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“It’s School Organized Like a Giant Videogame”: Participation Structures Embedded within the Mathematics Content and Curriculum of the Khan Academy

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Of late, the Khan Academy has earned considerable acclaim as a pioneer in school reform, particularly in the arena of mathematics education. This paper uses a discourse analytic framework to understand the participation structures of the Khan Academy’s espoused curriculum, including opportunities and barriers to participation in a mathematical discourse community. The participation structure of the Khan Academy, this paper demonstrates, depends upon an epistemological viewpoint that frames knowledge, teaching, and learning in particular ways. In doing so, this paper also raises questions about the replacement of curriculum materials with Khan Academy videos, at least until the website has more time to evolve and more is known about the ways users can engage with it.

Forbes magazine called him one of the “Names You Need to Know in 2011” (Upbin, 2010). Google gave him \$2 million through a social-innovation grant competition. He was one of five winners out of some 154,000 entries (Google, 2010). He has been profiled on news outlets, such as CNN, NBC *Nightly News*, ABC News, and NPR, to name just a few (Khan Academy, 2011a). Bill Gates said Khan is “amazing” and “a pioneer” (Gates, 2010, n. p.).

When Salman Khan left his position as a hedge fund analyst in late 2009 (Warner, 2010), he probably didn’t expect to become a YouTube sensation, but he has. Khan started an online school, the eponymously-named Khan Academy, which is a platform for embedding YouTube videos that provide instructional content in mathematics, economics, biology, and many other disciplines. From inception to date, the Khan Academy has posted over 2,100 videos that have collectively garnered over 53.5 million views (Khan Academy, 2011a) and is ranked as the 89th most-subscribed and the 72nd most-viewed YouTube channel of all time (YouTube, 2011).¹ The Khan Academy also partners with brick-and-mortar schools, encouraging teachers to replace classroom lectures with Khan Academy videos (Khan, 2011a; Khan Academy, 2011b). Of his plans to bring the Khan Academy into schools, Khan said, “Eventually, I want it to actually become the operating system

¹ All data presented in this paper concerning the number of views, the number of videos, and the distribution of videos at the Khan Academy were gathered in early May 2011.

for what goes on in the classroom..." (Gates, 2010, n. p.).

In this paper, I profile the Khan Academy, and I analyze a selection of its online mathematics lessons. I consider these videos against the backdrop of one of Khan's aims: to engage in a reform-oriented project by supplanting what he regards as traditional forms of curriculum and instruction. I employ a framework that draws on participatory culture in media studies, curriculum theory, and discourse analysis. With my framework in hand, I uncover possible synergies among the Khan Academy, YouTube, and a participatory view on mathematics learning. I also outline ways in which the Khan Academy and YouTube could undermine participatory views on mathematics. First, I provide a short history of the Khan Academy and features of its website, and then I discuss my conceptual framework and methods before summarizing my analysis.

Background

A Brief History of the Khan Academy

In late 2004, Salman Khan began tutoring his school-aged cousins in elementary mathematics. Khan, then a financial analyst in Boston, was unable to meet regularly with his New Orleans-based cousins, and so he tutored them remotely over the telephone (Kaplan, 2010; Khan Academy, 2011c). He also employed Yahoo's Doodle software (a plug-in for Yahoo Instant Messenger), which functioned as a "shared notepad," allowing multiple people to contribute simultaneously to a computerized drawing-screen. This arrangement proved cumbersome, as Khan's and his cousins' schedules did not adequately synchronize; so, instead, he began using YouTube as a repository for storing pre-recorded videos. His cousins also needed to practice and assess what they had learned, and so Khan even "started writing simple Javascript problem generators" (Khan Academy, 2011c, n. p.). With these Javascript programs, his cousins "would never run out of [randomized] practice problems" (Khan Academy, 2011c, n. p.). The practice problems are now regular features of the Khan Academy website and are intended to follow the videos. I describe the practice problems further, as well as and their epistemological underpinnings, later in this paper.

At the inception of his part-time project, Khan encountered a few surprises. First, he says, "My cousins...told me that they preferred me on YouTube than in person" (Khan, 2011a, n. p.). Khan argues that, because his cousins had the opportunity to "pause" and "rewind" the videos, they could engage with the material on their own terms. Second, Khan noticed that other students around the world enjoyed watching his internet videos. For example, one student commented on a calculus video, "First time I smiled doing a derivative" (Khan, 2011a, n. p.). A parent of an autistic child also remarked, "We have tried everything, viewed everything, bought everything [to no avail]; we stumbled on your video on decimals—and it got through!" (Khan, 2011a, n. p.). These surprises, Khan explains, are what led him to leave his job as an analyst and to devote himself full-time to developing the Khan Academy, which now describes itself as "a not-for-profit with the goal of changing education for the better by providing a free world-class education to anyone anywhere" (Khan Academy, 2011c, n. p.).

Features of the Khan Academy

The Khan Academy website appears to be a typical “Web 2.0” site (Jenkins, Purushotma, Weigel, Clinton, & Robinson, 2009; O’Reilly, 2005). In other words, the site serves as a platform for users to gather and to interact with each other and with information, much like YouTube or Facebook. Generally, Web 2.0 sites have shifted the balance of authority away from the creators and toward the users. According to Jenkins et al. (2009), users of Web 2.0 sites “no longer can rely on expert gatekeepers to tell them what is worth knowing” (p. 92). Instead, users must sift through the knowledge emergent within the community, determining for themselves what is relevant and useful (Jenkins et al., 2009). Navigating such sites, like YouTube or Facebook, is aided by the overall simplicity of the graphic design, which also serves as an easily-adaptable template for expanding the site’s modules. The Khan Academy website, then, conforms to many of the stylistic and functional aspects of a Web 2.0 site, since it serves as a repository, allowing users to search for information of interest to them and to comment on such information. As with YouTube, TeacherTube, and other Web 2.0 sites, Khan Academy users participate in knowledge construction by critiquing videos, by asking and answering questions about the content, and by obtaining feedback from fellow user-“coaches” (more on coaches below). Like YouTube and Facebook, the Khan Academy interface is also very clean, unadorned with excessive graphics, advertisements, tools, and so forth. There are notable differences between the Khan Academy and other Web 2.0 sites, of course, which I take up further in my analysis. Unlike YouTube, for instance, the Khan Academy appears to offer little opportunity for users to remix or re-interpret Khan’s own take on the academic content; presently, users cannot post their own videos on the Khan Academy’s website.

Since YouTube and Facebook do not utilize a curriculum—in any traditional sense—the Khan Academy represents a different sort of medium. Understanding the curriculum of the Khan Academy is crucial to understanding its relationship to the pantheon of the contemporary Web 2.0 internet. By the curriculum of the Khan Academy, I refer to both the way in which topics are selected, presented, and organized within the video library, as well as the broader context in which these videos are situated. This context includes the Khan Academy’s stances on learning, pedagogy, content, and the like—stances that are neither neutral, nor opaque. Indeed, Freire (1998) writes, “I cannot be a teacher without exposing who I am” (p. 87). In reviewing the Khan Academy’s website, as well as its related promotional material, I unpack these stances.

Researchers have long explored the ways in which curricula organically adopt positions on learning, teaching, and content knowledge. Brown (as cited in Remillard, 2005) describes curriculum materials as “cultural artifacts” (p. 231) that shape and are shaped by human activities and beliefs. Drawing on the work of Kang and Kilpatrick (1992), Remillard observes that curriculum materials represent “structured knowledge”—created and organized for the purpose of teaching others—and as such, can “reflect *social and ideological views* of knowledge and how it is learned” (Remillard, 2005, p. 231, emphasis added). I also take a wide-ranging view of curriculum in my analysis, and so I consider not only the substance of the Khan Academy videos themselves, but also how these videos are positioned with regard to ideology and epistemology.

It is important to note that researchers have conceptualized various meanings

of the term “curriculum.” Gehrke, Knapp, and Sirotnik (1992) distinguish among the curriculum as planned by institutions, written by developers, and enacted by students and teachers in classrooms. Gehrke et al. (1992) also note that the “enacted curriculum” is an elusive term to pin down, since curricular activity may be interpreted differently by different students in the same classroom (they use the term “experienced curriculum” to describe the curriculum-as-experienced by individual students). Furthermore, Stein, Remillard, and Smith (2007) describe how various transformations reshape the planned, enacted, and experienced versions of curricula. Such transformations are attributable to teachers’ beliefs and knowledge, policy contexts, classroom structures, and so forth. Consequently, a number of researchers also regard teachers and staff as curriculum designers, and curriculum is viewed as more than just the text in a lesson guide; instead, a contemporary view of curricula includes teachers, staff, and students as interactive co-constructors (e.g., Ben-Peretz, 1990; see Remillard, 2005, for a review). Here, I describe the espoused, or planned, curriculum of the Khan Academy, as instantiated by the website content itself and also by Khan’s vision—articulated within interviews and public relations materials. Later in this paper, I focus on the ways in which the curriculum may be experienced by the users of the Khan Academy, and whether or not there is synergy between the curriculum-as-espoused and the curriculum-as-experienced within the website.

The espoused curriculum of the Khan Academy includes several components. First, the primary feature of the Khan Academy website is the video repository, or library, which is easily accessible at the bottom of the homepage. Each video in the library consists of “digestible 10-20 minute chunks” of content material, presented as “chalk talks” by Khan, himself, who narrates lectures that are annotated on a full-screen digital chalkboard (Khan Academy, 2011c). Neither images of Khan, nor any other illustrations (except for Khan’s doodles) appear on-screen; the videos themselves are not interactive—in the sense that users cannot directly respond to content in the lectures (i.e., there are no question-and-response features, models, or simulations within the videos). (This contrasts with other online learning programs, such as Apex Learning, that allow students to practice and model while engaging with a lesson.²) In developing these lectures, Khan maintains that he is not using any outside curricular materials (Khan Academy, 2011c); yet, the video library of the Khan Academy includes detailed descriptions of mathematical concepts from whole-number addition to calculus, linear algebra, and beyond (as well as high school and college-level biology, chemistry, and physics, etc.). This stance on materials is emblematic of Khan’s hesitancy to engage with the educational establishment—that is, the superstructure of public schools, curriculum publishers, schools of education, and governmental agencies. I expand on Khan’s outsider positioning later in my analysis.

