Content Analysis of Coursera, edX, and Udacity Course Platforms

Course content analysis of 18 Massive Open Online Courses

COURSE # MBA 801

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"Thirty years from now the big university campuses will be relics. Universities won’t survive. It’s as large a change as when we first got the printed book ... Higher education is in deep crisis."

– Peter Drucker, quoted in Forbes Magazine in an article by Lenzner & Johnson, 1997

INTRODUCTION

Overview

Massive Open Online Courses, called MOOCs, have the potential to transform the business model of traditional universities. According to a prediction about the effects of MOOCs on higher education made by Harvard business professor Clayton Christensen in a New York Times article, “struggling colleges and universities, the bottom 25 percent of every tier, we predict - will disappear or merge in the next 10 to 15 years” (Christensen, 2013). The New York Times has called 2012 “the year of the MOOC” and described this new phenomenon in the field of online education as being free and flexible alternatives to “face-to-face” classes on campus. One day soon students will arrive on campus with MOOC credits the way they do with Advanced Placement (Pappano, 2102), or maybe not arrive on campus at all.

MOOCs as defined by the The Chronicle of Higher Education are “…classes that are taught online to large numbers of students, with minimal involvement by professors. Typically, students watch short video lectures and complete assignments that are graded
either by machines or by other students. That way a lone professor can support a class with hundreds of thousands of participants” (Young, 2014). One key measure of the success of MOOCs has been the rise in accreditations of individual MOOCs that have begun to count as university course credit, and in some cases had a requirement for an on-campus proctored exam (Coursera, 2014) or an online exam from a third party service such as ProctorU.com (ProctorU, 2014).

State legislators in California have also led the way to accreditation, motivated by the popular perception that online courses increased access while also lowering the cost of higher education (Cooper, 2013). On a broader scale than mere individual course credits, in January, 2014, Georgia Tech, in partnership with Udacity, began the first complete program based on MOOCs, a Master of Science in Computer Science degree at a cost of $6,600 (Udacity Website, 2013). The program was also open - available at no cost to anyone wanting to participate but without obtaining a degree.

Resistance to the integration of MOOCs into higher education has appeared from some faculties at US universities (Kolowich, 2013), but distance education has long been an alternative to face-to-face interaction in a classroom (Caruth, 2013). The highly scalable nature of MOOCs posed a greater threat to on-campus classes than conventional distance education. Coursera, one of the leading providers of MOOCs, claimed four million students have enrolled in the courses that it had offered in partnership with 33 universities around the world (Anders, 2013). Enrollments in MOOCs were projected to double in 2014, according to the Deloitte Canada Technology Predictions 2014 (Tsang, 2014).
With the support of prestigious universities such as Harvard, Georgia Tech, and Stanford University, web based learning platforms Coursera.org, Edx.org, and Udacity.com have led an effort to disrupt current higher education business models (Scholz, 2013). The MOOCs offered by these three web platforms (Pappano, 2012) were available for free to anyone in the world with web access, and offered high quality learning material without the obstacles of a schedule, travel, tuition cost, or the financial burden of attending class on-campus. MOOCs offered world-wide accessibility allowing a lot more people in the world to take part in higher education (UK Dept. BIS, 2013).

Research showed that the potential quality of online learning was very high. According to a US Dept. of Education study: “The overall findings of the meta-analysis is that classes with online learning (whether taught completely online or blended) on average produce stronger learning outcomes than do classes with solely face-to-face instruction” (Means, 2009). In the context of rising tuition MOOCs had created a lot of hype about the potential to reduce costs, to increase access to higher education, and to disrupt the higher education market (Wei, 2008).

**Background**

Online education is a descendant of correspondence learning, which started in the US in the 1870’s with a Harvard associated group called “The Society to Encourage Studies at Home” (Caruth, 2013). Some of the same challenges that faced distance education in the past continued to persist. For example, conflicts had always existed between face-to-face faculty and distance learning faculty (Kolowich, 2013). Yet the promise of distance education had not changed - MOOCs reach new and previously unserved student populations. MOOCs have the potential to leverage the increased
performance and reach of the Internet, thereby massively increasing access to new
students while delivering courses at “low or no-cost“(Cooper, 2013).

The term MOOC emerged from conversations between two colleagues, Dave
Cormier of the University of PEI and Bryan Alexander of the National Institute for
Technology in Liberal Education (Parr, 2013). Two types of MOOCs were discussed in
the literature: the cMOOC and the xMOOC (UK Dept. BIS, 2013). The former
emphasized connectiveness while the latter was an extension of the classroom.

