactions and conversations in field notes and video recordings and conducted debriefing interviews with participants about their collaborative experiences. In the discussion we examine what we have learned about youth's collaborative agency by examining the fluid roles in groups as forms of distributed engagements, their contributions in terms of feedback, and their awareness of their participation in relation to the online community.

2. Background

Some studies have begun to map out issues of understanding collaboration and learning in Web 2.0 communities [4], examined issues of trust building [7] or studied knowledge diffusion across and within local and virtual worlds [5]. Much less research has been conducted on using large-scale communities for creating collaborative learning opportunities as in designing wiki activities for university classes [18] or launching epidemics in virtual worlds for experiencing and learning about infectious disease outbreaks [11]. To build a framework for understanding collaborative agency, we bring together two distinct but related strands of research. One of those strands has investigated students' collaborative learning in the Knowledge Forum while contributing to a communal database [20]. The second strand investigated the nature of online creative collaboration in the context of animation and movie making [15].

While Knowledge Forum communities are a far cry in size from today's social networks, they have whole classes of students engage in science inquiry while contributing to a communal online database, sometimes in arranged small groups but at other times in open and flexible, or opportunistic, groups. Research found that students' knowledge building and engagement was equally successful in either opportunistic or arranged collaborations [20]. Scardamalia [19] suggested the term "collaborative collective responsibility" to explain students' ability to understand the "conditions in which responsibility for the success for a group is distributed across all the members rather than being concentrated on the leader" in addition for taking on responsibility "for knowing, what needs to be known, and for insuring that others know what needs to be known" (p. 2).

We argue that this collective responsibility provides a compelling learning objective for the kinds of collaborative agency youth need to develop in order to participate in different types of social networks such as Wikipedia or Linux [2] or the small opportunistic groups or collabs that form to produce online movies and animations [15]. Such collabs are also found in the youth online community of Scratch programmers that provides the research context for our study [1]. For this particular study, we examined students' collaborations by addressing three research questions: How do youth distribute roles in collabs? How do they integrate feedback? In which ways are they aware of the broader audience? Our analyses will focus exclusively on the youth's collaborative interactions in the local workshop context and include their online interactions.

3. Context, Participants, and Methods

The study took place from January to early March 2011 in weekly two-hour workshops at a local science museum that worked with the high school. During six workshop sessions the 21 high school freshmen (ages 14-15) who had signed up for the Scratch workshop, worked in self-chosen small groups to program and submit projects in Scratch to a “Collab Challenge” (<http://info.scratch.mit.edu/collabchallenge>) issued in the online community. Open to the entire Scratch community, the Collab Challenge had three requirements: (1) teams needed a minimum of two participants; (2) teams had to integrate three unique images into their projects; and (3) teams had to upload an initial draft midway through the competition to receive collective feedback from the Scratch team before submitting a final project three weeks later (for more detail, see [13]). Teams who creatively integrated these three disparate images using their own original ideas and coding sequences had their projects “featured” on the Scratch homepage, a highly-coveted status in the scratch.mit.edu online community.

Data for the study included observations recorded in field notes by three different researchers, videos from two cameras focused on individual groups, post-interviews with all participants, and weekly artifact collection of participants’ ongoing projects. Analyses focused on individual groups as case studies, looking at their development over time, and across the breadth of data through coding based on grounded theory [3]. We sought to understand the inner workings of these opportunistic small groups, and the roles of the larger workshop activities as well as the online Scratch community in their group work, project development, and awareness of broader audiences.

4. Findings

Explaining the nature of the Collab Challenge to the 21 freshman participants at the outset of our workshop, it was clear that the group was excited about the online component and the prospect of being a contributor to a project that could be selected for the front page. Twelve participants had prior experience using Scratch software during a previous workshop at the museum that had been geared entirely toward creating individual projects. While all students had to work with at least one other student and register their respective teams by the second session, otherwise group formation was entirely in their hands (see Figure 1 below).