The videos are also organized according to a sequence that is essentially linear, since each video contains hyperlinks to videos labeled “next” and “previous.” While students are free to choose any entry point into the library of videos, an overall order of videos is nonetheless maintained. This sequence conforms to the Khan Academy’s “knowledge map,” which is a graphical representation of the antecedents and descendents of each curricular topic; the map, *de facto*, proclaims that mathematical knowledge is cumulative. Within the knowledge map, a number

² See <http://www.apexlearning.com>.

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of topics are accessible via multiple “nodes” (i.e., other topics), and so the map is not strictly linear. The “previous” and “next” links obscure any inter-relationships among the topics, however. It is generally unclear how the knowledge map and previous/next sequences were constructed, and in what ways the nodes relate to one another. (Of the videos I sampled, a handful made reference to skills presented in previous videos, while others broke complex topics into multiple, related videos.) In other words, the Khan Academy website offers little explanation on how topics are selected and organized, a choice that contrasts with other curricula that are more transparent about their design rationale. Researchers have, in fact, called for curricula that elucidate stances on content, teaching, and learning, arguing that such transparency is an asset to teachers and students (e.g., Davis & Krajcik, 2005; Remillard, 2000, 2005; Stein & Kim, 2009). See Figure 1, which shows a portion of the Khan Academy knowledge map for mathematics.

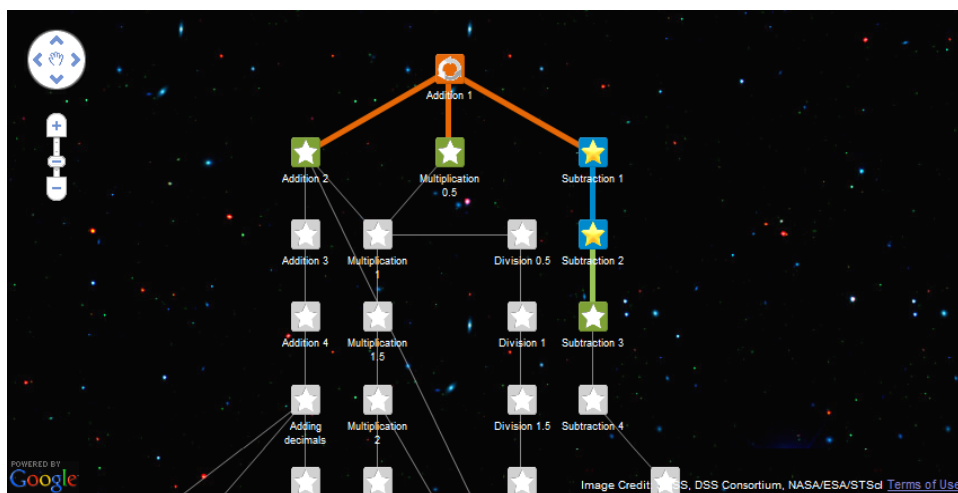


Figure 1. A Portion of the Mathematics “Knowledge Map”

A second important feature of the Khan Academy curriculum is the capacity to comment on the videos. Discussion boards appear beneath each video on the Khan Academy website. Users may contribute comments, provided that they have logged into the website (via a Google username or a Facebook ID).³ Underneath the comments, logged-in users may also ask and answer questions about the video’s content. Both comments and questions may be “voted up” or “voted down”—evaluated by other users as helpful or unhelpful. Comments and questions may also be flagged for moderator review and sorted, according to number of votes or chronological order. To participate in commenting, asking questions, answering questions, and voting, users must have attained the requisite number of “energy points.” Energy points are credited to user-accounts by watching videos and completing associated quizzes. See Figure 2, which shows

³ Notably, Facebook has a minimum-age requirement of 13 years old (<https://www.facebook.com/help/?faq=210644045634222>); Google also has a minimum-age requirement of 13, unless students are using Google Apps through their schools (<http://www.google.com/support/accounts/bin/answer.py?hl=en&answer=1333913>).

an example of the discussion board features of the Khan Academy website. Note, as well, that users may view the embedded videos on YouTube (either via a link on the Khan Academy website or via YouTube itself), which displays its own set of user comments; video comments on the Khan Academy website and on the associated YouTube site remain independent of one another.

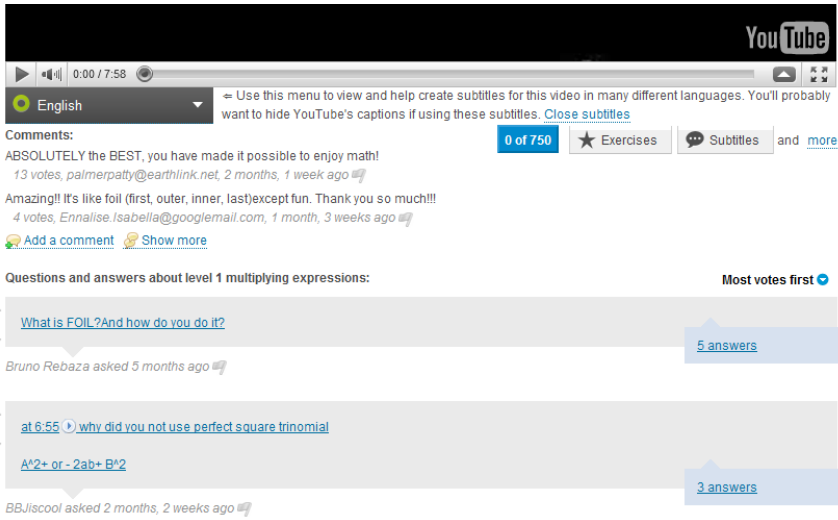


Figure 2. Discussion Boards of the Khan Academy—Commenting and Questioning Feature

A third key component of the Khan Academy is the practicing and coaching system. Practice problems are sets of questions, randomly-generated by the software, that are affiliated with a number of individual videos. Typically, users would complete practice problems by pressing the “Exercises” button after watching a video (see Figure 2). Whenever users complete 10 randomly-generated problems for a given skill, they are deemed “proficient” in that skill. Gaining proficiency in a variety of topics allows users to earn “badges,” which then appear on the user-profile. In this way, users who gain additional proficiency also gain social status within the Khan Academy community, much like the badges in FourSquare or other social networking sites. According to the Khan Academy’s frequently asked questions (FAQ) page, these problems provide opportunities for students to engage with the material and assess their understanding (Khan Academy, 2011c).

Users may also formally “coach” each other in completing practice problems. In order to become a “coach” a user must be nominated by another user; new coaches must then register with the website, but there do not appear to be any other coaching qualifications. Coaches may view the user-statistics on their affiliated students (including overall progress, amount of time logged-in, and correct/incorrect responses to practice problems), and coaches may offer tips on how to complete practice problems correctly. Users may also informally coach each other, of course, by responding to each other’s questions and comments in the discussion boards.

Having laid this groundwork, I now describe my conceptual framework and my analytical methods before presenting my findings. I construct my framework by drawing on bodies of literature related to media studies (broadly), participatory culture and videogames (more specifically), reform mathematics and curriculum theory, and discourse analysis. I concentrate on mathematics, because a majority of the videos (approximately 65%) are devoted to mathematics, and because the Khan Academy is piloting the use of mathematics videos in classrooms (Khan, 2011a; Khan Academy, 2011b). Currently, the school district of Los Altos, California uses Khan Academy videos in its fifth- and seventh-grade mathematics classes, and the Khan Academy is seeking additional brick-and-mortar partners (Khan Academy, 2011b). Another component of the Khan Academy’s espoused curriculum, then, involves replacing classroom lectures and textbook readings with videos (Khan, 2011a, 2011b). In so doing, Khan hopes that schools will “flip the script” of traditional classroom interactions (Khan, 2011a), allowing time for project-oriented work (Khan, 2011a, 2011b).

Conceptual Framework

Participatory Culture

Khan characterizes the American classroom lesson as a “fundamentally dehumanizing experience” with “a bunch of thirty kids with their fingers on their lips—not allowed to interact with each other” and “a teacher, no matter how good, [who] has to give this kind of one-size fits all lecture to thirty students; you know, blank faces, slightly antagonistic” (Khan, 2011a). Khan (2011b) contrasts this image with his “core philosophy” for the Khan Academy: “Namely, it [the Khan Academy] can be used to allow the core skills develop at a student’s pace and only during a fraction of class time. This liberates the rest of class time for peer tutoring, higher level interactions between teachers and students, and truly creative projects.” Khan therefore takes up intellectual space occupied by Dewey (1897; 1916; 1938; 1990 [1900]) and Freire (1998; 2007 [1990]), who argue against passive, consumerist, and standardized education, and who argue for interactive, experiential, and personalized education. To use a different set of terms, Khan argues for a *participatory culture* in schools and describes traditional classroom interactions as “non-participatory.”

Participatory cultures, like Web 2.0 sites, involve knowledge-sharing that extends throughout a broad community. Jenkins et al. (2009) conceptualize participatory cultures as those that have:

1. relatively low barriers to artistic expression and civic engagement,
 2. strong support for creating and sharing creations with others,
 3. some type of informal mentorship whereby what is known by the most experienced is passed along to novices,
 4. members who believe that their contributions matter, and
 5. members who feel some degree of social connection with one another (at the least, they care what other people think about what they have created)
- (p. 5-6)

In other words, in participatory cultures, individuals contribute easily and receive feedback readily within a supportive, connected community. Authority is distributed and there are many opportunities for active engagement, collaboration, and experimentation. Furthermore, Jenkins et al. regard participatory cultures as informal learning communities that are “ad hoc and localized,” that “evolve to respond to short-term needs and temporary interests,” that involve the free mobility of participants, and that “are also highly generative environments from which new aesthetic experiments and innovations emerge” (p. 11). Jenkins et al. (2009) therefore emphasize the responsiveness of participatory cultures in serving individualized needs and interests and in promoting creativity.

As Jenkins et al. (2009) also note, many researchers now regard participatory cultures as “ideal learning environments” (p. 10) that are naturally suited to ways people learn best. Indeed, citing a number of these researchers, Jenkins et al. write that “a growing body of work has focused on the value of participatory culture and its long-term impact on children’s understanding of themselves and the world around them” (ibid.). Research suggests that within participatory cultures, people are more active, more engaged, and hence have more opportunities to learn. Within participatory cultures, people display enhanced literacy skills, nuanced understanding of intellectual property rights, increased political engagement, greater facility with managing data, and stronger collaboration.