The cMOOC appeared first, in 2008, in the course “Connectivism and Connective
Knowledge” by the University of Manitoba (Downes, 2008). A cMOOC offered a new
structure for learning, based on connectivism, which had a network-based focus on
student interaction, wherein social networks were used to help form online communities
around the course concepts. These connectivist communities formed on Facebook, blogs,
discussions in Moodle and other platforms such as Second Life, a 3D virtual world.
Students build relationships and work together online to solve problems, led by an
acknowledged expert in the topic, and this interaction was at the heart of cMOOCs
(Yaeger, 2013). A cMOOC was less focused on content and more on the exchange of
ideas and developing online communities oriented around ideas.

Whereas a cMOOC was connectivist, an xMOOC was an extension of the
traditional classroom. An xMOOC was more focused on content and course delivery, but
also depended on online discussions to create peer-to-peer learning (Billsberry, 2013).
An xMOOC entitled “Circuits and Electronics” (6.002x), which began in March 2012,
was the first MOOC developed by edX, the consortium led by MIT and Harvard. Over
155,000 students initially registered (Breslow, 2013). The term “MOOC” was often used
in the literature to refer to an xMOOC, while the term cMOOC was used to distinguish itself as connectivist oriented. Figure 1 shows a timeline of cMOOCs and xMOOCs.

**Figure 1.**

![Timeline of cMOOCs and xMOOCs](image)

Source: Reproduced from EDUCAUSE Review (Hill, 2012)

The three leading MOOC platforms were Coursera, edX, and Udacity; these platforms were often mentioned together in the popular press coverage of the MOOC marketplace emerging in 2011. These three platforms were in the early stage of brand development and depended heavily on partnerships with universities such as Harvard (Pappano, 2012). The involvement of prestigious US universities offered a rare example of the establishment leading disruptive innovation (Christensen, 2011). Coursera had formed partnerships with 10 state systems (Coursera, 2013). EdX offered MOOC versions of many Harvard classes while Udacity has partnered with Georgia Tech and AT&T to offer a complete Masters Degree program in Computer Science (Udacity, 2013).
This partnership with AT&T demonstrated the reach that MOOCs had into corporate training, and according to a CNBC article, MOOCs have already had a billion dollar impact on the field of personnel training (Lee, 2014). Furthermore, an article in the Financial Times warning of the potential impact of MOOCs on small business schools called MOOCs a commoditization of the teaching function (Guillotin, 2014). Another MOOC from edX responded to a demand from industry, announced March 6, 2014, in partnership with the Linux Foundation. The Linux course had previously been offered online at a cost of $2500, but the free MOOC version was intended to address a shortage of professionals with Linux skills (O’Connor, 2014).

Some criticisms of MOOCs included complaints about the low completion rates of enrollees, as well as problems with measuring students’ performance and academic honesty (UK Dept. of BIS, 2013). MOOCs had also run afoul of the law, such as when a MOOC was cancelled in January, 2014 due to US export laws restricting course access to some countries including Iran, Cuba, and Sudan (Collins, 2014). Even with export controls it may prove difficult to block access due to the fact that most of the MOOCs examined in this study had downloadable versions of course content including videos, for offline use (Coursera, 2014).

**Problem Statement**

The problem is that higher education at a traditional university is expensive and inconvenient. MOOCs had the potential to solve some of the principle barriers to higher education: eliminating tuition costs, admission limits, class schedules, and the geographical distance from a campus (UK Dept. BIS, 2013). The high quality of the course materials and presentation added to the potential of MOOCs to disrupt higher
education. With no admissions process and free enrollment the courses were “available to anyone with an Internet connection who understands the language of instruction, often English” (Ehrlich, 2013).

Dwyer stated in an article from 2012 that “The experience of significant indebtedness among young adults today is new.” Student debt has been rising, reaching record levels in 2012, and research showed that “student debt—which, as has been widely reported, now exceeds credit card debt” (Bowen, 2012). The fact that MOOCs are offered at no charge was a stark contrast to the trend of rising student debt.

**Purpose of the Study**

This study aims to provide a deeper understanding of the types of courses being offered by MOOCs, and the course presentation used on each platform as found during the period of study. Deeper understanding of the structure and content of each course may give insight to university leadership in how to include MOOCs within programs, and help explain the potential benefits. This study may provide a benchmark to be compared in the future in order to map the trends in online course content. This study might also serve as a broad guide to understanding the state of the art of MOOCs at a particular point in time.

**Research Questions**

As communication technology has evolved, the opportunities for online education have grown. The research questions in this study explore the content of MOOCs to answer the following:

Q1. What were the pedagogical/media elements utilized within the Coursera, edX, Udacity MOOC platforms?
Q2. How is video content used in MOOCs?

