Connectivist learning environments: Massive open online courses

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Abstract – For most of human history, knowledge had a long and stable shelf-life. With the ubiquity of advanced computing, information, and the knowledge it generates, has a much sorter half-life, often measured in months rather than generations. Educators are hard-pressed to meet the knowledge demands of students, who are no longer content to engage with traditional learning pedagogies. Not only must content delivery options evolve, so must the learning paradigms. A connectivist learning pedagogy was proposed as a means to address the effect of technology on learning environments by placing the emphasis on the student-information relationship rather than the student-teacher relationship. Concurrently, the introduction of massive open online courses, in which very large numbers of online students participate in the same course at the same time, offers an interesting test to the connectivist pedagogy, in which the learning context, bolstered by technology, is given greater prominence.

Keywords: MOOC, connectivism, massive open online course

1 Introduction

In 2008, an educational experiment was conducted based upon a proposed learning theory and which was freed from traditional concepts. This theory, Connectivism, looked at how new technologies disrupt the learning process by shifting the dynamic of teacher-to-student to one of student-to-information, and how knowledge acquisition becomes a collective process that helps each student personalize her or his learning needs [1]. This approach was explored through an online endeavor described as a Massive Open Online Course (MOOC). In a MOOC, thousands, even hundreds of thousands, of students can participate in the same course, at the same time, and in an environment that provides multiple, even redundant, learning tools and resources [2]. Working within a topical framework and guided by a facilitator, students would devise their own learning process and seek out information to augment their own learning needs, in addition to the core content provided in the course resources. They would gain support and guidance from each other through formal forums and self-generated, informal study groups. In the few years since the 2008 inaugural MOOC course, several MOOC schools and private businesses have launched, with the belief that the world is witnessing the birth of a new force that will predominate education within just a few decades [2]. This article will review Connectivism and the MOOC phenomenon, as well as note some significant issues that will need to be addressed going forward if MOOC is to become a viable learning option.

2 The half-life of knowledge

For much of industrialized history, including the very recent past, education was a matter of learning the basics in order to get along in society, and to develop a skill or trade to provide for one’s self and one’s family. Formal learning often ended when school did. Informal, task-specific, as-needed learning took over. Historically, the pace at which society and jobs changed or evolved was often very slow and could be paced over generations. Knowledge had stability and longevity. Educational systems where also rather stable and long-lasting.

This has now all changed. With the advent of computers, the Internet, and mobile technologies, the creation of new information and increased need for it has exploded exponentially [3]. Social changes seem to be occurring daily, and some job skills can be outdated by the time they are taught. The what, when, where, why and how we learn have evolved into something rather unstable, and with a short shelf life. Vaill noted “Learning must be a way of being [in an attempt] to try to keep abreast…(p. 42) [4]. Keeping abreast of information generation and degeneration has become a paramount activity. In the 21st century, information creates knowledge of dubious long-term value. The ‘half-life of knowledge’ describes how knowledge becomes obsolete over an increasingly shorter period of time while, concurrently, new information doubles every 18 months [5]. Educators are faced with the task of trying to deliver current, useful content that keeps pace with the instability of information growth, information demand, and information decay.

3 Approaches to learning

“Learning” has many definitions but it is basically a process of change. For Driscoll [6], it is persistent change as a result of interactions with the world. This particular perspective aligns well with learning theories found in behaviorism, cognitivism, and constructivism. In behavioral
learning, the learning process is essentially unknowable and hidden from conscious awareness. As a result, we should be less concerned about the internal learning process and focus on what is observable, specific, and oriented toward change [7]. Cognitivism is also an internally oriented exploration. It attempts to define various constructs and mental maps as it traces the path of stimulus to response, while describing learning processes through abstractions, symbols, and metaphors [8]. It looks at how the learner eventually gives meaning to information based on the prior knowledge and perceptions of the world in which the information resides.

Behaviorism and cognitivism both approach knowledge as existing outside of the learner, which then becomes internalized. Conversely, constructivism is a process in which the knowledge already residing within the learner is altered and expanded upon as new information is added. In essence, the learner uses already-existing pieces of knowledge to construct new meaning. This information is turned into new knowledge, which is unique to the individual [6].

