Cognitive Science, a Massive Open Online Course

Converting the Cognitive Science and Ed Tech II Curriculum into a MOOC

Matthew Marsaglia
William Kemp
Samuel Jefferson
Claire Bradley
Evan Silberman
Background and Need

Our project aims to convert the existing curriculum for the Cognitive Science and Educational Technology Two course into a digital format, particularly a Massive Open Online Course (MOOC). A MOOC is a web-based course with no enrollment limits, and anyone can participate, usually at no cost (2013). There is currently a MOOC phenomenon because of the MOOC potential as an emerging model to deliver online learning to an unlimited number of students (Pirani, 2013).

Converting the curriculum to a new online format enables our group to discover the deficiencies of a MOOC for teaching learning sciences--be it synchronous or asynchronous--and improve them. Therefore, we'll be developing the next generation MOOC by improving on existing MOOC types, cMOOC and xMOOC, which are discussed in our literature review. The intended audience, in the spirit of MOOCS, is anyone with an interest in Cognitive Science. As part of our project, we'll also examine if casting the widest possible net is effective for teaching and learning, or, if a targeted MOOC is more beneficial for cognitive processes.

MOOCS are relatively new, and the research is limited. However, in the research that exists, it is clear that MOOCS are an important element in the transformation of online learning (Pirani, 2013). It is also evident there are different types of MOOCs, and there is no absolute recipe for a success. In fact, according to the EDUCAUSE center for Analysis and Research, institutions are interested in MOOCs “To explore this new method of teaching and learning, and to build the institution's overall reputation” (Parani, 2013). Our group aims to identify key characteristics of an effective MOOC to optimize learning
opportunities and increase institutional awareness. Of course, the discussion will be centered around key learning theories, and the application of those theories in the design of a MOOC.

We believe there is a need for a Cognitive Science MOOC because the information is foundational to teaching and learning, especially with technology. Providing greater access to the curriculum will benefit educators and technologist alike, and bridge a divide between the two by promoting retention, engagement, and provide legitimate credibility. There is a plethora of media coverage, moreover, about MOOCS ranging from articles in the Chronicle of Higher Education, to TED Talks, to essays in the New York Times. It is a trending topic, especially in higher education, in which many institutions and experts have an opinion. "Moocs had exploded into the academic consciousness in summer 2011, when a free artificial intelligence course offered by Stanford University in California attracted 160,000 students from around the world" (Waldrop, 2013). MOOCS are now being considered by some universities for credit. The heightened awareness of MOOCS in mainstream media presents sincerity of the program’s potential.

MOOCS present semi-permanent fixture of education; each platform presents a new modality for learning, and has the potential to motivate multiple learning identities from all demographics. The question isn’t only to MOOC or not to MOOC, but how to make a MOOC a legitimate tool for lifelong learning.
Summary of Existing Research

Existing MOOCs can be classified into two categories, cMOOCs and xMOOCs. cMOOCs are based on a theory of learning called Connectivism. Connectivism posits that learning is the result of making connections at the social, conceptual, and neural level (Siemens, 2008). In other words, learning is the process of creating patterns between concepts and the ability to navigate through the resulting network of connections (Mackness et al., 2010). Online courses based in Connectivism can be characterized by a set of governing principles that further illustrate the theory of Connectivism. These principles highlight the importance of autonomy, diversity, openness, and connectedness and interactivity (Mackness et al., 2010). Autonomy refers to the ability of the learner to determine how they would like to learn (Mackness et al., 2010). Therefore, cMOOCs are characterized by a lack of structure and instead encourage the learner to explore the material in whatever manner they wish (Kalz & Specht, 2013). Diversity refers to the importance of engaging a large audience that varies in prior experience with the material in an effort to encourage differences of opinion (Mackness et al., 2010). This diversity in learners in turn leads to differing levels of engagement, which is the focus of openness (Mackness et al., 2010). Finally, in cMOOCs connectedness and interactivity between learners is what makes the preceding characteristics possible (Mackness et al., 2010). In other words, cMOOCs place great importance on the interaction and discussion between learners. This form of MOOC is best suited for learning involving higher order creative skills (Grunewald et al., 2013).