The tenets of participatory culture are clearly invoked by Web 2.0 sites like YouTube, especially within niche communities like those that involve sharing spoofs (Willett, 2009) or skateboarding videos (Buckingham, 2009). Participants in such YouTube communities learn by submitting and creatively remixing each other’s material in an open, transparent fashion, while developing mentoring relationships with others who share their interests. Likewise, the Khan Academy strives to enact a participatory learning community, especially with regard to fostering informal mentoring relationships and by providing low-barriers to accessing content (see, for example, its democratizing mission statement above). The Khan Academy also co-opts many features of Web 2.0 sites that are indicative of participatory cultures (such as stylistic simplicity and discussion boards). In my analysis, I also review the degree to which the Khan Academy fulfills the tenets and learning capacities of participatory culture.

The Khan Academy also embraces the values of online, participatory video game culture, proclaiming, “We’re full of game mechanics. As soon as you login, you’ll start earning badges and points for learning. The more you challenge yourself, the more bragging rights you’ll get” (Khan Academy, 2011c). Therefore, I employ gaming literature in my framework, since researchers have linked video games and participatory cultures, and since the Khan Academy appropriates discourse from both. In particular, Gee (2007) describes the participatory cultures that emerge within “good” video games, particularly multi-player online games; he also extracts principles of learning that are embodied by such gaming environments. These learning principles are supported by current research and, Gee says, should be utilized in designing better and more authentic learning environments for students. In Gee’s (2007) words, “Good video games engage players with powerful forms of learning, forms that we could spread, in various guises, into schools, workplaces, and communities where we wish to engage people with ‘education’” (p. 216).

Among the many learning principles characterized by Gee (2007) are: engaging students’ identities and encouraging perspective-taking, fostering scientific thinking, lowering consequences of failure (Erickson’s “psychosocial moratorium,” as cited in Gee, 2007, p. 59), encouraging distributed and situated views of knowledge, promoting discovery, facilitating social connection, and valuing creative approaches to defining and solving problems. In other words, Gee also regards ideal, natural learning environments as participatory cultures that uphold two core values: creativity and connectedness. (Of course, Gee’s work reflects research findings in areas of social cognition, literacy, and learning science.) In my analysis, I consider in what ways the Khan Academy aligns with the characteristics of a fully-participatory, mathematical culture. In Gee’s language, mathematical learning would be characterized by individuals who come to see themselves as increasingly familiar with the semiotic domain of mathematics within an affinity group of other mathematical thinkers. And, for Gee, schools should foster mathematical learning by constructing environments that engage these fundamental learning principles (through meaningful problem-solving, collaboration, etc.). This perspective on mathematical learning seems to align with that of the Khan Academy. In my analysis, then, I also consider in what ways and to what extent Gee’s learning principles of gaming are manifest within the Khan Academy.

Media and Technology Studies and School Reform

As described above, Salman Khan regards the Khan Academy as a technological tool for reforming education. In fact, he argues that teachers who use the Khan Academy videos in the classroom “have used technology to humanize the classroom” (Khan, 2011a). He also contends that “deeper, more motivated learning” would emerge from schools that use “Khan-like lectures and problem sets” to carve out time for collaborations on “a portfolio of meaningful projects” (Khan, 2011b). The literature on media and technology studies, which is often cited in calls for school reform, encompasses the literature on participatory culture and video games. I therefore include perspectives from these bodies of research in my framework.

Scholars have long debated the role and influence of media and technology in education. On the one hand, Becker (2000) asserts that “access to computers and the Internet is necessary for children to grow up with the information-gathering, analytic, and written and graphical communications skills that will constitute ‘being educated’ in the twenty-first century” (p. 66). Citing his empirical study on social inequality related to technology-use, Becker (2000) claims that schools “need to obtain more advanced technology and adopt better strategies of integrating its use with classroom learning” (p. 69). A number of other researchers have also challenged the educational community to reshape classroom practices by investing in technologies—seeing technology as a means to solidify student-centered, exploratory, and multi-disciplinary education (e.g., Papert, 1980; Kafai, 2006; Kafai & Peppler, 2011).

In contrast, Light (2001) notes that, for decades, technology and media have been touted as false harbingers of social justice and educational improvement. In fact, cable television was originally regarded as a “tool for social reform” (p. 721). Light argues that the “technology gap” is merely a reflection of inequity in American society, which technology interventions alone cannot possibly remediate. Taking

a different approach, Kozma (1994) argues that in classrooms “both [the medium and the method] are part of the instructional design” and that “a medium’s capabilities enable methods and the methods that are used take advantage of these capabilities” (p. 16). In Kozma’s view, then, technology practices in classrooms are necessarily bound to the pedagogies and capacities of individual instructors. Extending Kozma’s view, Zhao, Pugh, Sheldon and Byers (2002) found evidence that mutually-dependent characteristics of teachers, schools, and technological tools all influence how technological practices are taken up in schools. In sum, researchers have found, time and time again, that the effects of teaching tools of teaching cannot be separated from who uses them and how. Therefore, I also adopt an ecological view in my analysis, as well—uses of technology in classrooms depend upon capacities and beliefs of teachers, students, schools, districts, and society at large. As Earle (2002) states, technology “integration is defined not by the amount or type of technology used, but by how and why it is used” (p. 7).

Looking specifically at the YouTube infrastructure of the Khan Academy, there are both affordances and limitations of using YouTube in particular educational contexts. In fact, the work of Burgess and Green (2009) problematizes YouTube as a universally-applicable educational medium. On the one hand, Burgess and Green argue, the “cultural, social, and economic values” of YouTube “are collectively produced by users *en masse*” (p. 5) and that “participation in this self-constituted YouTube ‘community’ relies on various forms of vernacular expertise” (p. 98). In other words, YouTube can be characterized as a social space, a space for social interaction and the joint construction of cultural meaning—not unlike modern conceptions of classroom spaces. Therefore, YouTube undoubtedly constitutes a learning community, especially in the way Gee (2007) characterizes affinity groups.

Hartley (2009) even speculates whether traditional schools have a purpose any longer, now that they can easily be supplanted by online media. On the other hand, Burgess and Green (2009) likewise note:

YouTube also presents us with an opportunity to confront some of participatory culture’s most pressing problems: the unevenness of participation and voice; the apparent tensions between commercial interests and the public good; and the contestation of ethics and social norms that occurs as belief systems, interests, and cultural differences collide. (p. viii)

Therefore, YouTube communities are not fully participatory, due to the involvement of mass media interests, screening of content, restrictive norms, and unequal access to technology. These questions, raised by Burgess and Green (2009), are especially relevant to the Khan Academy, which utilizes YouTube and which largely determines its own content and modes of participation. To more fully unpack the tensions noted by Burgess and Green (2009), Hartley (2009) argues a methodological point—that individual-level behaviors in YouTube must be studied “in order to understand how the system as a whole works” (p. 142). Therefore, paying heed to Hartley’s concerns, I consider the specific ways in which the Khan Academy is taken up by particular users to understand the Khan Academy as an educational technology.

Standards-Based Reform Curricula and Curriculum Theory

Stein, Remillard, and Smith (2007) note that among the most popular curriculum materials in the United States are so-called “standards-based curricula”—those that were funded by the National Science Foundation (NSF), or were inspired by the curriculum reform documents of the 1980’s and 1990’s that were published by the National Council of Teachers of Mathematics (NCTM). The NCTM standards documents emerged from a body of research that suggested American students were lagging behind the mathematical achievement of their peers in other parts of the world, especially with regard to conceptual understanding and communication skills (Thompson & Senk, 2003). Curriculum materials were developed in response, intended to support teachers in transforming classroom instruction (Stein, Remillard, & Smith, 2007).

An overarching goal of using standards-based curricula, according to Thompson and Senk (2003), involves providing experiences “that would help children understand concepts through exploring, investigating, and communicating mathematics” (p. 40). In other words, standards-based curricula emphasize the students’ roles in constructing meaning for themselves, through inquiry and peer collaboration. This newer vision of mathematics learning represents a significant departure from conceptions of traditional instruction that involve teachers’ didactic explanations and students’ repetitive practice of decontextualized skills. Thompson and Senk (2003) review research that attributes the performance gap of American students to skill-and-drill teaching and textbooks that support such instruction. In contrast, there is evidence that newer pedagogies emphasizing student participation, supported by newer curricula, provide enhanced opportunities for students to make deeper connections in mathematics classes (e.g., Boaler & Staples, 2008; Tarr, Reys, Reys, Chavez, Shih, & Osterlind, 2008). At the same time, because standards-based curriculum materials offer such a “radically different” view of learning mathematics, they are not without critics (Stein, Remillard, & Smith, 2007, p. 320). By and large, such critics maintain that standards-based curricula de-emphasize procedural fluency and efficiency. Researchers argue, however, that the overriding influence on student learning is how teachers, schools, and students interact in using curriculum materials, rather than curriculum materials themselves (see Stein, Remillard, & Smith, 2007, for a review).

Nevertheless, the NCTM standards and standards-based curricula have garnered broad-based appeal among mathematicians, educators, and the public. Such materials position the teacher as mentors and as facilitators of discourse in a collective, meaning-making endeavor (Silver, 2009). The NCTM (2000a, 2000b) also endorses student collaboration and efforts to promote student creativity and exploration. Likewise, these values are supported by Salman Khan and the Khan Academy (Khan, 2011a, 2011b; Khan Academy, 2011a, 2011b, 2011c). Furthermore, these values also dovetail with the tenets of learning in participatory cultures (Gee, 2007; Jenkins et al., 2009). Therefore, I employ an additional lens in studying the Khan Academy: the perspective on mathematics learning and curriculum espoused by NCTM (2000a, 2000b)—what I regard as a participatory view on mathematics learning. This additional lens provides a means for assessing the degree to which the Khan Academy represents participatory culture within the particular realm of mathematics pedagogy.