These three learning theories, behaviorism, cognitivism, and constructivism, made sense when the modes of learning where more linear, and the connections between information were more limited. In an age of advanced communication technologies, however, the sources of learning have become more matrixed, and information is expansive, fluid, and networked. To address these paradigm shifts, a new learning theory was proposed.

4 Connectivism

In today’s environment, learning is a process of connecting people to each other, and to information resources [9]. A triadic relationship between the teacher, the learners, and the information is nothing new; however, with the advent of new communications technologies and distance learning endeavors, the addition of context forms a new quartet relationship. This learning quartet – teacher, learner, information, and context - has, at its heart, a participatory element in which the student takes a much more active role in deciding when and how to learn, what to learn, and how to construct and apply the knowledge that comes of it.

This less-formal approach is described in Connectivist Learning Theory [10]. Connectivism recognizes that information is incredibly fluid, resides in multiple locations, and is often highly disorganized [1][10]. The learner has needs beyond basic skills, which are highly individualistic [11]. The learner wants, first, to discover how to effectively find information; next, to discern its value; then, decide how and where to store this information; and finally, what meaning to give this information as it is turned into useful knowledge.

We can easily link Siemens’s connectivist principles with Weller, an expert in virtual learning environments, who noted that e-learning is a matter of connections between people and connections between information resources [9]. Siemens developed a set of connectivist principles that allow for the influence of new technologies and rapidly changing information needs [12]:

- Learning and knowledge rest in diversity of opinions
- Learning is a process of connecting specialized nodes or information sources
- Learning may reside in non-human appliances
- Capacity to know more is more critical than what is currently known
- Nurturing and maintaining connections is needed to facilitate continual learning
- Ability to see connections between fields, ideas, and concepts is a core skill
- Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities
- Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision.

Context has become an important factor in how learning occurs. This next section looks specifically at the context of a MOOC learning environment.

5 Massive open online courses

The evolution of the educational context is fairly easy to track because it runs a parallel course with emerging technologies. In the second half of the 20th century, in particular, there had been exponential growth of information delivery options [5]. These options have become more refined and more advanced in the 21st century. Mail-order and TV educational options were supplanted by Internet-based learning. Desktops and laptops became online classrooms. Recently, mobile technologies and social networking sites entered the learning environment, further reinforcing a connectivist notion of learning as context-sensitive and relying on multiple sources connected to each other. Classrooms and information sources became accessible through smartphones, and are now in virtual spaces. In this digitized learning environment, the role of the teacher becomes relegated to a facilitative and administrative position, in which content is merely suggested within a general topical framework [13]. The focus on teacher capacity - that is, how many students can a teacher effectively manage - becomes an irrelevant issue. Automation of content
delivery, automation of student activity tracking, and automation of assessment and feedback, all dissolve the barriers of human capacity, opening the way for limitless class sizes. This automated context is not only about the technologies involved that technologies make possible [2].

Massive Open Online Courses were conceived by Stephen Downes, currently with the National Research Council of Canada, and George Siemens, currently with Athabasca University, as a means to address information overload, respond to student demands for relevant learning experiences, incorporate technological advancement, and reduce costs of education (for both students and schools) [10]. This proposed online learning environment would incorporate any number of students, content sources, and content delivery options (real and virtual), limited only by the capacity of the technologies and associated costs [10].

The first MOOC class, in 2008, consisted of 2,300 students, and was sponsored through Manitoba University, Alberta, Canada. Siemens and Downes suggested that the paradigm of tightly controlled learning processes needed to be re-evaluated in a manner that opened up learning networks, allowing students to customize their learning experiences within a loosely designed framework [14]. This framework looked at information resources as content clusters that surrounded a topic, from which students could sample content while adding to and discarding from it according to their own needs and goals. In essence, the course was a ‘destabilized’ [15] ‘uncourse’ [16] that enabled students to develop personal perspectives about information. Part of the process of personalization was in achieving meaningful connections with other students who played an active part in each other’s learning adventures [17].