Although cMOOCs have been shown to encourage learning among users, the
principles underlying their design can also interfere with learning if they are not adequately balanced. For example, Mackness et al. (2010) conducted a survey of participants after completion of a cMOOC centered on the theory of Connectivism and its practices, created by the University of Manitoba. According to the results of the survey, the learners' thoughts on autonomy were mixed, some learners enjoyed the freedom the course provided while others, especially those with little previous experience with the platform and content of the course craved more structure and instructor guidance (Mackness et al., 2010). Similarly, novice learners also found the discussions taking place in the forum to be too technical and therefore felt uncomfortable participating (Mackness et al., 2010). In other words, the open and autonomous nature of the course resulted in lower participation among less experienced users. Thus affecting the interactivity between users. The ability for learners to self-organize lead to the creation of small groups, which also jeopardized the connectivity between learners (Mackness et al., 2010). This study demonstrates that the presence of certain features in MOOCs does not guarantee success, instead MOOCs represent a complex learning environment in which instructional design has a strong impact on learning outcomes as well as learner satisfaction.

Other predominant MOOCs are classified as xMOOCs. Unlike cMOOCs, which are unstructured and focus on the interaction between learners, xMOOCs are highly structured and value the interaction between each learner and the content of the course (Kalz & Specht, 2013). xMOOCs are based on behaviorist learning theories and focus on information transmission (Clow, 2013). xMOOCs can be seen as traditional lecture-based courses translated for use on the internet. Due to the focus on transmitting information from
instructor to student, xMOOCs are best suited for material that can be absorbed through repetitive practice (Grunewald et al., 2013). Prestigious American universities such as Stanford, Harvard, and MIT have created popular platforms for MOOCs. The MOOCs delivered by these platforms are all examples of xMOOCs (Kalz, 2013).

A major concern in both cMOOCs and xMOOCs is the lack of active participation among users as well as the steep dropout rate as courses progress. According to current research the average completion rate, that is users who participate in the entire MOOC, is generally between ten to twenty percent, much lower than typical rates in higher education (Clow, 2013). Various researchers have developed different theories to account for this phenomenon. For example, Clow (2013) uses a model adapted from the field of marketing known as the “Funnel of Participation.” This model describes the different steps that a learner must go through in order to complete a MOOC (Clow, 2013). First, the user must become aware of the MOOC, sign up, actively participate in the course, and finally meaningful learning can occur (Clow, 2013). At each stage in this process more and more learners drop out (Clow, 2013). Another way of conceptualizing this diversity in activity is through "cultures of participation" which Fischer (2011) describes as stemming from the range of intrinsic motivations of learners. According to this theory, learners can be categorized into discrete levels of participation from unaware consumers to meta-designers, who extend the range of the platform by adding content (Fischer, 2011). As described in Clow’s (2013) Funnel of Participation, the number of participants decreases significantly as the cultures of participation become more active (Fischer, 2011).
Although research on MOOCs is in the early stages, several researchers have provided suggestions of features that could encourage active participation and improve learning outcomes. For example, in order to encourage participation and facilitate users transitioning to more active cultures of participation Fischer (2011) advocates the use of rewards and incentives for participation. Fischer (2011) also suggests that the instructional design of MOOCs should allow for a “low threshold and high ceiling” in regards to learner participation. In other words, opportunities for participation should be given early and require minimal effort on the part of the learner. However, learners who wish to delve deeper into the material should be given room to do so. Similarly, Rubens (submitted) suggests that the content presented in a MOOC should be applicable to everyday contexts, thus providing incentive for learners to continue with the material. Research also offers insights into effective learner supports. For example, Drachsler (2002) posits that recommender services, similar to those used by companies such as Amazon to suggest products for purchase, could be used to recommend further material to learners. This would allow for subtle navigation and learner support for more novice learners while still maintaining the autonomy that more experienced users enjoy. Fischer (2002) also recommends the use of visualizations to describe course content. According to Fischer (2002), these visualizations provide the support learners need to engage in meaningful collaborations.

**Storyboard**

Design principles of Cognitive Science, the MOOC, represent a synthesis of values supported by Grunewald’s “Designing MOOCs for the Support of Multiple Learning Styles,”
and Online Master-Classes hosted by the Open University of the Netherlands. Massively
Open Online Courses have been presented in two forms: cMOOCs and xMOOCs. The two
are seen as pedagogically dissimilar. While connectivist cMOOCs build “mainly on the
interaction between learners” and “offer little structure and directed support,” xMOOCs
focus on the interaction of the learners with the learning content” and has “very little
interaction opportunities” (Kalz, 2013). Grunewald’s essay influenced consideration on how
to design online courses offering aspects that seem mutually exclusive: structure and
flexibility, content delivery and social learning.