4.1 Distributed Engagement: Fluid roles within groups

Self-organizing within groups can be a challenge for youth, and the small groups in our workshop were no exception. Since we were interested to see how they took up the responsibility to work together, we provided little guidance on how to form or work in groups. Initially two primary patterns of collaborative work emerged: splitting up work between individuals then bringing it back together or sharing one computer and working together the whole time. During the first half of the workshop (before the February 9th initial submission) ProjectOne and Mage Battle split up responsibilities in some fashion amongst themselves, splitting up roles (artist and programmer), modules of the project, and/ or simply making different projects to evaluate. Meanwhile, Epic Myth, Shuriken, and BFP consistently did everything together, perhaps, in the case of Epic Myth and Shuriken, aided by the relative smallness of their group size (two members) while in the case of BFP (six members) slightly uncertain how to split tasks up among such a large number.

• ProjectOne (Brett, Chase, Jackson, Darrin, William)
--

Consisted of five boys (“a lot of smart people” according to one group member) known as the “powerhouse” group. Members shared a strong interest in gaming, programming, and computer science, and four boys had considerable prior experience using Scratch. Yet they struggled as a group, each bringing a different project to consider, eventually settling on one member’s idea (a “keep it up” game with a ball that changed form and moved erratically) and letting that member do most of the project work over the final two sessions.

• **Brickbreaker** (*Clayton, Jack, & John*)

Initially started as a group of three, joined by a fourth member later. Like ProjectOne, the “Brickbreaker” group consisted of all boys who shared an interest in gaming (if not programming quite so explicitly as ProjectOne members).. Personal connections played a large role in the team’s formation. The core trio knew each other closely from school and much of their work on the project occurred during shared lunches and study halls. Usually working together around a single computer in the workshop, the team used the three requisite images to create a variation of the classic brick-breaker game, a “featured” project.

• **Shuriken** (*Corbin & Ella*)

A group of two—one boy and one girl—who did not seem to know each other very well prior to the formation of their team. Corbin, the more outspoken of the pair, took the early lead in deciding what type of project they would create, but as the project progressed Ella took an increasingly larger role in trouble-shooting and adding details to produce a dodging game in which the main character must avoid flying pinwheels to collect balls of cheese for points.

• **Mage-Battle** (*Lawson & Lucas*)

Two self-professed “gamers” who also shared a strong mutual dislike for group work in any form. Nonetheless their pairing came easily based on their common interest in video games and shared antipathy toward school-based collaboration. Lucas, the more experienced member, took on the role of “programmer” while Lawson, new to Scratch, supported as the “graphics illustrator”. Their two-player combat game between wizards and demons was chosen as one of the projects featured on the Scratch website for its use of intricate graphics, ascending levels, and accompanying soundtrack.

• **BFP** (*Candie, Jayden, Laurel, Rachel, Reese, & Thomas*)

The largest of the six groups, the team (five girls and one boy) seemingly formed based simply on prior friendships. While the sole male member Thomas was a fairly experienced Scratch user, the remaining five had never used it before; initial collaboration consisted of the five newcomers creating their own characters and sending them to Thomas who proceeded to add code to the characters and integrate them into a wider animation. The resulting project was an amusing hodge-podge of figures assembled upon a beach, whose appearance was loosely tied to the narrative of singer Katy Perry disguised as a man on an evening stroll along the water.

• **Epic Myth** (*Violet & Avery*)

Another group of two, who—like members of Brickbreaker—formed in part based on their friendship at school. Sharing an interest in the anime video game series “Kingdom of Hearts” the girls created their project based on the series’ alternative universe motif. In the format of an animated story, their project depicts the origin of a new planet and while incomplete at the time of final submission, used self-drawn characters whose animation was coordinated to the girls’ own voiceover narration.

Fig. 1 Description of Collab Challenge Teams (all student and team names are pseudonyms)

However, after the initial submission date many groups shifted their collaborative style. For instance, ProjectOne decided that they needed to work only on one computer because having five versions of the project was too difficult to manage. In contrast, BFP started to split up the work on their project, with different members taking on improvements of different sprites and then adding them back into the larger project. When Corbin of the Shuriken group was absent one day, his partner Ella took up more responsibility than she previously had on the project, essentially splitting up the work previously done only together. Meanwhile, the Brickbreaker group moved fluidly between all of these modes. They worked together during

the workshop and during lunch and homeroom periods. In the interim periods they split up the work, emailing each other different versions of the project. Toward the end, one person took the responsibility of finishing the final tweaks to the project.