5.1 How MOOCs work

The components of a MOOC system include any combination and permutation of the following: Teachers, students, information (topic and related content), and context.

- **Teachers**
  Facilitate the learning process through the identification or creation of relevant content, establish the primary means of communication among students and with teachers and/or teacher’s aids, administer assessments based on general or specific learning objectives.

- **Students**
  Anyone who has an interest in learning about the topic. Students can be enrolled in a formal degree program, or they might just wish to learn for purposes outside of a degree program. Students who are merely curious and with no specific goals are also welcomed.

- **Topic**
  The main reason-for-being of the course. The topic is explored through the connectivist quartet of student, teacher, content, and context. The topic is infused throughout the learning network rather than existing in a centralized repository. It is narrow enough to provide focus but broad enough to allow expansive exploration.

- **Content**
  Exists in a variety of locations and formats and is accessible through a variety of technological and social means.

- **Context**
  The technologies, people, and networks that are part of the learning environment. This can include online social networks, mobile technologies, traditional information sources, various types of information delivery systems, types of communication systems, stated objectives and expectations, and the group culture that forms every iteration of the course.

![Figure 1: Components of a MOOC system](https://example.com/image1.jpg)

Students in a MOOC environment are given resources that serve as jumping off points rather than endpoints. Much like a person exploring links on websites, the student may follow a trail of information, guided by her or his interests related to the topic [18]. Forums are set up for students to interact with each other as they explore general areas of interest, offer support and additional resources, and form special interest groups in order to explore topics more deeply. The goal is to create a community of learners who bring personal resources and perspectives to those offered by the teacher, and to embark on a journey of discovery that is personalized, yet includes other students [2][10][11]. A course can be set up in weekly modules or may have no time frame at all, and can include videos created by the teacher and others, links to content, lists of additional materials, websites devoted to student and technical support forums, and accessibility to all of this through various computing devices over wired, wireless, and cellular networks. Conversations, information discovery, and sharing may occur in the class forums, in social networks, and in virtual worlds – at the choice of the student. The keyword in a MOOC system is flexibility. The following table (Table 1) breaks down the common elements of a MOOC learning environment.
### Table 1: Elements of a MOOC learning environment

<table>
<thead>
<tr>
<th>Type</th>
<th>Purpose</th>
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<tbody>
<tr>
<td><strong>Sources</strong></td>
<td>- Instructor-created</td>
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<td></td>
<td>- Video files</td>
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<td></td>
<td>- Audio files</td>
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<td>- Text documents</td>
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<td></td>
<td>- Existing Content</td>
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<td>- Websites / Online databases</td>
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<td>- Traditional Libraries</td>
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<td></td>
<td>- Students’ own content collections</td>
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<td></td>
<td>- Content is expansive, giving students a foundation upon which to explore, select relevant information, and to add to it with their own discoveries</td>
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<tr>
<td></td>
<td>- Content is shared and discussed – teacher-to-student and student-to-student</td>
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<td></td>
<td>- Groups may form around special interests related to the main topic</td>
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<tr>
<td><strong>Communications</strong></td>
<td>- Texting, chat, and e-mail</td>
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<td></td>
<td>- Voice</td>
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<td>- Cell phone/ landline</td>
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<td>- VoIP</td>
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<td>- Online forums</td>
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<td>- Course workspace</td>
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<td>- Support forums</td>
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<td>- Student forums</td>
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<td>- Instructor online</td>
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<td>- Office forum</td>
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<td></td>
<td>- Other virtual spaces</td>
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<tr>
<td><strong>Technologies</strong></td>
<td>- Desktop / laptop computers</td>
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<td>- Smartphones</td>
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<td>- Netbooks</td>
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<td></td>
<td>- Gaming</td>
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<tr>
<td><strong>Context</strong></td>
<td>- Online forums</td>
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<td>- Virtual worlds</td>
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<td>- In-person</td>
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<td>- Other virtual spaces</td>
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<tr>
<td><strong>Learning management systems</strong></td>
<td>- For the aggregation and display of course content</td>
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<td></td>
<td>- For the listing and monitoring of students</td>
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<td></td>
<td>- For administration of assessments</td>
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### 5.2 Current MOOC initiatives

During the past four years, experimentation with MOOCs has increased, especially among a few high-profile non-profit universities and with private, for-profit businesses [2]. Massachusetts Institute of Technology, Stanford University, University of Illinois, University of Michigan, University of California – Berkeley, Georgia Institute of Technology, Udacity, Udemy, and MOOC-delivery conduit, Coursera, are the current leaders experimenting with this connectivism learning model. They have sparked interest among students of all ages and skill levels, indicating that students are seeking something that might be more relevant to their lives and learning goals.