Additionally, Online Master-Classes address the diversity of large-scale open online
learning environments by balancing two different criteria: “Flexibility with regard to time
investment and the diverging interest of participants interested in applied topics or
academic topics” (Kalz, 2013). Cognitive Science, the MOOC, supports this integrative
approach to instructional design and reflects its design principles with features and tools
adopted from Online Masters Classes. In addition, original tools and features yet to be
presented by MOOC providers are offered in our course, which act as experimental
variables with potential to extend best practices in MOOC instructional design.

Informating Design

A comparison of xMOOC and cMOOC theories--and instances--reflects differences
not only between how users perceive value in MOOC learning, but also how instructional
designers perceive the function and role of the MOOC platform. Designing a course that
works to reconcile both instructional approaches and user demands presents challenges
we have attempted to address with decisions that reflect ideals of structured autonomy and incentivized open participation. Structured autonomy, additionally, is an attempt to offer curriculum that provides both guidance and opportunities for exploratory learning. Incentivized open participation refers to design that respects varying levels of participation and prior knowledge while scaffolding toward increasingly robust student output and mutually beneficial social contributions.

**Video Lectures & Linearity**

Our proposed Cognitive Science MOOC outlines course objectives, resources and schedules for lectures, webcasts and assignment due dates. However, students are not beholden to follow this linear path and are free to view video lectures, and take assessments at their discretion. Students, moreover, are not required to view lectures in sequential order, or to complete embedded assessments or follow-up assignments in order to unlock the next sequential lecture. We believe that granting students the freedom to decide their learning trajectories and communicating the direction and organization of a course upfront respects both the student who needs to know the macro and micro instructional details. In turn, an enrolling student may only watch two video lectures halfway through the class, for example. For the former student, he or she may benefit from assessment and lectures that builds from previous lectures, a key strength of linear curriculum. For the latter student, the chronologically listed menu of video lectures includes the time length of each video, an informative title (No “Week 1: Lecture 2” labels), and an abstract of the material presented in the lecture that is triggered by mouse hovering. This functionality is particularly helpful for the domain expert, who participates in the course only
for supplemental knowledge in a sub-topic that is explored in one or a few video lectures, and can’t be taxed with clicking through links and video timelines to find the content they value. For the student who visits our MOOC at various times during the day, or who participates in sessions weeks apart, we have a call-to-action icon that informs where the student left off.

**Assessment Agency**

Each video lecture is followed by an optional assignment. Expecting a majority of students to be current teachers, administrators, instructional design professionals, or students in residential higher education programs, respect for time and relevance to careers were major considerations in choosing assignment types. Because the amount of time students have to participate in an assignment will inevitably vary, our assignment options reflect this spectrum. For example, making a five question quiz requires less of a time commitment than developing a 50-minute lesson plan. Although ostensibly the less demanding assignment, notifying participants that strong submissions will be considered for use as embedded assessment in the next iteration of this course offers an incentive to spend a considerable amount of energy on the assignment.

A second concern was to make these assignments relevant to students’ professional lives. With the assumption that students are enrolled for professional development reasons, assignments were considered in terms of how they could present situations where applying the concepts in video lectures felt natural. Creating lesson plans embodying a week’s concepts, evaluating with learned material as a rubric, and reflecting on previous experiences with the week’s concepts are options that represent different
cognitive tasks.

**Social Incentives**

While students are not required to interact with other students, we encourage cross-functional communication. Online social features have a tendency to replicate non-digital social dynamics. In MOOCs, this is made evident by a tendency for learners to self-organize into small groups distinguished by domain experience, culture and learning styles, among others. To encourage connectivity between learners of varying intellectual backgrounds, our staff moderators reward domain experts who engage and scaffold in class discussions at the novice level by unlocking intellectually advanced video lectures in their video lecture dashboard. To encourage social participation and exemplary assignment performance among the larger base of students, excellent forum participants and outstanding assignments are recognized in post-lecture webcasts between the course moderator and a guest expert.

**MOOC Design**

Following are wireframes that are representative of our MOOC design. These depict key areas of the MOOC. A brief description of each area of the MOOC follows the item.

