

MOOCS and Applied Learning Theories

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Emerging Learning Theories and MOOCS: Social Constructivism to Connectivism - Evan Silberman

A precursor to MOOCS is online learning. Online learning is education in which "The teacher and the student are separated geographically so that face-to-face communication is absent; communication is accomplished instead by one or more technological media, most often electronic" (Guthrie, 2003). There is different types of online learning--from the traditional classroom with supplementary, web-based, material online, to a hybrid course where some learning is digital and some is physically located, to fully online courses with no physical classroom to speak of. Online learning is an appropriate place to start the discussion about MOOCs and Social Constructivism, because the genesis of MOOCS is distance education, and an iteration of online learning is the MOOC. In fact, many MOOC platforms have similar functionality -- at least from the student perspective -- as a traditional learning management system. Tools such as discussion forums, instant messaging, videos, and other interactive tools are common. Some MOOC features are also reminiscent of Web 2.0 environments that are the foundation of many e-learning systems.

"Technology continues to push e-learning and higher education boundaries further as computer and internet access expands globally, higher network bandwidth enables richer educational experiences, and the emergence of social networking introduces greater engagement among course participants. An outgrowth of these advancements is the MOOC, an emerging model for delivering learning content online to an unlimited number of students" (Pirani, 2013). The transformation of e-learning, the shift from residential to digital campuses, and the emergence of the digital networks are important factors for MOOCs. The MOOC provides a way for Universities to

extend their reach, while educating hundreds of thousands. If MOOCS are a transformation in e-learning, how has on pedagogy and learning theories changed to keep pace? What learning theory is most applicable to the MOOC, and what, if any learning theory is emerging as a result.

There are two learning theories whose characteristics match the MOOC environment, Points of Viewing Theory, and Constructivism, especially Social Constructivism. Both theories share the commonality learning with others, and through the lens of others.

Social Constructivism is a theory in which groups construct knowledge from one another, collaboratively creating a small culture of shared artifacts with shared meanings. It is 'born' from constructivism, a theory of learning where knowledge is constructed by the learner. The basic idea is that problem solving is at the heart of learning, thinking, and development. As people solve problems and discover the consequences of their actions – through reflecting on past and immediate experiences—they construct their own understanding. Learning is thus an active process that requires a change in the learner. This is achieved through the activities the learner engages in, including the consequences of those activities, and through reflection. People only deeply understand what they have constructed” (Guthrie, 2003). One of the key contributors to Social Constructivism is Vygotsky. One of Vygotsky core concepts is the “Zone of Proximal Development (ZPD). In brief, the ZPD, are the limits of learning that an individual is capable of with the help of others. “It is the job of the instructor-facilitator to stand in the gap - the zone of proximal development - and to create a social context that will pull students...to their potential” (As in...Angela, 2013).

Dulen, in her article Social Constructivism and Online Learning Environments, talks about the limitations of online learning environments to support Social Constructivism. Her argument is that social connection, and social learning is mostly body language, which is difficult to facilitate online,

especially for courses designed without intent toward Social Constructivism. The response is to create hybrid or blended learning in which learning is partly online and partially face-to-face.

In fact, Dulen's article was one of very few that examined online learning from a Social Constructivist perspective. The conclusion is that Social Constructivism is a lens through which one can view online learning. The content of the article suggest that online learning isn't necessary constructivist. Rather, how the course is design makes it so.

In Points of View Theory (POV-T), "Learners actively layer their viewpoints and their interpretations to elicit patterns, themes, and groups of ideas that lead to a deep understanding of the content under investigation..." (Goldman, Black, Maxwell, Plass, & Keitges, 2012). In other words, POV-T addresses the challenges of a global society by helping individuals capitalize on others perspectives. POV-T is widely applicable to learning media. In particular, Goldman, et al. discuss perspectivity technologies that provide "a place and space for building cultures or communities of practice where one "catches sight" of the other while participating in learning". POV-T in essence is about shared learning.

MOOCS are an ecosystem that promotes shared learning in a massive form. Although Social Constructivism and POV-T hold some applicability to MOOCS based on their general definition, and defining characteristics, there is limited research to support how applicable these theories are to MOOCS. In fact, in a Systematic Study of MOOC literature from 2008 - 2012, "the majority of articles were primarily concerned with the concept of MOOCS, discussing challenges and trends, while other themes generally appeared within only one paper except for the concept of connectivism and its implications" (Liyaganawardena, Adams, & Williams, 2013). In the research for this section of the paper, the experience was similar. With the exception of one

article, there was limited information about learning theories and MOOCS, again, except for connectivism. The discussion about MOOCs appears to be focused on an understanding of MOOCS, and the impact on higher education. The recurrence of connectivism suggests a new learning theory is emerging for MOOCS worth exploring.