Given the timeline of the Collab Challenge that had multiple built-in deadlines, we found that the groups took responsibility for figuring out how best to work together. In two instances where the work seemed ill distributed amongst group members, one researcher spoke privately to the defacto leaders (Corbin of Shuriken and Thomas of BFP), suggesting that they try to draw in the other members more. It is unclear whether this made a difference, but the distribution of work within the groups shifted afterwards, with the other members taking more responsibility for programming and project work. If students are supposed to be aware of and take responsibility for making sure that their group work is effective, then the students in these unstructured groups succeeded in that aspect. This is not to say that groups worked seamlessly or that every member contributed equally. Rather, in completing the open-ended, creative programming projects, the groups managed the distribution of work at different times in the ways they found more effective. They evaluated how well they were working and, for the most part, shifted to become more effective. It appears that the mid-workshop initial submission deadline assisted with this self-evaluation.

4.2 Complementary Contributions: Support between groups in the workshop

Beyond the collaboration within small groups, we also sought to provide feedback within the larger workshop. Over the six meetings, we developed a model of 10-minute whole group reflections where groups took turns sharing their in-progress, unfinished projects and receiving feedback from the other members. Presenters would initially demo their project, then reveal the underlying code operating its mechanics, and then briefly explain what they planned to do next with their creation. Initially students appeared slightly awkward with this model, uncertain how their peers would receive a project that was not yet complete as well as uncertain, in certain instances, where they themselves planned to take their project in next stages. Over the initial two presentations, feedback came only from 1-2 members of the group with more generous feedback being supplemented by the adult researchers. However, as this mode was repeated, more and more students provided constructive criticism on each other's projects until the final meeting where the five ProjectOne members showed their project on laptops at each of the other groups and received feedback from nearly every other member. Further, the constructive feedback became more specific and tailored to the projects as students learned this mode of constructive criticism: making suggestions related to game play (adjusting speed, making things more playable), story plot (making story more clear, helping audience to understand symbols), and programming (tweaking code, adding or adjusting variables, smoothing interactions between objects).

Most groups used the feedback from these sessions to change their projects, showing the value of the large group mini-sessions. A few said it was one of the most valuable aspects of the Collab Challenge in general. Consider Lucas' comments on the importance of his group's presentation of their in-progress work:

- Researcher: Was there anything that worked well for you two as a group?
Lucas: Uh, the group collaborations where we went and presented and we got the information.
Researcher: How was that helpful?
Lucas: Like I changed the different graphics on how I was going to make the health bar. So that was something that really was [great].

Other members, like Corbin and Ella, said that seeing others' presentations helped them think of new possibilities in Scratch. The increased number and quality of comments during these workshop mini-sessions as well as the statements by individual members suggest that not only did they learn to take responsibility in determining how to distribute work amongst small group members, but they also learned to see the value of contributions within the larger workshop — recognizing the value of audience [16]— which brings us to the next aspect of our analysis, namely audience awareness.

4.3 Audience Awareness: Projects in relation to larger programming community

One important result of the youth's participation in the Collab Challenge was their growing awareness of the broader Scratch online community and their sense of participation in that affinity space. Since these youth were largely new to Scratch (about half of them had learned it in a series of four workshops two months earlier), it is interesting to understand their emergent impressions of this larger affinity space and to what degree they felt a sense of connection to it. Below we describe how, through their participation in the Collab Challenge, students came to view the Scratch online community as a “cool” place with programming projects that interested them and as a community that provided constructive feedback. Further, some groups began to situate their projects in relation to the Scratch community, developing a sense of the community as both audience and resource.

First, students saw themselves participating in an online community that was valuable because of the quality of projects and potential of the constructive criticism. As Chase remarked, “I like participating in the [Collab] project because I got to contribute to the cool projects on the website.” Like Chase, many youth felt good about their project posted next to others. This was a form of participating in a community that they valued. Further, most youth also expressed that the online Scratch site was a place where they could receive positive, constructive feedback on their projects and find examples of projects that were helpful to their programming. For instance, as William summarized,

“Well, I really like the community of Scratch online because... it is always really helpful to have positive feedback instead of continual accusations like “Make this better” or “Just do it--I don't really know how you're going to and I'm not going to help” which is sometimes the case on different forums like that. But on the Scratch website it's alot more helpful.”