In its standards documents, the NCTM (2000a) describes curricular and pedagogical goals in a number of mathematics content strands (such as “number and operations,” “geometry,” and “data analysis and probability”). A full review of the Khan Academy’s 2,100 videos with respect to these content standards would be a time-intensive endeavor. Therefore, for this working paper, I only touch on content analysis of the Khan Academy curriculum. At the same time, the NCTM (2000b) espouses several “process” standards for helping pre-kindergarten through grade 12 students to understand mathematics as a field of inquiry and sense-making. These process standards closely map onto the learning principles of participatory culture; they include (NCTM, 2000b):

- Apply and adapt a variety of appropriate strategies to solve problems (problem-solving)
- Monitor and reflect on the process of mathematical problem solving (problem-solving)
- Make and investigate mathematical conjectures (reasoning and proof)
- Develop and evaluate mathematical arguments and proofs (reasoning and proof)
- Communicate mathematical thinking coherently and clearly to peers, teachers, and others (communication)
- Analyze and evaluate the mathematical thinking and strategies of others (communication)
- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole (connections)
- Create and use representations to organize, record, and communicate mathematical ideas (representations)
- Select, apply, and translate among mathematical representations to solve problems (representations)

Indeed, there is a synergy between the NCTM curriculum reform movement and theories of participatory culture. As with Gee’s (2007) depiction of learning within online video game environments, the NCTM emphasizes the importance of creativity and connectedness. Students are encouraged to find unique representations of mathematical concepts, and to uncover these representations through their own explorations, while sharing their conclusions amidst a supportive community of learners.

Discourse Analysis

I also draw on methods of discourse analysis in undertaking my analysis. In so doing, I am following in the footsteps of Morgan (1996) and Herbel-Eisenmann (2000), who have used methods of discourse analysis in analyzing mathematics curricula (cited by Remillard, 2005). Morgan (1996) outlines linguistics tools for researchers in mathematics education to consider ways in which students take up and produce mathematical texts. She explains:

By going beyond the traditional focus on vocabulary and symbolism it becomes possible to interrogate both written and oral texts produced

within mathematical contexts in order to address a wider range of questions about the nature of the mathematical activity, about the relationships between the participants and the activity and about the forms of reasonings involved. (Morgan, 1996, p. 8)

Herbel-Eisenmann (2000) used such tools in her investigation of a standards-based curriculum package and its deployment in classrooms. In her work, Herbel-Eisenmann (2000) found that the language employed by teachers, which is influenced by the curriculum, helps to shape the way students consider mathematical ideas and the way teachers position themselves and students in relationship to mathematical authority. Likewise, in my analysis of discourse related to the Khan Academy, I consider the types of mathematical questions that emerge, the ways in which they are raised, and how students reason about them; I also consider how relationships to mathematical authority are construed.

Even more broadly, Wortham (2008) argues for linguistic approaches in education research, because educational spaces are “mediated by language use”; when speaking or writing, educators and students “signal things not only about the subject matter they are learning but also about their affiliations with social groups both inside and outside the speech event” (p. 39). In other words, studying discourse in educational interactions reveals actors’ stances on both content knowledge and relationships. Further, according to Gee (2010), “We continually and actively build and rebuild our worlds not just through language, but through language used in tandem with actions, interactions, non-linguistic symbol systems, objects, tools, technologies, and distinctive ways of thinking, valuing, feeling, and believing” (p. 11). Therefore, language and tool-use help actors construct identities and position themselves in relationship to other actors. Finally, like Gee (2010), Goffman (1981) contends that utterances involve more than merely communicating information. For Goffman (1981), speakers and listeners constantly shift *footing*, or the status of their participation, in relationship to statements and actions by each other and about each other.

I, too, adopt the position that educational spaces are linguistic spaces, that linguistic spaces incorporate use of words and other tools, and that linguistic events construct identities, relationships, and stances. Therefore, I find the discourse analytic tools offered by Gee (2010), Goffman (1981), Schegloff (2007), and Wortham (2001) especially useful. I marshal these resources in unpacking the stances of Salman Khan, as he carves a position for the Khan Academy within spaces of mathematics, educational reform, and educational technology. These tools are also useful in considering how users respond to the ways in which the Khan Academy positions learners and learning. As noted in the “Methods” section, I consider a number of different *participation frameworks* (Goffman, 1981) for discussing the Khan Academy, including speech between presenters and an audience, conversations among individuals, and asynchronous speech that occurs via electronic media.

Methods

Data Selection

As noted at the beginning of this paper, all data was gathered in early May 2011. I first imported the list of Khan Academy videos into a spreadsheet program. I then eliminated all non-mathematics videos (leaving 1,308 from 2,088), and videos on post-secondary mathematics (leaving 900). Finally, I used the spreadsheet's random-number generator to identify a random sample of twenty videos (constituting roughly 200 minutes of video). (I also watched one additional video that was a continuation of a previous one.) See Table 1 for a list of my sample videos, including my assessment of the content area and grade-level covered.

Table 1 also indicates whether or not the video is as a test-prep sample problem. A significant number of the Khan Academy's videos are worked examples from practice standardized tests. By including standardized test preparation in its curriculum, the Khan Academy acknowledges the current high-stakes testing environment, but I did not regard the selection of such problems as necessarily indicative of the pedagogical philosophy of the Khan Academy; such problems are developed by outside agencies and, by definition, worked examples are didactic. Therefore, I watched but did not necessarily concentrate on analyzing these test-prep videos.

I also recorded the number of views of each video (provided by YouTube), as well as the number of YouTube "likes" and "dislikes." Among my sample of videos, there was an average of 25,244.4 views per video, compared to an average of 23,115.4 views per video in the entire Khan Academy library. I could not gather data on the total number of "likes" and "dislikes" for Khan Academy videos; nonetheless, my sample does not appear to contain an unbalanced selection of highly popular or highly unpopular videos.

Finally, I also reviewed the Khan Academy website's FAQ, blog, and promotional materials, in order to gain insight into Khan's stances on mathematics, learning, and teaching. To gain a broader perspective, I used internet search engines to find Khan-related profiles, interviews, and news reports.

Analytical Methods

I viewed each sample video on the Khan Academy website. I also read the user comments on both the Khan Academy website and on YouTube (because these two sets of comments are different). For this working paper, I recorded ethnographic fieldnotes as I watched the sample videos. I also took notes on the comments associated with the videos. I then coded my fieldnotes to highlight examples that reflected my framework—the learning principles in participatory cultures, participatory views on mathematics learning, and perspectives on media in education. (Future data collection could include detailed transcripts and complete records of comments.) Significant cases are presented in my analysis below; note that any quotations from YouTube comments are denoted as such, while all other quotations are presumed to come from the Khan Academy website.

"IT'S SCHOOL ORGANIZED LIKE A GIANT VIDEOGAME"

Video	Grade*	Khan Academy Category**	Video Title	Test-prep
1	HS	ck12.org	Identifying Quadratic Models	Y
2	MS	Developmental Math 1	Adding fractions with different signs	N
3	HS	Developmental Math 2	Slope of a Line 2	N
4	HS	CAHSEE Examples	CAHSEE Practice: Problems 17-19	Y
5	MS	Developmental Math 1	Understanding Exponents	N
6	MS	Pre-algebra	Exponent Rules Part 2	N
7	HS	Algebra	Rational Inequalities	N
8	HS	Pre-calculus	Sequences and Series (part 1)	N
9	HS	ck12.org	Square Roots and Real Numbers	Y
10	HS	ck12.org	Systems of Linear Inequalities	N
11	HS	Trigonometry	Proof: $\cos(a+b) = (\cos a)(\cos b) - (\sin a)(\sin b)$	N
12	HS	Trigonometry	Trigonometry word problems (part 1)	N
13	MS	Developmental Math 1	Identity Property of 1	Y
14	HS	Algebra	Quadratic Inequalities	N
15	HS	Geometry	Angle Game (part 2)	N
16	HS	Algebra	Quadratic Equation part 2	N
17	HS	Algebra	Complex Numbers (part 2)	N
18	HS	ck12.org	Order of Operations	Y
19	ES	Developmental Math 1	Dividing Whole Numbers and Applications 1	N
20	HS	Precalc	Complex Conjugates	N

Table 1. Description of Videos Sampled (with URLs hyperlinked in this table)

Notes: *ES = Elementary school, MS = Middle school, HS = High school.

**According to the Khan Academy, ck12.org problems are from the ck12.org open source textbook on algebra; CAHSEE problems are from the sample test for the California High School Exit Examination; and Developmental Math videos are from the Monterey Institute for Technology and Education (<http://www.montereyinstitute.org/nroc/nrocdemos.html>).

My overall analytical lens was therefore interpretive, and by abstracting an understanding of what it means to participate in the Khan Academy community, I engage in what is essentially a hermeneutic phenomenology (van Manen, 1990). In using discourse analysis to analyze videos and comments, I worked to construct a view of both the user-experience within the Khan Academy and also how users interpreted the Khan Academy's stances on mathematics and learning. Therefore, comments were coded for reactions to mathematical substance as well as stylistics. It should be noted that the YouTube and Khan Academy discussion boards appear to be monitored (there are notes indicating that "comments have been removed" and there are buttons for flagging "inappropriate content"). Consequently, my analysis is limited insofar as moderation shapes the discussions. For users, there are also different experiences in visiting the Khan Academy versus YouTube, since discussion boards are "threaded" in the Khan Academy (organized in a relational series of questions and responses), while YouTube discussions are ordered chronologically. I touch on implications of these differences in my analysis.

Results and Discussion

Stance on Learning Mathematics and Educational Reform

By interrogating Salman Khan's public statements and blog posts, I illustrate his stances on learning mathematics and educational reform. I found that Khan's perspective is not without competing tensions. In fact, Salman Khan works to position himself as an outsider to the educational establishment, while simultaneously endorsing some of its values. Consider, first, how Khan describes the challenge of juggling a full-time job while making YouTube videos for his cousins:

But, the whole time I kind of rationalized that the only reason that I'm doing this is because I want to, one day, start a school. In my mind, I didn't want to start a school, write grants and go to the Department of Education and get a charter and all of that. I felt the constraints. I just want to become really rich and just do it on my own terms. So, that was my rationalization for just trying to generate alpha day and night. As the Khan Academy story goes, I kind of got an outlet for some of my ideas with my cousins, tutoring them virtually. And then, the YouTube thing took off, viral software app. (Warner, 2010, n.p.)