First, it is important to note that connectivism applies to one of several types of MOOCS, the cMOOC. Other MOOC types, such as the xMOOC are without a pedagogical treatment. The cMOOC is a result of Connectivism. Connectivism is a new learning theory introduced by George Siemens in 2004 in order to cope with the increasing complexity and fast-paced change of the new knowledge era (Chatti, Jarke, & Quix, 2010). The most common example of a cMOOC is the first MOOC ever created by Siemens and his colleague Stephen Downes called Connectivism and Connected Knowledge 2008 (CCK08). "In cMOOCs, the learners take a greater role in shaping their learning experiences than in a traditional online courses. ,while facilitators focus on fostering a space for learning connections to occur" (Milligan, Littlejohn, & Margaryan, 2013).

Connectivism was created by Siemens based of the belief that current learning theories didn't address the characteristics of Web 2.0. That is "The rapid growth of knowledge, which makes knowledge itself a dynamic phenomenon; the new kinds of production and externalization of knowledge, which multiply the perspectives embedded in knowledge" (Milligan, et al. 2013). Connectivism contrast behaviorism, cognitivism, and constructivism, which operate on the premise that knowledge is construction, and objects-to-think with are created as an outcome of constructing thought. In Constructivism, there is no artifact per se, and knowledge is dynamic.

"Siemens (2005, 2006) and Downes (2005, 2012) summarized the existing learning theories in three theoretical positions: behaviorism, cognitivism and

constructivism. They assumed that these three positions share two key attributes: (a) knowledge resides in the individual; and (b) knowledge is a thing—a representation—that people create or appropriate. Siemens and Downes argued that these two attributes are not compatible with the characteristics of knowledge in Web 2.0. In their view, the dynamism of knowledge in Web 2.0 contradicts the thingness of knowledge assumed by the existing learning theories, and the multiplicity of perspectives embedded in knowledge in Web 2.0 contradicts the individual location of knowledge assumed by the existing learning theories (Milligan, et al., 2013, p. 130).

Therefore, Connectivism addresses the challenges posed by Web 2.0 for learning, and is adopted to the cMOOC based on four learning activities: “aggregation (sometimes referred to as curation, accomplished through an initial list of resources on the MOOC website and then added to through a daily newsletter sent to all participants); remixing (where the connections are made and documented through blogging, social bookmarking, or tweeting); repurposing (often referred to as constructivism, in which learners then create their own internal connections); and feeding forward (that is, sharing new connections with others)” (Yeager, Hurley-Dasgupta, & Bliss, 2013). In other words, learning in cMOOCs is based on networks. In the true sense of MOOCs it is designed for anyone who is interested in learning about something new. Unlike the traditional school model of an instructor in the front of the classroom, knowledge is shared. “The MOOC acts as an environment in which new forms of distribution, storage, archiving, and retrieval offer the potential for the development of shared knowledge and forms of distributed cognition” (Yeager, et al.)

However, is Connectivism enough to support the rapid adoption of MOOCs? Does a single learning theory define the future of the MOOC? Will new educational theories, and pedagogical approaches emerge? Connectivism addresses the challenges posed by web 2.0 for learning, but the practice of Connectivism has friction with its online counterparts, our culture and tendencies of Internet use, and principles advancing web UX design and the translating Connectivism into successful design. In the next section of the paper MOOCS, Connectivism, and UX design is explored, especially in the context of games, which we posit have successfully implemented UX.

MOOCs, and are still a new concept, and the evolution of the MOOC is unclear. What is clear, is that additional research is necessary about educational theory and MOOCs. It is not enough to aspects, concepts, examples, or technology of a MOOC. For MOOCs be effective for learning, a better understanding of how educational theories and their applicability to MOOCs is needed. Or, similar to Connectivism, a new paradigm is required. The silver lining, either way, is that the power lies in the hands of the educator, technologist, and even student influence a new pathway for learning in a MOOC.

“As approaches to education shift, students are relying more on the Internet, not only for information for coursework, but for their social communication, cultural knowledge, and modes of expression. All of these interactions influence the way each student approaches the educational environment, which is largely at odds with its online counterpart.”

-Livia Veneziano, UX Designer

UX Affordances to Inform Hybrid MOOC Design

The International Organization for Standardization defines user experience as "a person's

perceptions and responses that result from the use or anticipated use of a product, system or service." The field of user experience (UX) is rooted in the behavioral sciences — especially ergonomics, psychology, and human factors — and considers all aspects of the end-user's interaction with a product, service and/or brand. Increasingly competitive media and ecommerce industries have emphasized a need for digital environments that encourage user adoption and profitable behaviors. A majority of UX professionals are active in this segment, and, consequently, UX principles, which focus on utility, consistency, efficiency, ease of use, and emotional response, have largely evolved out of best practices in the commercial sector (Disaboto, 2012).