To William and many of the students, the Scratch site was a place for positive, constructive feedback that made them enthusiastic about the community. Looking at students' projects, it is clear that the constructive comments not only built enthusiasm but also influenced the quality of the projects. Based on the comments, all the groups improved their projects, tweaking programming, improving storylines, making games more playable, adding instructions. In sum, workshop members began to understand the ethic of the Scratch community as an exciting, constructive, project-sharing site, and through posting projects and responding to comments began to situate themselves as participants in the site.

Finally, a few groups expressed a growing awareness of the Scratch online community as an audience. For instance, the Brickbreaker group researched the different types of the game on the Scratch site, and built their game it to improve on the existing versions on the site. As John expressed, “we just liked the idea of [that game] and we saw what worked and what didn't work.” Many groups also added project notes or instructions on how to activate/play their projects after receiving feedback that the mechanisms were not obvious to online users. This moves from “awareness of contributions” [20] to responding to the online community as an authentic audience. This involves what Magnifico [16] argues is critical thinking about

communicating ideas to a group of people. Since the online community is a programming audience, this has meaning for how kids adapt to the ways of viewing and kinds of programming in the Scratch online community.

5. Discussion

This paper presented initial findings on how youth participated in the online creative production of Scratch programs. As in knowledge forum [20], collab members assumed collective cognitive responsibility, meaning members needed to negotiate multiple roles and make adjustments to their designs as they provided and received feedback on programming designs. In addition, they negotiated these responsibilities not just in local contexts but also in the online context of the larger Scratch community with thousands of other members. We saw in youths' reflections that the awareness of this larger community played an important role in how they thought about the improvements of their programs. This should not be taken for granted as we know from previous research that leveraging the Scratch website as a means for participants to share their own work with wider audiences and download others' creations is not always an easy and obvious step [11].

We have called this type of needed participation in online creative production 'collaborative agency' to highlight that it is youth themselves who need to make choices about who to work with, how to contribute to work, and how to deal with issues very much like the adult volunteers in the collabs studied by Luther & Bruckman [15]. This new focus on collaborative agency of learners is a distinct departure from collaborative research that has focused on identifying arrangements and features that would make small groups productive in their collaborations. By extension, in prior research teachers were the ones with more collaborative agency because they set up groups, organized roles, and distributed work. Participating in online collabs asks youth to assume more agency because their collaborations are no longer confined to a local group but extend into a broader social network. This also brings implications about the online community as a place of belonging to a collective of programmers (and how they think, program, and provide feedback) and as a potential audience. As Magnifico [15] elaborates in regard to writing, thinking about audience requires critical reflection on "how to align themselves with these practices and values, portray themselves as members, and communicate these ideas to an outside audience" (p. 180). Applying concepts of audience to programming opens up possibilities for how a massive online programming community can influence students locally.

Ultimately, we want to know how to support learning of collaborative agency needed in these new hybrid and distributed communities. Just as spatial arrangements of tables and chairs and a teacher's organization of groups can facilitate or hinder collaboration between members, we seek to understand the design levers in online spaces that promote productive contributions in terms of content and feedback. The structures in the Collab Challenge, both online (with the structure of initial submission, Design Team comments, final submission, and "featuring" on the home page) and in the local workshop (with structures to facilitate constructive criticism on in-progress projects) influenced the ways that students created their projects and thought about their participation in these multiple, layered settings. These findings give pointers that recognition in its various guises, from simple presence to constructive feedback, can provide powerful incentives for collaboration and give us a starting place for facilitating membership in online programming-based communities.

Acknowledgements

The writing of this paper was supported by a grant from the National Science Foundation (NSF-CDI-1027736) to Mitchel Resnick, Yasmin Kafai and Yochai Benkler. The views

expressed are those of the authors and do not necessarily represent the views of the Foundation or the University of Pennsylvania or MIT.