Here, Khan explains his long-held passion for schooling. He says that he had maintained a vision of becoming "really rich" and then starting a school, because he perceived that traditional routes were more challenging. But he also implies that starting a school by filing paperwork with the Department of Education was more than just burdensome; he sees them as inevitably restrictive and compromising. In this interview, he linguistically opposes "the constraints" and his "own terms"; therefore, to Khan, the Department of Education and charter school regulations represent barriers to implementing his own ideas. Presumably, they are part of a broken establishment that he is intent on reforming, and in his view, affiliating with the educational establishment would necessitate transforming his vision or accommodating outside influences. He was surprised and pleased to learn,

however, that he could succeed with the Khan Academy in its earliest incarnation and without pursuing much additional capital—and so he could circumvent more traditional routes for starting a school.

Likewise, Khan paints a contrast between his own teaching and what he regards as traditional forms of teaching. In the Khan Academy FAQ, he writes:

A lot of my own educational experience was spent frustrated with how information was conveyed in textbooks and lectures. There would be connections in the subject matter that standard curricula would ignore despite the fact that they make the content easier to understand, enjoy, and RETAIN. I felt like fascinating and INTUITIVE concepts were almost intentionally being butchered into pages and pages of sleep-inducing text and monotonic, scripted lectures. I saw otherwise intelligent peers memorizing steps and formulas for the next exam without any sense of the intuition or big picture, only to forget everything within a matter of weeks. (Khan Academy, 2011c, n.p., emphasis in original)

Here, Khan decries rote memorization and the blind application of algorithms in mathematics education. He also emphasizes the value of making connections between seemingly different ideas. This is a rhetorical move that aligns his values with those of the NCTM, which might be regarded as part of the educational establishment. Therefore, this declaration does not add much new to the contemporary milieu of mathematics education. On the other hand, as I now discuss, Khan’s language also runs somewhat counter to the NCTM reform movement.

He uses the iconic signifiers “textbooks” and “lectures” to represent his childhood educational experience implying that American classroom lessons largely consist of textbook readings and listening to scripted lectures. These textbooks and lectures become the primary agents that “convey information” to students; their failures in doing so are not structural, however, but rhetorical: textbooks and lectures neglected to explain the conceptual-oriented connections that Khan himself discovered and found useful. Khan also states in the FAQ that he “teach[es] the way he wishes he was taught”; in other words, he aspires to illuminate the connections that his own teachers and textbooks failed to make. By taking this stance, however, Khan replaces the primary teaching agents (teachers/textbooks with Khan, himself) but does not change the overall authority structure. Regardless of who or what is conveying information, Khan’s espoused perspective on teaching and learning holds that external authorities—such as textbooks or teachers—are responsible for defining the disciplinary boundaries of mathematics and forging conceptual connections. The NCTM, on the other hand, adopts a perspective that is often called *Piagetian* or *constructivist*. In this contrasting view of teaching and learning, authority for making mathematical connections is located within the students themselves. In other words, teaching is about facilitating opportunities for students to develop their own forms of understanding and learning itself becomes redefined as a connection-making process. In a constructivist model, the responsibility for shaping what it means to do mathematics lies more with students than it does with teachers and textbooks.

When Khan describes the instructional videos, he introduces other tensions with the NCTM reform movement. In the FAQ, he proclaims:

The [video] content is made in digestible 10-20 minute chunks especially purposed for viewing on the computer as opposed to being a longer video of a conventional 'physical' [in-person] lecture. The conversational style of the videos is the tonal antithesis of what people traditionally associate with math and science instruction. (Khan Academy, 2011c, n.p.)

On the one hand, Khan hopes that students will be able to make connections between mathematical topics, and on the other, content is reduced to "digestible 10-20 minute chunks." To some degree, content delivered in "digestible chunks" might conflict with students "making connections," because such realizations often emerge after prolonged exposure to complex ideas. If content material is already digestible on its own, the need for making connections seems to be obviated.

Presumably, Khan also regards his "conversational style" as more casual and engaging than the dry lectures stereotypically delivered by math teachers. Khan explains why, in his view, his video lectures are different:

The lectures are coming from me, an actual human being who is fascinated by the world around him. The concepts are conveyed as they are understood by me, not as they are written in a textbook developed by an educational bureaucracy. Viewers know that it is the labor of love of one somewhat quirky and determined man who has a passion for learning and teaching. I don't think any corporate or governmental effort—regardless of how much money is thrown at the problem—can reproduce this. (Khan Academy, 2011c, n.p.)

Here, again, the same distancing language is used, wherein Khan portrays himself as an outsider to the educational establishment. He also highlights his own passion, contrasting it with the stultifying bureaucracies of corporate and governmental interests. In another interview, Khan also says that to be a good teacher "you don't have to necessarily have a PhD," but instead, "you just have to have a passion for the subject" (Warner, 2010). Further, Khan minimizes the role of using resources in teaching: in the FAQ, Khan responds to a question about the curriculum of the Khan Academy, writing, "The simple answer is [we have] none" (Khan Academy, 2011c). As Lortie (2002 [1975]) found, a popular conception of a teacher is of an especially charismatic individual, a competent leader with admirable interpersonal skills. Khan himself appears to subscribe to this view, as well.

On the one hand, then, Khan aligns himself with standards-based reform curricula—arguing for project-oriented work, conceptual understanding, and lively classrooms. On the other hand, though, Khan distances himself from the educational establishment that produced standards-based reform curricula—publishers, educators, and mathematicians, who were supported by funding from the NSF (Stein, Remillard, & Smith, 2007). He also undercuts lecturing as a pedagogical technique, but simultaneously promotes it as a key feature of the Khan Academy. He supports students in making connections across topics, and yet, content discussions are reduced to "digestible 10-20 minute chunks." In other words, Khan's stance on educational reform both affirms and contradicts aspects of the participatory view on mathematics learning that is espoused by the standards-based reform movement. In so doing, Khan also locates himself as the authority on mathematics; in other words, he determines (perhaps in consultation with outside

references) what it means to do mathematics and by what criteria mathematical reasoning is to be evaluated. Students clearly respond to Khan’s charisma, often referring to him affectionately as “Sal” while praising his sense of humor or his step-by-step solutions (e.g., video 6, comments).

I should also note, here, that Khan’s view of traditional American mathematics education contrasts with a number of other perspectives that suggest anything but homogeneity. First, a number of studies demonstrate that teachers’ use of curriculum is mediated by a variety of factors, such as teachers’ beliefs about mathematics teaching and learning (Lloyd, 1999), teachers’ orientations towards curriculum (Remillard & Bryans, 2004), and contexts of schools and communities (Manoucheri & Goodman, 2000), among others. In other words, there is substantial evidence that teachers rarely, if ever, follow a pre-written script. Such research is not new: nearly forty years ago, Lortie (2002 [1975]) and Weick (1976) emphasized how American teachers act in highly autonomous ways. Finally, there is also evidence that American teachers can and do maintain classroom environments that are consistent with the aims of standards-based reform—that is, environments that emphasize student exploration, collaboration, and conceptual understanding (e.g., Boaler & Staples, 2008; Tarr et al., 2008). Criticisms of American teaching typically consider the broader American “cultural script” that portrays mathematics and mathematics learning as the acquiring of skills and vocabulary (Stein, Grover, & Henningsen, 1996; Stigler & Hiebert, 1998, 1999). Next, I take up Khan’s espoused mathematical epistemology before unpacking how these shape learning experiences for students using the Khan Academy website.

Mathematical Epistemology

Burgess and Green (2009), writing about YouTube, note the tension between amateur producers and commercial, mass-media interests: while grassroots user-created content continues to flourish on YouTube, the professional media increasingly strives to assert control. This question is even more pervasive for the Khan Academy with regard to who controls what it means to do mathematics and how to learn mathematics. Who structures learning experiences? How are they structured? What images of mathematics are presented? As described earlier, answering these questions as they relate to the curriculum of the Khan Academy involve understanding design decisions and stances from which such decisions emerge (Brown, 2002, 2009).

Buckingham (2009), Willett (2009), and Rymes (2011, in press) explore ways in which youth recontextualize productions of mass media to suit localized purposes. Many scholars argue that such recontextualizations, and the concurrent development of repertoires, evidence learning (e.g., Gee, 2007; Jenkins et al., 2009; Rymes, 2011). Gresalfi, Martin, Hand, and Greeno (2009) cast the kind of learning that takes place as being shaped by the kinds of learning opportunities afforded within a given system, such as a classroom environment. In promoting creative recontextualizations, then, participatory cultures foster a production and connection-oriented lens on learning. Production and connection-making indicate deeper, conceptual understanding and remain key goals of standards-based reform in mathematics education.

And yet, the Khan Academy website departs from typical, participatory Web 2.0 sites in significant ways. Salman Khan remains the sole lecturer at the Khan Academy, since he produces and narrates each of the site's videos. Khan and his small team also organize content according to their knowledge map. The knowledge map, as a construct, presupposes that the discipline of mathematics is essentially cumulative and static; that is, the knowledge map prioritizes a view of mathematics that is imbued with what Pickering (1995) termed *disciplinary agency*. According to Pickering (1995), disciplinary agency represents the ceding of practices to the long-established norms of the mathematical community (i.e., skills, conventions, and terminology), whereas *conceptual agency* involves utilizing mathematical tools in the service of questioning, adapting, exploring, and strategizing. Disciplinary agency remains with external sources, like textbooks or charismatic teachers, while conceptual agency remains with those making sense of mathematical scenarios. I should also note that Pickering (1995) asserts a "repertoires" view on learning, as well—that tools, concepts, theories, and practices together produce successful intellectual advances. In other words, neither disciplinary agency nor conceptual agency exists in isolation when meaningful learning occurs.

As do others in this special issue, I suggest that participatory cultures (and conceptual agency) therefore advance the idea that knowledge is situated and distributed. Other researchers also find this to be the case with regard to knowledge of mathematics learning and teaching, and hence, advocate for teachers' ongoing participation in professional learning communities, or PLCs (e.g., Darling-Hammond, 1996; McLaughlin and Talbert, 1993). PLCs locate the authority over the meaning and practices of teaching within a community, rather than bound up with particular individuals. These notions contrast with the Khan Academy, wherein the disciplinary knowledge and structuring of content largely rests within a single person, Salman Khan.