A considerable challenge these principles are applied to is translating complex processes into hospitable online interactions moving toward a transaction. These experiences are often presented by reducing cognitive load to enable frictionless consumption. Critical thinking, for the most part, is not encouraged. Two top-selling books on usability, "Don't Make Me Think" and "Rocket Science Made Easy", illustrate a preoccupation with simplicity. Massively Open Online Courses (MOOCs), which offer higher education courses to tens and hundreds of thousands of online participants from different locations and varying backgrounds, is a complex operation that can benefit from UX principles. However, "deep learning", where learners are engaged at the outer edge of their competence is noticeably at odds with UX principles of simplicity, efficiency and ease-of-use. Learning is sometimes not simple or streamlined — sometimes it is a struggle. In comparison, video games, MOOCs' cohort in educational media, strive to make games that are "pleasantly frustrating", not too easy as to bore the player and not too difficult as to generate feelings of incompetence. In juxtaposition, it is difficult to imagine web environments encouraging "pleasantly frustrating" through UX design. Nevertheless, perhaps the Browser has something to learn from the

Boss. If MOOCs are to develop into effective conduits for learning and favorably separate themselves from a consumption-heavy online culture, where does UX and game design fit in?

In this chapter I hypothesize that xMOOCs have realized greater user-adoption and funding because the UX principles they uphold—namely path length and guidance—present more feasible, scalable and in-demand options than cMOOCs. I also argue that xMOOCs have leveraged behaviorism’s fundamental belief in universal truths to incorporate elements of game design (most notably Well-Ordered Problems and Cycles of Expertise) in a way that cMOOCs have yet to adopt in their own terms. Ultimately, this chapter is in an effort to consider effective xMOOC practices in contrast to cMOOCs so as to inform the design of a hybrid MOOC that accommodates a larger audience and provides an engaging learning experience on the level of current video games for learning. To better understand the two MOOC varieties, a comparison of cMOOCs and xMOOCs will begin the chapter and will be followed by an identification of UX principles in xMOOCs and their relation to learning principles afforded by video games. Lastly, the chapter will conclude with a look at connectivism’s social focus, and how its trouble translating to an adopted practice presents opportunities for UX and game design solutions.

MOOC Varieties

MOOCs have predominantly been presented in two forms: xMOOCs and cMOOCs. George Siemens, a pioneer of connectivist learning, summarizes the polarity: “cMOOCs focus on knowledge creation and generation, whereas xMOOCs focus on knowledge duplication” (Mackness, 2010). cMOOCs are grounded in the connectivist learning theory, which posits that learning is the result of making connections at the social, conceptual, and neural level. cMOOCs are

characterized by a lack of structure and focus on learners exploring a wide swath of material on their own (Kop et al, 2011). Conversely, xMOOCs are grounded in behaviorist learning theories and are highly structured, focusing on information transmission (Clow, 2013).

The two modes differ further by how their curriculum and assessment is presented. xMOOC curriculum is linear, and course content is delivered through video lectures and computer-graded assignments. Assessment is typically presented in the form of multiple choice, matching, and fill-in-the-blank questions that interject a lecture or stand alone as a quiz/exam.

Although some cMOOCs offer video lectures, a majority of cMOOCs are produced by individuals and groups that cannot afford video production costs (xMOOCs, such as Coursera and Udacity are for-profit companies funded by venture capitalists, Andressen-Horowitz and Charles River Venture, respectively; EdX is supported by Harvard and MIT's combined \$43B endowment). cMOOC learning resources are typically online essays, articles and blog posts that are presented without guiding prompts, in effect, "fostering a space for learning connection to occur," and relying on the learner to "take a greater role in shaping their learning experiences" (Milligan, 2013). Assessment, if enacted, is typically conducted by peers or course moderators.

While cMOOCs see learning as an open-ended process that is experienced differently by each person, high value is placed on contributing to a domain's ongoing global dialogue. Connectivism sees the evolution of a domain as directed by conversations on the matter; current domain knowledge, then, is an understanding of both a domain's current state and it's projected trajectory. These observations and foresights require active listening to and meaning making of these conversations. Although research has shown that the type of collaborative methods of instruction enacted by cMOOCs are more supportive of learning, the significant production,

user-adoption and financial support realized by xMOOCs appears to represent an instructional preference back to behaviorism. MOOCs are a relatively nascent learning platform (the first MOOC was hosted in 2008), and such a shift may represent a preference not for behaviorist instruction, behind the xMOOC platform, but the user familiarity and feasibility the frame provides.