Q3. What uniquely online elements were found in MOOCs?

**Nature of the Study**

The research design was based on a content survey of pedagogical elements found in three xMOOC platforms: Coursera, edX, and Udacity. The three platforms were the focus of the study because of the prominence given in the popular press and also because of several articles that referred to these as the top three platforms (Pappano, 2012). The courses chosen in the sample represent six available course offerings from the widest variety of subjects available at the time within each platform. The total sample size was 18 courses.

The survey consisted of 69 questions focused on measuring pedagogical elements such as number of lessons, quizzes, and videos. Data collection occurred over a six week period, and was performed exclusively by the researcher. The research questions were answered using a descriptive approach based on content analysis methodology. Data specific to each of 18 MOOCs (six each from Coursera, Edx, and Udacity) was collected using an Excel spreadsheet containing 69 questions about course content.

The data collection was performed during the period from January 5, 2014 to February 25, 2014. In order to record the data from each course in a consistent manner, a single researcher administered the survey. The survey included some broad questions such as a rating of the quality of the video presented. The duration of video content in each course involved traversing thousands of short video segments to record the length of each one. The specific question on video durations was designed to reveal different video
presentation strategies among the 18 courses and to reveal platform styles of video delivery.

**Limitations**

Similar to most research projects, this study will be unable to answer all of the pertinent questions relevant to MOOCs and the role played by the course contents. The range of course content was extensive and a more nuanced approach would include expertise in the area of instructional design, an area where a great deal of research has already been done. Future research, including insights and observations from this study, may help institutions of higher learning to develop strategies to gain a competitive advantage regarding MOOC design and integration.

A limitation of this study is how well the sample represented the population. The study was limited to only three MOOC platforms without including all other MOOC platforms, or individual MOOC offerings, or MOOCs offered in languages other than English. The survey offered only a snapshot at a point in time; further studies may include a longitudinal perspective. Finally, while the content analysis can quantitatively identify and provide data on the frequency of certain course elements, in particular the video presentations, it does not shed light on the meanings of these patterns (Babbie, 2001).

**Assumptions**

The content analysis method used by the researcher in this study attempted to discover the course elements and to create an inventory across all of the 18 courses. Assumptions were made as to what constituted a course element. The creation of course element categories were determined from the course materials presented. The assumption
that each MOOC presented the same content to all students was made, and it might be possible that students had some customized course content based on how each student proceeded in each course or based on the geographic location of the student or other variables such as the type of web browser. Furthermore, it was assumed that the researcher collected data in a consistent manner and in a timely fashion during the period of the study.

**Results and Findings**

From 2010 to 2013, online education has evolved into a new category of university courses, in the form of MOOCs. The increasing popularity was evidenced by the coverage of MOOCs in the popular press and by the course enrollment statistics reported by each provider. MOOCs reached new students, were free, and were gaining accreditation within the current university system (Marr, 2013). The three big platforms, Coursera, edX, and Udacity continued to innovate in the area of course design and delivery and to create partnerships.
LITERATURE REVIEW

Purpose of the Literature Review

The purpose of this literature review is to provide an overview of the body of knowledge on the subject of Massive Open Online Courses, or MOOCs. The term MOOC first appeared in a published, peer reviewed journal in 2009 with a single article, then climbed to 250 published articles on the subject in the year 2013. The history of MOOCs can be seen as an offshoot of online education (Caruth, 2013). Online learning began to appear in the literature in the year 2000. According to the UK Department for Business and Innovation, in that period of pre-MOOC online learning from 2000-2007 trends ran from open learning (UK Dept of BIS, 2013), to LMS (Learning Management Systems), iTunes U, and Khanacademy. During the year 2008 a series of failed ‘dot-coms’ attempted to deliver online learning (UK Dept of BIS, 2013). On the other hand some online learning success occurred in virtual universities with roots in the 1970s that flourished during the 2000’s such as University of Phoenix and Walden University. From the humble beginnings of early correspondence courses by postal mail in the 1870s, distance education began to flourish with the rise of the Internet. The history of distance education has run parallel to the history of communications technology that supports interactions at a distance (Caruth, 2013).

Academic articles from peer reviewed journals were used as much as possible in this review, but some information came from the popular media. Several themes were found in the topics of the peer reviewed articles published on MOOCs (Liyanagunawardena, 2013) including: agency, connectivism, actor network theory,
dangers, learner experience, pedagogies, technology, and trends. Many of the articles in the literature studied the effectiveness of distance learning, as well as the potential for MOOCs to increase access to quality higher education and to reduce costs. Business models of MOOC platforms were another minor theme. MOOC pedagogical content and design including peer assessments, computer grading, and the effectiveness of video content was explored in the literature review in order to give context and terminology to the survey data collected.