As a consequence, I generally encountered students asking questions of one another about Khan's videos, but these questions (and responses) typically remained at the *receptive* level. By this, I mean that questions presumed Khan's representation of mathematical content as essentially correct and asked for clarifications on procedures or for error-checks. Interaction between users and coaches on the Khan Academy website and on YouTube, largely, did not result in production of new models, new connections between topics, or new interpretations. Therefore, the Khan Academy represents somewhat of a closed system for distributing knowledge. This is not to suggest that students cannot produce new recontextualizations within the Khan Academy, but rather, that in the website's current incarnation—with its top-down delivery structure—interactions and learning opportunities are necessarily constrained. In Burgess and Green's (2009) terms, if YouTube is located somewhere in the middle of a continuum between tightly-controlled and fully-participatory cultures (perhaps leaning toward the participatory end), then the Khan Academy lies closer to the tightly-controlled end. How this control is understood by users is discussed in greater detail below. Indeed, there are additional implications of the Khan Academy's mathematical epistemology on how participation is structured for users of the website and how users take up such opportunities.

Impact of Epistemology on Student Participation Structures

One implication of the work by Tarr et al. (2008) pertains to the impact of participation structures on student achievement. In their study, Tarr et al. (2008) found that students of teachers using standards-based curricula in ways that were more consistent with standards-based reforms performed better in mathematical reasoning, problem-solving, and communication. Likewise, Gresalfi et al. (2009) found that student competence in mathematics is mediated by the ways in which participation is structured. In other words, students can produce mathematical reasoning when given opportunities to do so, but when such opportunities are limited, students’ thinking is also likely to be constrained and reproductive.

Consider the notion of “mastery,” as defined by the Khan Academy. According to Khan (2011a), traditional schooling “penalizes you [students] for experimentation and failure, but it does not expect mastery,” while the Khan Academy model “encourages failure” but also “expects mastery.” “Mastery,” according to the Khan Academy involves correctly answering ten consecutive practice problems that are associated with a given video, and upon doing so, students earn badges and energy points. This model has a number of benefits and limitations. On the one hand, the relative anonymity of internet interactions (as compared to traditional classrooms) likely lowers barriers to risk-taking. In my analysis, it was relatively common for Khan Academy students to have inscrutable usernames like “luna212121,” and so asking or answering questions presents little psychosocial danger; there is little fear of feeling foolish. In addition, when completing practice problems, student errors are not penalized as they would be on traditional classroom tests, and so barriers to risk-taking are further lowered. Here, the psychosocial moratorium principle is certainly at work (Gee, 2007). On the other hand, for those teachers at brick-and-mortar schools, the Khan Academy provides detailed analytics on individual student performance, including the amount of time spent working on correct and incorrect problems, the amount of time watching videos, and the like. In the case of classroom use of the Khan Academy, anonymity is presumably absent, and it is unclear whether teachers would penalize students for incorrect answers—rather than just gauging how many badges and energy points they earn. In classrooms, then, the psychosocial ramifications are different for students than for anonymous users on the Khan Academy website.

Furthermore, the types of problems offered to students on the Khan Academy website, generally reify the disciplinary authority of mathematics. In other words, problems are generally skill- and procedure-based, rather than oriented toward reasoning- and problem-solving. The overall effect, then, is a potential funneling of what it means to do mathematics, such that the accumulation of skills is emphasized over the development of reasoning capacity. In fact, in a blog post, fifth-grade students in Los Altos, California (whose school district is piloting the Khan Academy in its mathematics classrooms) write that “students now have ignored the exercises and videos, only to focus on badges” and that ultimately, “sometimes people rush through the exercise without learning it just to get a badge” (LASD, 2011 March 31). In addition, one teacher in Los Altos blogs about a recent lesson:

While most were busy working on KA [Khan Academy], many were just horsing around and looking for silly ways to keep each other busy. This

was not the usual feel for this time in our classroom. So, I asked them what was up. They responded with: “I’m kind of bored,” “I’ve done everything that I can,” “I don’t know what to do next.” I think we’ve hit the wall. Most of my students have completed a major chunk of the modules [i.e., the videos and associated practice problems] and the few they have yet to complete are extremely complicated and a bit over their fifth grade heads and require some major work and a lot of help. Now what? (LASD, 2011, May 3)

A possible result for students is acceleration through content without enriched, or deeper, understanding of the connections and underlying motivations of mathematical ideas. Many curricula, consequently, spiral through content and return to older material to keep students’ understanding fresh and to promote connection-making (see Stein & Kim, 2009). Admittedly, the Los Altos pilot is in preliminary stages and constitutes a small sample; nonetheless, there is evidence from Los Altos suggesting that teachers may be unsure how to integrate project work with Khan Academy videos and that teachers may be dependent upon the videos to determine the trajectory of content delivery. In other words, there could be a perception in Los Altos that what is known as “math” only exists within the boundaries defined by the videos; no other types of math are known to exist.

At the same time, students appear motivated by the game mechanics of the Khan Academy. Samuels (2011) quotes a seventh-grader in Los Altos, Devon Nemelka, who says, “I love Khan Academy. Things that I’m having trouble with, it helps me set a goal to be proficient at it and get energy points and stuff.” Blogger and Khan Academy user Francis Santos proclaims:

Salman Khan has managed to do something no educator has done before, he’s turned school into a glorified videogame. How could anyone born in the age of the internet resist this?... it’s school organized like a giant videogame, but this time the achievements actually mean something. (Santos, 2011, n.p.)

Blogger “LRK” also explains that after watching a Khan-narrated video, “You also will earn badges and points like a video game which gives you feedback and incentive to do better and faster as well as just practice for speed” (LRK, 2011). To some degree, then, the students’ enthusiasm for earning badges reflects Gee’s (2007) learning principles, particularly the *achievement principle*—that learners are gratified by customized rewards signaling each other’s level of effort and skill—as well as the *affinity group principle*—that a community of learners develops as a result of shared goals and experiences. In the Khan Academy, it seems, personalization works in concert with community support in order to motivate students’ progress through the knowledge map.

The espoused curriculum of the Khan Academy includes more than just the videos, coaching, discussion boards, and badges, however. As described previously, Khan also hopes schools will use the Khan Academy to *flip the script* of traditional classrooms. Classroom time, according to Khan, should be reserved for differentiated instruction, peer mentoring, and project-oriented work, while homework would consist of watching videos and completing basic exercises. Yet, with an epistemology oriented toward disciplinary agency, new tensions are

introduced by this flipped curriculum. For one, teachers may no longer be viewed as experts on content matter, and are therefore not necessarily positioned to help shape students’ perceptions of mathematics and how to do mathematics.

Further, researchers have maintained that teachers need support in understanding how to interact with curricula (Remillard, 2005), which would include support in how to setup and maintain a laboratory-type environment for modeling real-world relationships with mathematics. Researchers have long established that transferring abstract, decontextualized knowledge to real-life problem-solving is elusive and contingent upon a variety of factors (see, e.g., Niss, Blum, & Galbraith, 2007). Indeed, Niss, Blum, and Galbraith (2007) also write:

This [contingency] suggests that if we want students to develop application and modeling competency as one outcome of their mathematical education, applications and modeling have to be explicitly put on the agenda of the teaching and learning of mathematics...In the same ways as students do not become able to apply mathematics and to analyse and construct mathematical models as an automatic result of having learnt purely theoretical mathematics, teachers do not become able to orchestrate environments, situations, and activities for applications and modeling as an automatic result of having been trained as mathematicians or mathematics teachers in traditional ways that focus entirely on purely mathematical subject matter...they need opportunities to develop that capacity during their pre-service education and through regular in-service activities of professional development. (p. 6-7)

Without extensive support in understanding how to construct and use mathematical models, as well as how to teach modeling and applications, a significant rift seems likely to develop between the Khan Academy’s espoused curriculum and that enacted or experienced on the ground. There is also little agreement on the degree to which modeling and applications should be represented in pre-collegiate mathematics classrooms (Pollak, 2003). Regardless, Pollak (2003) notes that a number of popular curricula already incorporate contextual, real-world problem-solving within their programs and simultaneously support teachers in enacting these goals: curricula such as *Math in Context* or the *Interactive Mathematics Project*. Salman Khan himself acknowledges that the Khan Academy needs more time to develop support for teachers in project-oriented learning (Khan, 2011b), but note again that the Khan Academy is already being piloted as a replacement for other curricula.

Participation Structures Embedded within Discussion Boards

I found evidence that users participate in the Khan Academy discussion boards in robust ways. First, users find social support when commenting and questioning. Consider the user “VincentPare” who asks about the way in which a particular formula is presented in a video. Several respondents provide helpful clarifications, and VincentPare replies, “Thx guys :)” (video 16, questions, VincentPare). As another example, one student complains about the relative difficulty of a particular topic, writing: “i’m confused. i’m only in 9th grade” (video 11, questions, luna212121). Another student replies: “I’m also in 9th grade and it took me hours to grow proficient in that topic” (video 11, questions, blakester95).

Moreover, a number of respondents also provide their “coaching usernames” to various questioners, in order to facilitate social connections. Offering to coach appears to be relatively common practice on the Khan Academy website. (On the other hand, it does not appear that coaches are screened or monitored by the Khan Academy, which contrasts—for example—with the elaborate training program undertaken by mentors at The Math Forum.⁴) Therefore, social connections, mentoring, and expressions of gratitude represent the support system inherent in the participation framework of the Khan Academy; this support system also reflects the collaborative values of participatory culture described by Jenkins et al. (2009), Gee’s (2007) affinity groups, and the NCTM’s (2000b) emphasis on mathematical communication.

Second, the discussion threads (organized in a question-and-answer format along with voting buttons) also provide support for users wishing to probe deeper into the content of the videos, to collaborate with one another, and to share differing perspectives. See, for example, Figures 3 and 4, which highlight productive exchanges. In Figure 3, the user “asmigel” questions a particular approach employed by Salman Khan in solving a problem. Then, asmigel looks to generalize by asking, “And how do you know *when* to keep the negative exponent and *when* to eliminate it?” (video 6, questions, asmigel, emphasis added). The interrogative “when” indicates a desire to develop a rule or heuristic about these types of problems. Two users respond to asmigel, providing a broader construct: they supply a possible rationale for Khan’s choice, and they connect the mathematics here to other sorts of problem-solving endeavors, such as working with word problems or in physics. Figure 4 shows a similar conversation between “citygirlonchocolate” and other users. In both cases, Khan Academy users are clearly engaged in pursuits that align with the NCTM (2000b) process standards, including: analyzing strategies of others, making connections between mathematical ideas, developing mathematical arguments, reflecting on how to solve problems, etc. Mentorship, social connection, and creativity are also reflected (Gee, 2007; Jenkins et al., 2009). Note that, by virtue of turning to fellow users (and not Khan, himself), these learners also embrace the principle of distributed knowledge (Gee, 2007). In other words, these users acknowledge that an understanding of mathematics is spread throughout their community, rather than being located within a single authority.