Paths, Flow & Feedback - UX & Game Design Aspects Afforded in xMOOCs

The series of actions a user takes to accomplish a task online is considered one path of the total paths viable by a website's mechanics and potential use-cases. The easier (quicker, less choice involved) the path, the more likely the user is to not only be satisfied with their experience, but to also return to the site for similar and different tasks, because of an established confidence in the site's mechanics and navigability (Disaboto, 2012). When designing online environments, there is a UX effort to limit the number and length of paths, because "if there are many ways to begin an interaction, then you automatically have to support, and account for, those many different use cases....It makes sense to simplify the number of paths as much as possible, so the product is easy for users to learn, and for you to maintain" (Disaboto, 2012). xMOOCs' foundation in behaviorism, which values instructional design that identifies "the correct sequence of learning experiences and how they should be organized to maximize learning for the largest number of students," aligns well with UX considerations that are similarly utilitarian. Considering a MOOC's audience size, diversity, viable instructional approaches and attenuated staff, behaviorist decision trees appear a more feasible and scalable approach when compared with path considerations in cMOOCs, where content is "formed as a cluster of resources around a subject-area, rather than a linear set of materials that all students must follow...and participants create their own materials, [and] sample the

materials, selecting only those they found interesting and relevant, thereby creating a personal perspective on the materials” (Downes, 2009). Predicting, enabling and supporting this range of interactions as paths is a considerable development challenge requiring extensive labor and costs before it can be scaled out.

Moreover, this type of self-regulated and highly motivated user behavior is not representative of a substantial enough population of online learners to actualize the degree of funding secured by xMOOCs. Instead this ideal participation “epitomizes the constructivist learning in that he comes to the learning task already motivated and with enough relevant prior knowledge to be successful in his learning efforts” (Driscoll, 2005). As Feltovich has noted, a majority of learners like straight roads, and show a “tendency...to understand a complex subject matter too narrowly; to try to inappropriately impose some dominant, central organization” (Feltovich et al., 1996). Although Feltovich acknowledges this need as inappropriate, it represents a comfort that, if not afforded in design, can disenchant visitors favoring instruction and web design that holds your hand and leads the way. In summation, better representing the online learning demands of the majority and addressing the concerns of pragmatic investors are perhaps a few of the reasons xMOOCs have received more user adoption and funding thus far.

Flow & Feedback as Examples of Well-Ordered Problems and Cycles of Expertise

Flow is a psychological state of feeling fully immersed in an activity. Interface design, a field under the UX umbrella, makes an effort to induce flow so that it keeps visitors on a site, undistracted by external stimuli and focused toward an end goal. One common strategy to induce flow in an online environment is by “provid[ing] a way to repeat similar tasks efficiently, leading the user to adopt a

rhythm” (Disaboto, 2012). An effort to induce flow is similarly seen in video games, where designers make an effort to “foster a sense of suspended disbelief and provide players with a sense of immersive engagement in the gameplay environment,” (Dickey, 2005). One affordance of games for learning is that “good games create and support the cycle of expertise...as formed in any area by repeated cycles of learners practicing skills until they are nearly automatic” (Gee, 2005).

In xMOOCs and similarly behaviorist online learning mediums such as KhanAcademy, skill-and-drill assignments often follow or interject a video lecture. The repetitive, rapid-fire nature of these assignments encourages mastery, or the successful replication of applied thinking encouraged by a system. In Khan Academy, for example, learners can advance to the next level only when they correctly answer seven questions consecutively. Mastery, in this example, is a byproduct of flow, and arguably more feasible in behaviorist online learning where a belief in universal truths is supported. This belief affords assessment that can not only induce flow, but provide the opportunity for interfaces that “talk back” to a user, providing instant feedback on incorrect responses. This feedback can scaffold the learner toward the correct answer with appropriate on-screen explanations. In some cases, automated feedback can offer more than showing learners how to close gaps between current and desired performance. Khan Academy and Coursera, for example, satisfy several principles outlined by Dick as of effective feedback, including clarifying what good performance is, facilitating self-assessment, encouraging positive motivations, and providing individual assessment information to teachers.