[Download the functioning wireframe here.](#)

**Landing Page**
Sites such as Coursera, Udacity, and Skillshare offer one-size-fits-all templates for MOOC creation. However, different subjects must be learned in different ways. While these templates may work to teach a wide range of topics, they do not offer the flexibility to create optimal learning experiences for a given subject.

For this reason, we've chosen to host our MOOC on its own website. This allows for maximum flexibility in terms of instructional information design and instructional interaction design. Click the LOGIN button to be taken to main dashboard.

Dashboard
On the dashboard, the entire course is divided into several appropriately-scaffolded lessons. (Three are shown here, but a full course would contain many more than this).

Within each lesson is an introduction video, a mini-game, an assignment, and a conclusion video. In a future version of this site, students will also be able to see the badges they have received as rewards for assignment completion on this page.

All four of the center buttons are clickable. The navigation bar at the top of the page is also fully functional. Click the Lesson 1 button in the upper-left corner at any point in the wireframe and you will be brought back to this dashboard.

**Introduction Video**
The scientific literature surrounding MOOCs indicates that users prefer animations, visualizations and simulations to traditional lectures. Therefore we open each unit in our class with a series of short animations that provide an overview of the topic at hand. We insert intermittent single-question multiple choice questions between videos to help keep viewer engaged and help them gauge their retention.

Click Game in the navigation bar to continue to the next portion of the wireframe.

Theory Hunter Game
Theory Hunter, is a learning theory game being developed by our classmates Lawrenberg Hanson, Jonathan Hodrick, Gabrielle Moor, Rina Patel, and Geoffrey Suthers. It is comprised of several mini-games. In this section, we have the students of our MOOC play the mini-game associated with the learning theory at hand. We chose to have the game section come after the introduction videos but before the official assignment so as to deepen students’ familiarity with the concept before heading off to use it on their own.

Click Assignments in the navigation bar to be taken to the next page.

Assignments Page
Subscribing to the low-threshold-high-ceiling theory, we offer four different assignment options and provide the probable time commitment for each so that students can work at their own level of engagement. These four assignments are specifically designed so that students from different fields will be able to put the theories into practice in everyday contexts.

Click Conclusion in the navigation bar to be taken to the next portion of the wireframe.
Each unit is wrapped up with a video discussion between the class instructor and an expert on the week’s topic. The pair will use user projects, questions and comments that have received in the forum as their points of discussion. We hope that this positive reinforcement by public recognition will continuously spur user motivation.

**Workflow**

<table>
<thead>
<tr>
<th>Who</th>
<th>What</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matthew Marsaglia</td>
<td>Design Principles/ Workflow</td>
</tr>
<tr>
<td>William Kemp</td>
<td>Relationship to Learning Theories, and Clean up</td>
</tr>
<tr>
<td>Samuel Jefferson</td>
<td>Storyboard/Wireframes</td>
</tr>
</tbody>
</table>
Related to Class Instruction:

According to Cole (2010), knowledge has historically been transferred based on societal demands. That is, as contemporary cultures transform requests, the traditional classroom structure remains complacently secure within education. Essentially, the more technology our students are introduced to—and the complex demands that follow—the more our classrooms stay the same (Cole, 2010). A whiteboard is simply a chalkboard with markers; a SmartBoard is simply a whiteboard connected to a computer. While the blackboard itself has molded to reflect contemporary education, the relationship between instructor and pupil has waivered slightly (Goldman, Class Lecture).

The MOOC actively pushes against the constraints of traditional education by placing itself in a category of its own. Collaborative interactions, or Cognitive Apprenticeships, provide participants with the ability to reflect and grow as active learners (Brown et al., 1989). While the MOOC is built upon the relations between expert and novice, it does not approach instruction in the same manner as a historical classroom. The cognitive interactions fostered by the MOOC stimulate a fluid motion for vigorous and dynamic learning. Users actively participate in forum discussions, are presented with wide-ranging assessments, and have access to collaborative platforms. These notions produce further understanding and allow for genuine application. Put simply, there are no dictatorship relations between mentor and pupil. That is, teachers do not decide what is
important to teach. Rather, the information is presented from experts for users to wrestle with. While the MOOCs ultimate goal is for users to complete the course and possess the ability to transfer knowledge, it approaches these lofty endeavors by encouraging users to discuss, debate, disagree, and ultimately teach one another (Slavin, 1991). That is, academic relations between expert and novice create a platform for Cooperative Learning. Essentially there are three critical pillars to Slavin’s Cooperative Learning: Rewards, Individual Accountability, and Equal Opportunities for Success. The MOOCs badge system, differentiated instruction, and massively open concept correlates closely with Slavin’s learning theory.