There is also some evidence that users “select, apply, and translate among mathematical representations to solve problems” and work to “understand how mathematical ideas interconnect and build on one another” (NCTM, 2000b). In other words, there are ways in which students use discussion boards to recontextualize Khan Academy videos. In one such example, a YouTube viewer remarks:

There’s a very simple GRAPHICAL proof that you can’t take the square root of a prime number [sic]. Graphically, squaring is taking the side of a square consisting of that many little “unit squares,” as the number you’re squaring. But no matter what you do, you can’t build a square from any prime number, because there’s always something left making the square incomplete. (video 9, YouTube, Saskatchewan)

In other words, Salman Khan makes a claim in the video and does not provide a full justification for it. Here, “Saskatchewan” expands Khan’s argument, supplies a new

⁴ See <http://www.mathforum.org>.

"IT'S SCHOOL ORGANIZED LIKE A GIANT VIDEOGAME"

Questions and answers about exponent rules part 2:

Most votes first

Q. 2
 When he simplified the problem down to $(3 \cdot 18)^{-2}$, why didn't he eliminate the negative number from the outside exponent by flipping the base into a fraction = $(1/3 \cdot 18)^2$ and then multiply $18^2 = 36 = 1/3 \cdot 36$? Why keep the negative exponent this time, but not other times? And how do you know when to keep the negative exponent and when to eliminate it?

Thank you for your great answers!

asmigel asked 4 weeks ago

A. 2
 Well, basically he did. $1/(3 \cdot 36)$ is the same thing as $3^{-2} \cdot 36$. But which one looks simpler? To me, the one that's not a fraction looks simpler, and since Sal was simplifying, I think that's why he went that way with it.

But you're absolutely right to observe that he COULD have turned it into a different form, by doing what you said. When you're working with these things in practice, in a word problem or figuring out some physics formula or something, which way you choose to simplify will be guided by whatever form you think will make your overall problem easiest to deal with. Sometimes, the fraction with the positive exponent will be easier to work with. Sometimes, the whole number with the negative exponent will be preferable. It just depends on what is going on in your problem.

Jason Black answered 5 days, 14 hours ago

A. 1
 That way also works, but he's teaching the exponent rules in this video so he decided to use them to help the audience understand how they work.

cyblackemberyo answered 3 weeks, 5 days ago

Figure 3. Questions and Answers from Sample Video 6

Q. 1
 In this video Exponent Rules Part 2, the problem $(2 \cdot 7)^{100}$ has me wondering. I understand how you did the problem, but concerning the rules of the order of operations in this problem I just want to know why you don't do the parentheses first then exponents. Is it a rule-breaker or is it a distributive property or something like that? I just need an explanation as to why a problem such as this is worked that way.

citygirlonchocolate asked 1 month, 1 week ago

A. 1
 IIRC, it works in any order so long as you do them properly at the end.

Jourdan Cameron answered 1 month, 1 week ago

A. 1
 It works either way, and I was wishing Sal had talked about that in the video.

$(2 \cdot 7)^{100} = 2^{100} \cdot 7^{100}$, but you're right, it also = 14^{100} .

When you're working with actual numerical values in a problem, I think you would of course do the multiplication first, and then just drop the parentheses. I mean, why not? Then you only have one term to work with. But it is really important to understand this distributive property of exponents, because when you're doing algebra and calculus, you'll be working with variables that you can't just multiply together so easily. You'll have something like:

$(a \cdot b)^3$

And it's helpful to know that you can convert this to:
 $a^3 \cdot b^3$, because maybe there's an a^3 on the other side of the equation and then you could cancel it out or something. Like, if you had this:

$(a \cdot b)^3 = 29a^3$

and you had to solve for b, you would proceed like this:

$(a \cdot b)^3 = 29a^3$
 $a^3 \cdot b^3 = 29a^3$ (Now you can divide both sides by a^3)
 $b^3 = 29$ (now take the cube root of both sides, which you'll need a calculator for because 29 isn't a perfect cube)
 $b = 3.072...$

Jason Black answered 5 days, 14 hours ago

Figure 4. Questions and Answers from Sample Video 6

perspective, and makes a connection between geometry and number theory. Nonetheless, in reviewing the discussion boards, such recontextualizations were rare.

These productions are, nonetheless, still constrained by Khan's original explication and limited by the text-based interface. Other teachers or students might start in a very different place than Khan does by merely posing an open-ended problem, for example, "Can you take the square root of a prime number and can you find a way to model this situation?" Alternative viewpoints, such as these, indicate that Khan's mathematical epistemology is but one of many possible entry-points and perspectives on the content. Saskatchewan is, in effect, responding to Khan and accepting Khan's general framework for laying out the material. This contrasts with Rymes (in press) observation about a wildly divergent recontextualization of "Soulja Boy" to "Foljer Boy," in which "the lyrics (very raunchy in the original), while still rhythmically intact, have taken on funny, coffee-oriented content" ("The variations," para. 2). Saskatchewan also could have modeled the square-root solution with a sketch or hand-held objects, but at present the only medium for communicating on the discussion boards is the written word.

Indeed, there are a number of limitations to developing a fully participatory culture within the Khan Academy. First, there are a few structural barriers that are reflected on the discussion boards of both the Khan Academy website and YouTube. For example, users may "vote up" or "vote down" in a binary fashion to rate whether or not they like or dislike a particular question or response; the software then prioritizes some questions and comments over others, based upon these votes. (On the Khan Academy website, users are not allowed to vote or contribute commentary unless they have earned a significant number of energy points.) The Khan Academy website only displays a handful of highly-rated comments and questions for any given video. In order to uncover other comments and questions, users need to click multiple buttons and read through many screens. Consequently, comments are, in effect, hidden, even though they may be helpful to users.

In addition, comments on YouTube are not organized according to voting scores or by topic thread, but instead, comments are sorted chronologically by posting-time. This ordering permits several conversations to occur simultaneously, which also could give an impression of disjointedness. Users need to be vigilant readers in keeping track of comments and responses as they navigate through the screens of the discussion board, and sometimes, users must infer connections among posts. Some users will respond to other users by tagging the original poster with an @ symbol (e.g., "@barnamah," YouTube, video 8), but this is by no means a community norm. Users appear to regard this relative lack of structure in the discussion forums as a barrier to coherent conversation; one YouTube user even complained, "This [idea] may be covered somewhere in the seven pages of comments, but I don't want to read through all of them to check" (video 8, YouTube, daengbo). It is also unclear why there are questions and comments posted on both YouTube and the Khan Academy websites without any attempt to reconcile them; students wishing to ask and answer questions, it seems, should review both sites to be thorough.

Duplication of questions and comments also appears to add to the lack of coherence within the discussion boards. Throughout my sample, in fact, I found numerous duplicate questions and responses (see, for example, the YouTube

comments to video 8). I also found that users would write comments in questions, and vice versa, which at least once led to users reprimanding each other. (For example, in video 14 on quadratic inequalities, a user posts the question “I am in second grade and i’m aredy here!!!!” The user “psychedelicvaccine” responds that this is not, in fact, a question and should be posted in the comments.⁵) Users also make statements that are mathematically imprecise. For example, users responding to “peacesigngirl2000” incorrectly describe multiplication notation (video 13, questions). Such duplication and confusion suggests that students are having difficulty searching the discussion boards or that they are having difficulty interpreting one another. More so than face-to-face classroom interactions, these online discussion boards certainly place an emphasis on literacy skills; communicating in written fashion about mathematics adds another layer of challenge, as it is sometimes difficult to represent the symbolic and graphical aspects of mathematics in the form of text. In a classroom, of course, a teacher could facilitate question-asking and could encourage students to make appropriate connections between each others’ questions.

Furthermore, there are surprisingly few questions and comments for a number of videos, relative to the number of page views. For instance, video 1 was posted over one year ago and has been viewed over 2,400 times and there are no questions on the discussion board. Without further study, it is difficult to understand why there are so few questions on video 1, but experience suggests that students must have questions and are not posting them online. It is doubtful that Khan’s (or any teacher’s) explanation of the mathematics could be fully satisfactory to all students.

Finally, many students ask questions intended to clarify points in the videos, but the discussion board is highly asynchronous. The format therefore poses difficulties in receiving timely answers. In one case (video 17), the user “ray20ven” asked a clarification question and did not receive a response until two-and-a-half months later. When the user “megaviv” eventually provided a suitable answer, ray20ven thanked megaviv—but almost three months after megaviv’s response. Returning to older posts might be difficult, as well, since it does not appear that discussion boards are easily searchable.

I should note, here, that it is also highly unusual for original questioners to reply to respondents, and many questions go unanswered. For example, one student even pleads (without reply), “can someone help me out please...im so confused” (video 8, EditTyler). A number of other students express similar levels of confusion and frustration (see, e.g., comments to videos 5, 8, 11, 12, and 13). A tension emerges, then, as Salman Khan takes responsibility for providing content, but leverages the users themselves for clarifying or elaborating on his statements and in correcting any errors. The overall effect, therefore, is that conversations frequently appear broken, so to speak, within the discussion boards. Schegloff (2007) notes that classroom discourse often contains “sequence-closing sequences” (p. 186). In other words, comments are made in classrooms, then responded to, and finally validated or expanded. Students may reply to explanations, for example, by affirming, “I see.” It is therefore difficult to assess whether the Q&A boards facilitate student learning, since there is little follow-up from questioners. Students can make comments or ask questions, but they are effectively silenced if no one responds; this brokenness of conversation

⁵ This comment by psychedelicvaccine appears to have been removed from the Khan Academy discussion boards (as of July 26, 2011).

essentially mirrors Khan's critique of traditional classroom environments, where students sit "with their fingers on their lips" (Khan, 2011a). Younger students who struggle with typing or who cannot effectively express themselves in writing also lack the full capacity to participate on discussion boards.