A similar experience of flow and feedback is considerably more difficult to program into connectivist environments, which offer students more open-ended and self-directed assignments. Surely it is possible to get into a state of flow in connectivist environments (and some would argue

that this instance of flow is more intrinsic and valuable to learning than behaviorist flow), however it is difficult to induce this form of flow in an interface, because user decisions are not constrained, and decisions cannot be recognized as right or wrong as they would be in an xMOOC. To a certain extent, the type of flow connectivism calls for is a cognitive process that is less distributable to an interface—it requires more intrinsic, self-directed learning and meaning-making; its is more of a jazz solo than reciting a mantra. Salomon and Perkins call this effort to reach cognitively potent flow an intellectual partnership. It is an effort on the user's end to be mindful of what the technology can afford, and use it to push themselves beyond their cognitive limits. While Salomon and Perkins argue that “the more open-ended the activities afforded by a tool, the more freedom the learner has in becoming, or not becoming, mindfully engaged in them,” they recognize that while this freedom, is afforded by technology, “people rarely engage in such mindful processing when using a technology under normal noninstructional circumstances” (Solomon, et al., 1991). MOOCs are instructional circumstances; however, they are also without the pressures and incentives that motivate students in traditional learning environments (tuition costs, person-person support, industry recognized certifications). cMOOC providers cannot assume learners will devote similar levels of mindful participation. Rather, it is up to the design of these environments to inspire such action.

In addition to flow being difficult to catalyze, feedback is similarly less programmable. In xMOOCs, feedback at output is triggered by input that is constrained to a set of options. cMOOCs, however, allow highly variable responses representing intellectual idiosyncrasies yet to be understood by an algorithmic soul-mate. This variability has prevented any type of automated scaffolding similar to those afforded by xMOOCs. While open-ended and self-directed lessons afford learners the freedom to explore a domain at their own pace, it also allows students to spend

too long going down a “garden-path” which yields to learning that can be transferred to other tasks
fruitless paths: “If learners face problems early on that are too free-form or too complex, they often
form creative hypotheses about how to solve these problems, but hypotheses that don’t work well for
later problems” (Gee, 2005). The double-sided sword of cMOOCs is their lack of well-structured
problems. Because MOOC students are typically college-educated professionals using the platform
to learn new skills to advance their careers (Fowler, 2013), a pragmatic, outlined path to knowledge
currently presents a curriculum that meets these needs.

Pattern Making & Participation -- Challenges with cMOOCs

The University of Manitoba’s 2008 Connectivism and Connected Knowledge course (CCK08) is
credited as the first MOOC in the sense that it attracted a large number of non-paying students who
used distributed technologies for participation and communication. The course’s instructors,
Stephen Downes and George Siemens, chose this medium to reflect connectivism in action. A
number of lessons were learned from this course, namely that interactivity was afforded but not
adopted and that students expressed a need for structure, support, and moderation, requests at
odds with the characteristics of connectivism—autonomy, diversity, openness and interactivity—
outlined by Downes (Mackness, et al. 2010).

Many learners in CCK08 experienced problems finding ways to establish and maintain a
beneficial learning dialogue with other classmates (Kop, 2011; Mackness et al., 2010). During the
course, active participation and interaction was only sustained by 14% of the total participants
(Mackness, et al 2010). Interviews conducted after the course revealed that many students
disengaged from the course’s forum and other social features because of inappropriate

communication (“trolling”) and a tendency to self-organize into conversations delineated by levels of domain expertise. The forum, with its chaotic and unmoderated threaded discussions, quickly became “noise” to many who visited; it was difficult to glean value from the firehose.

These results present critical needs for cMOOCs to consider how connectives ideals are implemented as sociality is a foundational ideal of connectivism. Connectivism recognizes that in Web 2.0, knowledge of a concept is dynamic. This rapid evolution is directed by the multiplication of perspectives discussing the domain at varying levels. Amongst the multiplication of perspectives, patterns and connections emerge that help members of the community to evince shifts, identify ideological groupings, and pose questions that should be addressed in light of a domain’s current trajectory. Because a domain’s evolution is dependent on its patterns, which are dependent on dialogue, understanding a domain in step with the domain’s overall evolution requires recognizing patterns in the dialogue, a skill that is highly relevant in an interconnected world that considers data with an exponentially shrinking half-life. These patterns, or as I imagine them, constellations, are formed by connecting the seemingly random placement of individual stars (commentary) that make up a stretch (domain) of the total firmament (knowledge).

In the case of MOOCs, we can have a very starry night, and yet find it difficult to make constellations. (Engeström, 1999, 2001). In a user’s defense, forming constellations, is both challenging, and an effort not typically called upon by a web environment. Scanning the multiplicity of perspectives for emerging pattern is a high favor to ask, especially considering “the biggest issue with analytics is that it can very quickly become a distracting black hole of ‘interesting data without any actionable insight” (Cardello, 2013). Recently, Google has entered the MOOC arena with a MOOC builder that is slated for Spring 2014 deployment. Google’s participation can conceivably

include tools that distribute the cognitive energies required to visualize patterns. Google's recent interest in applying their data visualization chops to the MOOC space offers promise, however, instructional designers have already made significant strides toward designing an interface evincing patterns and meaning-making.