The MOOC platform itself, moreover, fosters what Bown et al. (1989) calls a Domain Culture, or active transfer of knowledge to authentic practice. Knowledge, it seems, is readily available to access when faced with a new culture or demanding space. The tools acquired from a MOOC have the ability for numerous applications as opposed to the traditional hammer-to-nail ideology. Ultimately, the MOOC serves as a, what Nieto (2010) calls, Sociocultural Mediator. Due to its ability to bridge home and academic cultures, users are able to create authentic application of one specific course to numerous cultures. The MOOC forwards a brand of crisscrossed knowledge to serve the crisscrossed landscapes in which modern students dwell (Spiro & Jheng, 1990).

According to Spiro & Jheng (1990), cognition can be actively distributed through the Cognitive Flexibility Theory (CFT). That is, active exchanges between users offer different representations of ideas. Since MOOC users derive from ranging demographics, desires, and purposes, CFT presents information so each user can re-assemble the content
needed to pursue their own interests. Essentially, Cole’s (2010) rendition of education presents superfluous understanding of wide-ranged topics. The MOOC, in contrast, aims to authentically approach one specific topic in hopes for application in wide-ranging cultures or landscapes (Spiro & Jheng, 1990). Traditional education, historically, placed knowledge into artificial packages. According to Spiro & Jheng (1990), students never know what situation they will be exposed to; knowledge must offer the same fluidity in non-linear components. Essentially, the MOOC exemplifies *ill-structured domains*—as student's approach the course, each is free to work with and apply the materials in manners that suit their needs. Knowledge, therefore, is not rigidly prepackaged into linear thoughts. Rather, it is presented to a massive audience to struggle with, and work alongside knowledge’s complex nature (Spiro & Jheng, 1990).

Even so, it is imperative to highlight the Social Constructivist components of the MOOC in order to fully appreciate its flexibility. According to Palincsar (1998), Social Constructivism denounces the role of a formal teacher and expands on collaborative explanations. Essentially, the MOOCs platform serves as a communal data-base of accumulated wisdom, which users have access to take note of, or respond to (Palincsar, 1998). Learning, therefore, is a complex process that cannot be approached in a linear fashion. Instead, background knowledge and previous experiences are highlighted in order to discover alternative meanings hidden from original thoughts. Essentially, MOOC offers a public space to generate and access these alternative meanings through participation and collaborative struggles.

The MOOCs structure is a cognitive networking site, which fosters what Stahl (2006)
calls, *Computer-Supported Collaborative Learning (CSCL)*. CSCL actively brings all learners together, which offers a flexible exploration of knowledge through *group cognition*. That is, no single entity owns and transfers information. Instead, users learn to become functioning members of a community and engage, record, and bring new meanings through social interactions (Stahl, 2002). According to Koschmann (1996), users come together to form specific knowledge communities. The MOOC users have the opportunity to find sub-communities within the vast data-base, and connect with students applying information in similar manners. This notion is quite evident through forum exchanges; both small and large group discussion accesses community-sized conversations in order to promote—and monitor—joint meaning-making (Stahl, 2002). For example, our MOOC may have a sub-community of teachers attempting to apply information to their own professional endeavors. Their application of this flexible knowledge will vary drastically from a Graduate Student, using the MOOC for studying purposes. Koschmann (1996) continues this ideology by stating that CSCL platforms weave the numerous learning theories, including situated cognition, to promote problem solving through technology.

Traditional vocabulary instruction in which Cole (2010) denounces, criticizes instructors for “assuming that definitions and exemplary sentences are self-contained ‘pieces’ of knowledge. But words and sentences are not islands,” and must provide flexible contexts (Brown et al., 1989, p. 32). The MOOC, simply put, has revolutionized contemporary education to meet the technological advancements and open-mindedness of our modern society. Essentially, the MOOC offers a CSCL platform unlike any other, as it actively demonstrates the ability provide information for all learning styles, cultures,
demographics to not only access, but also actively apply information in meaningful fashion.

**References**


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