In late 2011, Peter Norvig and Sebastian Thrun created a MOOC Artificial Intelligence course for Stanford University. It was delivered in 44 languages, to students in 190 countries. It ran concurrent with a for-credit course of enrolled Stanford students and, at its peak, had 160,000 registered students participating at the same time [19]. The positive experience of this endeavor prompted Norvig and Thrun to create a for-profit MOOC university called Udacity, launched in February, 2012. Stanford continues to role out a series of new MOOC courses that have evolved beyond technology-related topics to include courses such as Human Anatomy and Entrepreneurship [20].

### 5.3 Considerations

The primary characteristics of connectivism and, thus, of a MOOC are autonomy, diversity, openness, and interactivity [21][22][23][24]. Sense of presence, a cognitive requirement to help maintain interest and motivation, should also be added to these characteristics of connectivism [25]. However, these characteristics also bring limitations to the learning experience. There is reduced structure in a pure MOOC course, which can become a demotivating factor for students used to, or requiring, firmer guidelines with measured milestones [11]. Additionally, while the support forums provide assistance for issues, they can quickly become unwieldy and inefficient when searching for the right answer to a problem, especially one that is rather unique or, as is often the case, when the student does not know how to phrase the question [2]. There are also issues regarding assessment, in that the potential for cheating is increased and assessments have little value to anyone other than the student [2].

There are also limits to student participation in a MOOC learning environment. Students must have some proficiency in the use of computer and Internet technologies, search strategies, and basic functioning of forums. Students also need to be self-motivated and have a high tolerance for structural ambiguity [26]. While some initial MOOC endeavors are multi-lingual, the language of choice at the moment is English. Additionally, MOOC learning will lend itself more favorably to students with high critical thinking skills, simply because they are primarily responsible for
searching, aggregating, and validating relevant information for their own purposes rather than for the purposes of the accrediting body [2]. Students are also responsible for accessing and creating their own content in a variety of formats and for communicating it to other students. Their knowledge of the intricacies of how networks operate – in the case of MOOC, between student-to-student, resource-to-resource, and student-to-resource - would be helpful in being able to negotiate the complexities of the learning environment [27]. Finally, the learning environment itself needs to provide a sense of presence that will be compelling enough to keep the student involved in the learning activities [25]. These three basic challenges – critical literacy, learner autonomy, and sense of presence – are the cornerstone of a successful MOOC endeavor that not every student is capable of achieving [28][18][29][30]. We can note that of the aforementioned Stanford Artificial Intelligence course of 160,000 students, only 23,000 made it to the end and graduated: A rate of 14% [31].

Connectivism, as a new learning theory, also seems to have some issues worth noting, including the difficulty in isolating unique features that are not already existent in other learning paradigms. For instance, many of the social and cognitive learning theories already have a long history that show how people learn through observation and social modeling [32][33][34][35] and through collective or community efforts [36]. Current learning theories are sufficient, although Connectivism does present an interesting pedagogical viewpoint, and notes a shift of power from the teacher to an autonomous learner [37].

6 Conclusions

It is clear that educational approaches in the technological age are in a transitional stage with regard to information retrieval, storage, and use. Additionally, educators must grapple with different ways of employing learning pedagogies to assist students in converting that information to knowledge. Considerations of constantly evolving technologies and their associated costs, as well as demands for relevant learning experiences that encompass formal, informal, and personalized goals, are causing reevaluation of current learning theories and principles. Connectivism, with its emphasis on the matrixing of human and technical networks, appears to be an interesting learning paradigm, especially in light of the emergence of MOOC learning environments.

7 References