The Social Networks Adapting Pedagogical Practice (SNAPP), for example, investigates student interactions based on forum postings. This software visualizes exchanges in order to find disconnected students who are at risk of not completing the course, high versus low performing students, before and after snapshots of teacher interventions, and benchmarking student progress" (West, 2013). How this may be applied to cMOOC assessment and data visualization of has yet to be considered, but I urge instructional designers to these features from a game design perspective, with special interest in Gee's concepts of distributed knowledge and skills as strategies.

The promise of data visualization may take time to realize, and there are design choices MOOCs can make to encourage the dynamic communication and pattern making hybrid MOOCs call for. Ahead, In our "informing design section" of the project paper, we highlight design solutions influenced by UX principles and the beneficial principles of learning that good game designers have hit on, most notably customization and distributed knowledge of pattern making.

Behaviorism - Claire Bradley

One of the first theorists to attempt to study human behavior in a quantitative way was behaviorist E.L. Thorndike (Skinner, 1953). According to Thorndike, behavior is "stamped in" or learned when it is followed by specific consequences (Skinner, 1953). For example, a cat learns that it must lift a latch to escape from a box after behaviors it engages in allow it to escape (Skinner, 1953). If the cat is placed in the box again and again the specific behavior that results in escape will

occur after a shorter period of time (Skinner, 1953). Thorndike labeled this phenomenon “The Law of Effect” and noted that it occurred with no “thought-process” on the part of the cat (Skinner, 1953). This example illustrates the central tenets of behaviorism, learning occurs when desired behaviors are demonstrated following a given stimulus and that the study of learning should be limited to observable behavior and should not include the description of internal states as they cannot be directly observed (Watson, 1913). Similarly, behaviorists believed that behaviors could be conditioned through reinforcement (Skinner, 1953). In other words, the likelihood that a given behavior will be exhibited can be increased if it is paired with a reward (Skinner, 1953). In later conceptualizations of behaviorism this concept was somewhat tempered. The most powerful reinforcers were seen as those internal to the learner, while outside feedback was described as important for correction and continued motivation (Bullock, 1982). Behaviorists also place a great emphasis on the characteristics of the learning environment, rather than those intrinsic to the learner (Ertmer & Newby, 2008). Thus, the role of the learner is simply to react to stimuli presented by the environment.

In the 1950s concerns about the educational system were raised because of the growth in population, also there was an increased interest in training large groups in short periods of time, led primarily by the military (McDonald, Yanchar, & Osguthorpe, 2005). Due to their belief that a properly designed learning environment could lead to the development of desired behaviors, behaviorists sought to create programmed instruction in an effort to automate education to encourage learning with minimal input from instructors (McDonald, Yanchar, & Osguthorpe, 2005). Programmed instruction was founded on several underlying assumptions that mirrored those of behaviorism. First, the idea of ontological determinism stated that behavior was the result of natural

laws, and as such free will did not exist in human behavior (McDonald, Yanchar, & Osguthorpe, 2005). Therefore, in programmed instruction, the active work in the learning process was done by those who designed the learning environment. Leaving the learner to simply absorb and react to the material as it was presented (McDonald, Yanchar, & Osguthorpe, 2005). Programmed instruction also assumed that abstract concepts of the mind and memory were not important in learning processes, instead instruction focused on physical events and observable behaviors (McDonald, Yanchar, & Osguthorpe, 2005). Thus, complicated material was broken into small segments defined by sets of specific and observable behaviors (Cooper, 1993; McDonald, Yanchar, & Osguthorpe, 2005). Programmed instruction was also based on social efficiency, the desire to eliminate unnecessary costs, and technological determinism, which posited that technology was the most important contributor to social change (McDonald, Yanchar, & Osguthorpe, 2005). Advocates of programmed instruction believed that if these principles were followed correctly then students would successfully learn (McDonald, Yanchar, & Osguthorpe, 2005).

Although later research showed this approach to be less effective than other methodologies, much of current online instruction, including xMOOCs, can be seen as descendant from programmed instruction and behaviorism (McDonald, Yanchar, & Osguthorpe, 2005). xMOOCs, such as those provided by online platforms like Coursera, are characterized by a fixed course structure, video lectures, and embedded tests (Kalz & Specht, 2013). These courses focus on the interaction between the learner and course content and the ultimate goal is to transmit information from the instructor to the learner (Kalz & Specht, 2013). Thus, in xMOOCs learners are not active participants in the learning process, instead their role is to take in the course material as it is presented. This can be seen in the description of the pedagogy behind Coursera courses, which