**Description of the Database Search**

In 2014 MOOCs were yet an emerging phenomenon with articles just beginning to appear in the literature on the subject. In order to demonstrate the trend of published articles, a search was performed on Robertson Library Onsearch (EBSCO Discovery Service) for each of the years from 2008 to 2013 using the search terms:

“MOOC” in Title or “Massive Open Online Course” in Title Limiters on for Peer Reviewed, and Academic Journal, were applied and the search was repeated for each year from 2008 to 2013. The results are listed in the table, by year:

<table>
<thead>
<tr>
<th>Year</th>
<th>Articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>250</td>
</tr>
<tr>
<td>2012</td>
<td>29</td>
</tr>
<tr>
<td>2011</td>
<td>4</td>
</tr>
<tr>
<td>2010</td>
<td>1</td>
</tr>
<tr>
<td>2009</td>
<td>1</td>
</tr>
<tr>
<td>2008</td>
<td>0</td>
</tr>
</tbody>
</table>
The bulk of the research (88%) was published in 2013. This trend corresponded with the trends found in an article “A Systematic Study of the Published Literature 2008-2012” (Liyanagunawardena, 2013). Furthermore, a Google Trends search on the term MOOC revealed the same trend line sharply rising in 2013 from the initial appearance of the term in April 2007 as a Google search request.

The search terms used in this literature review include:

(MOOC in Title or “Massive Open Online Course” in Title), AND
(Pedagogy in Abstract)

(MOOC in Title or “Massive Open Online Course” in Title), AND
(Video in Abstract)

(MOOC in Title or “Massive Open Online Course” in Title), AND
(Disruptive technology in Abstract)

(MOOC in Title or “Massive Open Online Course” in Title), AND
(Student debt in Abstract)

(MOOC in Title or “Massive Open Online Course” in Title), AND
(Distance education in Abstract)
What is a MOOC?

Key aspects of a MOOC were similar to traditional face-to-face courses, such as a syllabus and weekly topics, quizzes, and “the facilitation of an acknowledged expert in the field of study” (Yaeger, 2013). MOOCs depended on the social networking interactions of hundreds or thousands of students in the course and the range of prior learning and backgrounds of participants. MOOCs had no mandatory prerequisites other than Internet access and interest in the topic (McAuley, 2010).

MOOCs were highly automated and allowed for synchronous and asynchronous interactions among students, course content, and instructors (Anderson, 2012). This new form of online courses were described as a “first generation testing ground” for knowledge growth in a global digital world (UK Dept of BIS, 2013), and it was claimed that MOOCs reduced barriers to learning and increased the possibility of massive collaboration among students. The online courses offered by the three platforms were offered gratuitously along with additional services for a fee such as issuing a certificate, or taking an exam either online or proctored in-person (Pappano, 2012). These additional services were an example of unbundling where the teaching function was free, and testing and accreditation were for profit (Pappano, 2012).
Value Proposition of MOOCs

Two obstacles to higher education were cost and access, both of which were reduced by MOOCs, according to the study done by the UK Department of Education. Even so, some obstacles remained with MOOCs as participants were required to have basic competencies, specifically ICT skills and a good level of English proficiency (Fini, 2009). MOOCs in languages other than English were appearing. For example, Coursera offered 44 courses in Chinese and 21 in French as well as 10 other different languages (Coursera, 2014).

The value of a MOOC hinged on the question about the effectiveness and quality of online learning. A meta-study by the US Department of Education and another by the UK Department of Education both found that online learning was as effective as face-to-face learning (Means, 2009). The UK study suggested that a blended model may be best, combining online and face-to-face learning. MOOCs have opened the door for mature students, international students, or anyone with Internet access. The flexible access combined with mobile devices meant “Students who have children can attend class while their kids are at soccer practice or once they put the baby to sleep” (Nagel, 2011). Students who had transportation issues or who were disabled found MOOCs to be an appealing alternative that reduced commuting to class and travel across country to a campus (Nagel, 2011).

Removing the need for formal admission and the prerequisite academic background allowed courses to be sampled in a casual way so a potential student could test the waters (Voss, 2013). This opportunity to experience higher education can serve as a gateway to becoming a student and was a more inviting model in terms of ease of entry.
MOOCs can be an icebreaker to encourage more students to try before buying. In marketing terms many universities have offered introductory level MOOCs as a sort of loss leader to attract students to the campus and to promote the university brand online (Voss, 2013).