Participation Structures Embedded within Video Content

Khan argues that users can interact with his videos in highly personal ways—rewinding and replaying them at-will (Khan, 2011a). Users of the Khan Academy appear to agree. A number of students describe watching the videos multiple times, including rewinding and pausing during especially challenging portions of the videos. For example, one student posed a question on how to simplify a particular algebraic expression; the same user responded to his or her own question shortly thereafter, saying, "i figured it out... i was jumping ahead and kept pausing and rewinding at the answer when thinknig [sic] there was still a plethora of steps still" (video 16, questions, omniscientken). Another student made a similar observation, such as, "It took me at least 3 viewings of this on different days to finally get it. This is the genius of Khan Academy—I am allowed to learn at my own rate, on my own time!" (video 17, comments, rbwilliams).

Users also applaud YouTube as the distribution medium of the Khan Academy. One commenter suggests that Salman Khan start a private school and another disagrees, arguing that "if he were privately training, all of youtube wouldn't have access" (video 16, YouTube, idster). Another student remarks, "lol man, this is weird.. i use youtube everyday, but never thought of actually using it for study :\" (video 17, YouTube, NonEternal). Both "idster" and "NonEternal" highlight the accessibility of YouTube, as well as its importance in distributing content for learning.

While YouTube might be more accessible than classrooms or textbooks to some students around the world, it is clearly not a universal medium. Not only are there still "participation gaps" (Jenkins et al., 2009), due to unequal access to such technology, but the videos are also delivered in English. One Khan Academy user remarks, "how can i watch this video in urdo language can u plz tell me" (video 16, comments, faithfulfriend21). The Khan Academy and YouTube are both undertaking translation and subtitling projects, but this is clearly a laborious process, and it is unclear how many of the world's languages they plan to accommodate. At the same time, the language used in the videos is also mainly standard, academic English. Scholars stress that such language can be alienating to students of color or students from impoverished backgrounds and call for the development of culturally-relevant pedagogy, or styles of teaching that are responsive to and inclusive of students' home cultures (e.g., Ladson-Billings, 1997; Martin, 2009). Sometimes, users critique Khan for speaking too quickly or for hard-to-read handwriting (e.g., comments and questions for videos 12, 14, and 17). While YouTube is clearly a useful distribution mechanism for Khan Academy videos, some users still face linguistic, cultural, and technological challenges.

Conclusions and Implications

Salman Khan has said that he hopes the Khan Academy will "become the operating system for what goes on in the classroom" (Gates, 2010). When employed

in a school, there are implications of the participation structures inherent in the Khan Academy website for both learning and teaching. In my analysis of sample videos produced by the Khan Academy, I found that a particular epistemological viewpoint frames the presentation of mathematics and opportunities for learners to participate with content material. Khan Academy videos largely construe learning mathematics as an accumulation of skills and specialized vocabulary. This epistemological viewpoint is implicit in the packaging of mathematical content within video files. Mathematical authority—what it means to do mathematics—is located within external, disciplinary sources. Consequently, the practice problems typically ask students to replicate skills, rather than to engage in non-routine problem-solving, constructing representations, or other “high-demand” cognitive tasks (Stein, Grover, & Henningsen, 1996).

At the same time, the participation structures established by the Khan Academy website permit students to interact with the material and with each other on their own terms and on their own timeframes. Students can pause and rewind especially difficult moments of the videotaped lectures; in using the discussion boards, they can also collaborate with one another, extending ideas and clarifying misconceptions. Evidence suggests, however, that mathematical discourse within the discussion boards remains somewhat fragmented and that, as a result, truly collaborative discussions are uncommon. In a number of discussion board threads, I also found unresolved, contradictory statements and misrepresentations of key concepts, made by users. Furthermore, the “game mechanics” of the Khan Academy website seem to incentivize completing routine practice problems instead of trading the currencies of participatory culture: asking questions, mentoring, creating, critiquing, and the like. The rhetorical claims of the Khan Academy seek alignment with the learning principles of participatory culture, and yet, there are also tensions between how the Khan Academy is currently being used and the participatory framework established by Jenkins et al. (2009), Gee (2007), and the NCTM (2000b).

There are also numerous implications for teachers. Using Brown’s (2002, 2009) terminology, the espoused curriculum of the Khan Academy generally offloads—or transfers—responsibility over shaping understanding of content knowledge to Salman Khan and his video production team. Teachers are therefore positioned in somewhat subordinate roles, as respondents to the Khan Academy’s viewpoint on mathematical knowledge. This positioning changes the nature of the teaching practice. Brown (2002, 2009) conceptualizes teaching as a design activity that involves marshaling a variety of resources (including subject knowledge, curriculum resources, and teachers’ own beliefs and goals) in order to respond to unique needs of their local contexts. When absolved of the primary responsibility for content material, then, teachers are divested of a critical component of their design toolkit. Brown (2009), in contrast, calls for curriculum resources that support teachers in navigating design decisions with regard to pedagogical and content resources. Such resources could, for example, describe how materials can be modified to suit a variety of purposes, explain the designers’ intents and perspective on math, or permit response to local needs (Brown, 2009).

In addition, Ball, Thames and Phelps (2008) build on the work of Shulman (1986, 1987) and argue that content knowledge and pedagogical knowledge cannot be separated: in their words, content knowledge and pedagogical knowledge are

inextricably linked, because “one need only sit in a classroom for a few minutes to notice that the mathematics that teachers work with in instruction is not the same mathematics taught and learned in college classes” (Ball et al., 2008 p. 404). To do the work of teaching, teachers must grasp mathematics well enough to help students make sense of it, and they must understand their students well enough to utilize representations that are salient and powerful. Likewise, Segall (2004) argues that “the relationship between content and pedagogy is more complex, the boundaries between them more porous” (p. 498) than are commonly conceived. At present, however, the Khan Academy establishes a rift between content and pedagogy without explicitly building a bridge for teachers to navigate both shores. Content and pedagogy need to be linked in order to accommodate project-oriented problem-solving; as the Khan Academy evolves, it may yet develop better coordination between its portrayal of content and its project-oriented aims.

It is also unclear how assigning Khan Academy videos as homework is substantively different than assigning textbook reading. In theory, teachers could (and often do) assign textbook readings in the evenings, while engaging in project-oriented work in the classroom. Further, the content material, presented by the Khan Academy, consists of ten- to twenty-minute “chunks,” which some may regard as “easily digestible,” while others may regard as fragmented. My point, here, follows Brown (2002, 2009): curriculum materials are tools with various affordances and constraints (Wertsch, 1991, 1998, cited by Brown, 2009). Therefore, endorsing exclusive use of either textbooks or videos overlooks a key issue of teaching—namely, that different teachers marshal resources differently. Skilled teachers might use textbooks effectively, which is not necessarily an unwelcome goal, since college-level mathematics and science students need capacities for reading technical material. Analogously, less-skilled teachers might use Khan Academy videos in ways that might be considered undesirable—by reinforcing teacher-directed, skill-and-drill pedagogies. Regarding educational reform efforts, Brown (2009) consequently cautions that “there is good reason to be skeptical about the influence of curriculum materials” (p. 18) as vehicles for changing education. Instead, Brown and others (e.g., Remillard, 2005) maintain that “materials that support teacher design stand a better chance of engaging practitioners with the curricular ideas the reform intends to foster and thus have a greater potential to transform teacher practice” (Brown, 2009, p. 18).

Together, these findings question the wholesale replacement of mathematics curriculum materials and classroom instruction with Khan Academy videos until more is known about the Khan Academy’s development plans. Without sufficient support in how to construct an inquiry-based classroom environment, and how to utilize videos effectively as resources, teacher-student interactions could be constrained and teachers could be positioned in more of a support role instead of a design role. NCTM standards documents and standards-based curricula already promote many of the goals espoused by the Khan Academy; standards-based curricula provide a number of supports for teachers in using these materials (including professional development opportunities provided by the developers). Research has suggested that a project-based or standards-based curriculum is demanding for teachers to implement, and presents numerous professional development challenges (Tarr et al., 2008). To be fair, the Khan Academy is still in its infancy. Salman Khan has stated his commitment to project-oriented learning and has described plans for supporting teachers in creating such a culture (Khan, 2011b).

This is not to say that the Khan Academy is not an important innovation. Providing free, online videos would certainly be helpful to home-schooled students, to those without easy access to schools or educational resources, to those wishing to accelerate their schooling, and to adults seeking refresher courses. In fact, a number of Khan Academy users identified themselves as older students, who, for personal or professional reasons, want to review content they encountered in school. The user “mchancellor.md” comments, for instance, “Sal, for years I’ve intended to refresh my memory of high school and college math.... Now I study at night instead of watching TV!” (video 11, comments). In showing that teaching is a cultural activity, Stigler and Hiebert (1998, 1999) demonstrate that any educational enterprise is a product of broader social norms. It is therefore difficult to disentangle “reforms” from the scripts that are so firmly embedded in our collective consciousness. The Khan Academy certainly reflects many of the scripts we hold about teaching and learning, but this does not mean to imply that the Khan Academy will not grow, nor does it mean that it is presently devoid of more conventional uses.

Ultimately, the merit of the Khan Academy depends upon how it evolves in implementing its core vision. Whether it has a transformative effect on education, encouraging teachers and students to build portfolios of meaningful project-work, remains to be seen. As a cost-free and largely accessible resource, the Khan Academy certainly has the potential to connect scores of students to one another, to foster mentoring relationships, and to provide educational materials to those who might otherwise have difficulty obtaining them. Moving forward, though, the Khan Academy could more effectively align its operating philosophy with its epistemology and its incentivizing and participation structures. In particular, the Khan Academy could provide more opportunities for students to make and remix content, provide more incentives for students to ask and answer questions of each other, and provide means for other forms of expression (graphical, symbolic, etc.). The Khan Academy should also pay heed to the various linguistic repertoires of its diverse student body, even taking into consideration the principles of culturally-relevant pedagogy, so that it can better fulfill its mission of “providing a free world-class education to *anyone anywhere*” (Khan Academy, 2011c, emphasis added). After all, those who need the Khan Academy most are those who have been marginalized by traditional forms of education that dogmatically uphold traditional forms of expression. As Salman Khan writes of the current high-stakes testing environment, “To completely ignore this testing reality does a disservice to students, but to cater 100% to it would be equally damaging” (Khan, 2011b). The Khan Academy continues to grow rapidly, and how it navigates these difficult balancing acts will be telling.

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