focuses primarily on the features of the online platform (Coursera). This emphasis on the learning environment is inherently behaviorist and mirrors the claim of programmed instruction that certain components of the environment will guarantee student learning. Coursera also states that their goal is for learners to “learn the material quickly and effectively” (Coursera). This reflects the principle of social efficiency, foundational to programmed instruction. Similarly, some institutions of higher education are beginning to consider the possibility of using MOOCs in combination with traditional face-to-face teaching (Scholz, 2013). In these situations MOOCs could be used as homework, allowing students to listen to lectures outside of class, while class time would be reserved for interaction and hands-on learning activities (Scholz, 2013). In this sense MOOCs would serve to automate learning in much the same way as programmed instruction, thus allowing educators to focus their time on more worthwhile endeavors (McDonald, Yanchar, & Osguthorpe, 2005). Coursera courses also feature tests embedded in lecture videos in an effort to gauge student retention of material (Coursera). This prompt feedback mimics the immediate reinforcement used by behaviorists to condition behavior (McDonald, Yanchar, & Osguthorpe, 2005). Furthermore, the cultures of participation inherent to MOOCs speak to the importance of reinforcers intrinsic to the learner. Cultures of participation refer to the differing levels of activity of MOOC users (Fischer, 2011). For example, MOOC users begin as unaware consumers, transitioning to contributors only when they actively participate in the MOOC (Fischer, 2011). At the more active levels of participation fewer users are represented, with only a small group reaching the most active level of meta-designers who extend the range of the learning environment (Fischer, 2011). According to the behaviorist view the internal motivations of MOOC users are the most important factors in propelling them through the various levels of participation and the external feedback present in the MOOC

would simply provide correctional feedback (Bullock, 1982).

Sources

Cognitive Apprenticeship - Sam Seidenberg

The concept of apprenticeship emerged in the Middle Ages. In exchange for formal training in a particular craft, as well as food and lodging, novices would work diligently for a master craftsman, learning through observation and modeling of the master's actions in order to create items of real economic value. During the Industrial Revolution, when machines began to produce goods with unprecedented precision and speed, the demand for master craftsman--and thus for apprenticeships--rapidly declined. However, the concept of apprenticeship never disappeared. In his book *Mastery*, Author Robert Greene argues that "Each age tends to create a model of apprenticeship that is suited to the system of production that prevails at the time. With the advent of the Industrial Revolution, [the Middle Age] model of apprenticeship became largely outmoded, but the idea behind it lived on in the form of *self-apprenticeship* (emphasis mine)" (Greene 2012, p. 237). In self-apprenticeship, the archetypes of Apprentice and Master both reside within the individual. That is, the individual must guide *herself* toward mastery of a field that is entirely unique, acquiring not just one skill but a wide variety of skills along the way through.

The M in MOOC stands for massive, referring to the (supposed) inherent scalability of an open online course; a lecture recorded and uploaded to the internet by an NYU professor can be accessed as easily in Bangladesh as it can in Brooklyn. It is this theory on which MOOC platforms such as Coursera, Udacity, and Skillshare rest their business model. By expanding higher education beyond the

spatial and temporal constraints of the university classroom, the hope is that more people will be able to develop more skills and thus further their self-apprenticeships. However, while video lectures and multiple-choice quizzes have scaled quite easily online, the *cognitive apprenticeship*--the rigorous, detailed feedback that is necessary for obtaining mastery in a given subject--has proved more troublesome.

Cognitive apprenticeship is the use of modeling, coaching, and fading to help a learner move through their self-achieve mastery of a given skill set. Collins, Brown, and Newman succinctly describe cognitive apprenticeship in their seminal paper on the topic,

[First], the apprentice repeatedly observes the master executing (or **modeling**) the target process, which usually involves a number of different but interrelated subskills. The apprentice then attempts to execute the process with guidance and help from the master (**coaching**). A key aspect of coaching is the provision of scaffolding, which is the support, in the form of reminders and help, that the apprentice requires to approximate the execution of the entire composite of skills. Once the learner has a grasp of the target skill, the master reduces his participation (**fades**), providing only limited hints, refinements, and feedback to the learner, who practices by successively approximating smooth execution of the whole skill (emphasis mine). (Collins, Brown, and Newman 1987, p. 2)

The use of cognitive apprenticeship in the classroom has seen some very positive results. But for one professor to sustain such intense feedback and support for a class of thirty students for a four-month semester is already incredibly challenging...how could he possibly do the same for 100,000 students? Obviously, this is impossible for a single human.

While not considered MOOCs in the traditional sense (if a traditional sense could even be said

to exist at this point), at least two online education entities--KhanAcademy's *World of Math* and Duolingo, have scaled cognitive apprenticeship successfully through harnessing the power of machine learning and artificial intelligence in their instructional systems. The instructional designs of both services are essentially based on the same model of deeply analyzing individual student learning data in order to provide timely and appropriate modeling, coaching, and fading. In other words, the software acts as a *virtual master* by identifying and remembering certain aspects of a student's learning with unprecedented detail and providing support only as needed.