References

- [1] Aragon, C., Poon, S., Monroy-Hernandez, A. & Aragon, D. (2009). A tale of two online communities: Fostering Collaboration and Creativity in Scientists and Children. In *Proceedings of the Creativity and Cognition Conference*. Berkeley, CA. New York: ACM Press.
- [2] Benkler, Y. (2006). *The wealth of networks: How social production transforms markets and freedom*. New Haven and London: Yale University Press
- [3] Charmaz, K. (2000) Grounded theory: Objectivist and constructivist methods. In N. K. Denzin & Y. S. Lincoln (Eds.) *Handbook of Qualitative Research, 2nd Edition*. SAGE Publications, London.
- [4] Dohn, N. (2009) Web 2.0: Inherent tensions and evident challenges for education. *International Journal of Computer Supported Collaborative Learning*, 4(3), 343-363.
- [5] Fields, D. A., & Kafai, Y. B., (2009). "U wanna go to the moon?" A connective ethnography of peer knowledge sharing and diffusion in a tween virtual world. *Journal of Computer-Supported Collaborative Learning*, 4(1), 47-68.
- [6] Gee, J. P. (2003). *What video games have to teach us about learning and literacy*. New York: Palgrave Macmillan
- [7] Gerdes, A. (2010) Revealing preconditions for trustful collaboration in CSCL. *International Journal of Computer Supported Collaborative Learning*, 5(3), 345-353.
- [8] Hung, D., Lim, D., Chen, V. & Koh, T. S. (2008). Leveraging online communities in fostering adaptive schools. *International Journal of Computer Supported Collaborative Learning*, 3(4), 373-386.
- [9] Ito, M., Baumer, S., Bittanti, M., boyd, d., Cody, R., Herr, B., Horst, H. A., Lange, P. G., Mahendran, D., Martinez, K., Pascoe, C. J., Perkel, D., Robinson, L., Sims, C., & Tripp, L. (2009). *Hanging out, messing around, geeking out: Living and learning with new media*. Cambridge, MA: MIT Press.
- [10] Kafai, Y. B. (2010). The world of Whyville: Living, playing, and learning in a tween virtual world. *Games and Culture*, 5(1).
- [11] Kafai, Y. B., Feldon, D., Fields, D. A., Giang, M., & Quintero, M. (2007). Life in the time of Whypox: A virtual epidemic as a community event. In C. Steinfield, B. Pentland, M. Ackerman, & N Contractor (Eds.), *Communities and Technologies* (pp. 171-190). New York: Springer.
- [12] Kafai, Y. B., Fields, D. A., & Burke, W. Q. (2010). Entering the clubhouse: Case studies of young programmers joining the online Scratch communities. *Journal of Organizational and End-User Computing*, 22(2), 21-35.
- [13] Kafai, Y. B., Fields, D. A., Ricarose, R., & Monroy Hernandez, A. (2011). Collaboration by choice: Youth online creative collabs in Scratch. T. Hirashima et al. (Eds.) (2011). Proceedings of the 19th International Conference on Computers in Education. Chiang Mai, Thailand: Asia-Pacific Society for Computers in Education
- [14] Kafai, Y. B., & Peppler, K. A. (2011). Beyond small groups: New opportunities for research in computer-supported collective learning. In *Proceedings of the 9th Conference of Computer Supported Collaborative Learning*. Hong Kong, China: International Society of the Learning Sciences.
- [15] Luther, K., Caine, K., Ziegler, K. & Bruckman, A. (2010). Why it works (when it works): Success factors in online creative collaboration. In *GROUP '10: Proceedings of the ACM Conference on Supporting Group Work* (pp. 1–10). New York: ACM Press.
- [16] Magnifico, A. M. (2010). Writing for whom? Cognition, motivation, and a writer's audience. *Educational Psychologist*, 45(3), 167-184.
- [17] O'Donnell, A. M. (2006). The role of peers and group learning. In P. Alexander & P. Winne (Eds.), *Handbook of educational psychology, 2nd Edition*. Mahwah, NJ: Lawrence Erlbaum.
- [18] Rick, J. & Guzdial, M. (2006). Situating CoWeb: A scholarship of application. *International Journal of Computer-Supported Collaborative Learning*, 1(1).
- [19] Scardamalia, M. (2002). Collective cognitive responsibility for the advancement of knowledge. In B. Smith (Eds.), *Liberal education in a knowledge society* (pp. 67–98). Chicago: Open Court.
- [20] Zhang, J., Scardamalia, M., Reeve, R., & Messina, R. (2009). Designs for collective cognitive responsibility in knowledge-building communities. *The Journal of the Learning Sciences*, 18(1), 7-44.