Though these types of systems are quite effective (Thompson, 2011) (Vesselinov and Grego, 2012), by themselves they currently only foster the mastery of the declarative and procedural knowledge of a given subject. Undoubtedly, this knowledge is vital to subject fluency; you cannot speak a language without knowing its vocabulary and grammatical rules, nor can you perform formal mathematics without understanding what the symbols represent and how they interact with one another. However, they do not explicitly foster the social and emotional intelligence necessary to use these skills for their ultimate purpose: working for and with other humans.

Cognitive apprenticeship, like traditional apprenticeship, is greatly facilitated when paired with *situated cognition*, the wrapping of learning in a real-world situation or context. Researchers with the University of Helsinki's computer science department took this notion to heart when designing a MOOC for introductory programming, and developed an "extreme apprenticeship" system by means of two core features. First, the MOOC functions as an assessment tool for the university by doubling as an entrance exam to the CS/IT major. Through adding tangible consequences to course performance, the course creators aim to increase student engagement and attentiveness. Second, the course puts a large emphasis on "[c]ontinuous feedback between the learner and the advisor. The learner needs

confirmation that tells her that she is progressing and to a desired direction. Therefore, the advisor must be aware of the successes and challenges of the learner throughout the course” (Vihavainen, Luukainen, Kurhila 2011, p. 1).

As previously discussed, scaling cognitive apprenticeship under a one-to-many advisor-to-student ratio quickly becomes inconceivable. But Vihavainen, Luukainen, Kurhila were able overcome this obstacle by means of a pyramid system:

As XA (extreme apprenticeship) is a form of apprenticeship education, the “pyramid” of the stakeholders is essential in organizing the course: there are masters (tenured teachers working also as advisors) that are on the top of the pyramid, crafting material and exercises, coordinating and controlling the operation; journeymen (paid advisors that contribute to exercises and help the students with explicit responsibilities); apprentices (unpaid advisors among fellow students with limited responsibilities); and finally, students of the course (potential apprentices of future courses)...Using the apprenticeship system allows us to provide teaching and coaching experience for many of the students, as well as give them responsibility (Vihavainen, Luukainen, Kurhila 2011, p. 2-3).

This “extreme apprenticeship” system is without a doubt quite challenging to organize and maintain. Yet the educational potential it holds is huge. To date, no other system of online education has allowed students to learn within such an authentic context.

While current MOOC platforms such as Coursera, Udacity, and Skillshare have provided a revolutionary and important service through increasing access to higher education, they have only done so with the parts of education that are easily scalable: “set-it-and-forget-it” video lectures combined with static quizzes and assignments. These traditional MOOCs will not be able to compete with

dynamic, subject-specific digital educational systems--such as KhanAcademy's *World of Math* and Duolingo--which incorporate cognitive apprenticeship into their instructional design. These systems require much more time to build and much higher maintenance, but the quantity and quality of feedback they provide makes them much more potent educational products. In turn, systems such as these focus heavily on delivering declarative and procedural knowledge, while struggling to situate the content in a human context. Designers of online education platforms will have to steadily iterate on innovative strategies such as the University of Helsinki's "extreme apprenticeship" method in order to ensure students develop the social and emotional intelligence necessary to implement their new skills in the real world. Ultimately, the instructional systems that will rule the day are the ones that take full advantage of the affordances of digital education, and empower learners by not just giving them an introduction or overview of a topic, but ensuring that they obtain the subject mastery needed to further their self-apprenticeships.

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Intro/Conclusion + Limitations, Criticism, and Areas for Further Research - Bill Kemp

General Outline:

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In terms of structure, this section will come at the end of our theory conversation. This section's primary goal is to seamlessly move from theory discussion into a fluent and cohesive shift to the MOOC's limitations and criticism. As a genre, the research paper's ultimate goal is to not only present our ideas in a compelling manner (theory and research support), but also open doors for further investigation. Using Bruner's *The Acts of Meaning* as the primary source, this section will *warn* Cognitive Revolutionists of the need to incorporate visceral communities and cultural acknowledgement in order to prevent the dehumanization of education. This notion will lead into our group's final suggestions.

According to Bruner, humans are the creators of meaning--we are active and open. While the MOOC's platform reflects this ideology, how can we create nonlinear *materials* that are applicable to numerous cultures and demographics? Here, as Sprio (1990) would say, I will make a

few suggestions to lead future researchers towards finding materials that foster *Multiple Representations*, and allow students to truly *understand* the course as opposed to *knowing* it.