**The Political Environment**

The political environment has been positive for MOOCs. State legislators in California and Florida attempted to recognize MOOCs within each respective state university system. In California, MOOCs may help solve the waiting list of more than 472,000 of the 2.4 million students enrolled in the California Community Colleges in 2013 (Young, 2014). State legislation emerged in California granting college credit for MOOCs, but had not become law (Gillis, 2013).

Colorado has succeeded with a single computer science course from Udacity that was made eligible as a full transfer credit towards a CSU bachelor degree. In this case a proctored exam, in-person, was required at a cost of $89 (Young, 2014). Universities have begun to find effective ways of testing learning outcomes and were assessing cost saving options using MOOCs (Chen, 2012). White House advisers have pushed for accreditation flexibility allowing MOOCs to be accredited within the US university system (ecampusnews, 2013). Another political link involves Bill Bennet, the former United States Secretary of Education, who was made a member of the Udacity advisory board (Udacity, 2104).
The Economic and Social Environment

Reducing costs was important in the context of rising debt and the trend of rising costs of a university education (Slaper, 2013). According to the research, rising student debt was a growing concern posing an obstacle to higher education. MOOCs were seen by some as a way to avoid or reduce the high costs of traditional face-to-face classes (UK Dept of BIS, 2013). From the point of view of traditional universities, MOOCs competed for students and posed a potential threat to their current business model (Christensen, 2012).

Social networking was a driver in student interaction and social networks offered learning benefits, especially in a MOOC where students from different cultures interacted globally (UK Dept of BIS, 2013). The isolated nature of distance education has been offset by the use of discussion forums within each course, where students posed questions and chatted with other students. The interaction often extended outside the course discussion forum into interactions on social media sites like Facebook and Twitter. In larger urban centers, some students who were enrolled in a MOOC gathered face-to-face, using course provided links to the website Meetup.com to organize meetings (Coursera, 2014).

Social development efforts involving MOOCs have taken place on an international scale. A partnership was formed with the US Department of State, Coursera, edX, and EducationUSA to hold “MOOC Camp” events in 22 countries from Armenia to Uruguay. The Department of State had also begun to promote MOOCs at US Embassies and consulates (US Dept of State, 2014).
The Technological Environment

Global trends in ICT indicated that access to the Internet was growing and this was a driver in access to online learning and MOOCs. The trend towards mobile devices increased the flexibility in accessing course material while commuting, or in any location untethered from the desktop computer (UK Dept of BIS, 2013). In terms of the Gartner Hype Cycle, it appears MOOCs were near the “Peak of Inflated Expectations” and the hype was poised to fall into the “Trough of Disillusionment” as shown in Figure 2.

Figure 2.

Gartner Hype Cycle

At the Peak of Inflated Expectations, according to the technology consulting firm Gartner, “Early publicity produces a number of success stories—often accompanied by scores of failures” (Gartner, 2014). According to this theory MOOCs should enter a Trough of Disillusionment following the peak of hype before maturing into the Plateau of Productivity.
Another Hype Cycle mapping from Gartner that related to the potential quality of online learning was the human-computer interaction hype cycle. As humans and computers merge, the potential to engage on a deeper level rises (Kurzweil, 2005). Of particular importance to online learning was the concept of presence. Originally defined as tele-presence, it described the extent to which media can represent the world in both physical and social terms (Minksy, 1980). As illustrated in the Human-Computer Interaction Hype Cycle, in Figure 3, the quality of ‘presence’ was predicted to arrive within two years and ‘rich presence’ within 2-5 years.

**Figure 3.**
All of the Human-Computer Interaction technologies in the Gartner chart have the potential to ameliorate online learning, which depends on human-computer interaction. Artificial intelligence, such as Siri voice command in Apple products was an example of how computer interaction has become more accessible. Human to human interaction mediated by Information and Communication Technology had also become more reliable and useful in education as evidenced by the use of tools like Skype, BlackBoard, and Google Hangouts - to facilitate student interaction (Gartner, 2014).

**Business Models of the Three Platforms**

Coursera, Edx, and Udacity are all formed out of partnerships with companies, universities, non-profits, and venture capitalists. This separation from the operations of the traditional institutions allows the MOOC providers to focus on the creation and production of courses on a deeper level (Vardi, 2012). Operating outside the campus system also avoids the direct internal resistance from faculty (Anderson, 2012). Finally, the MOOC platforms allow for technical expertise in producing high quality course materials beyond what has been possible with productions made within universities themselves (Kolowich, 2013).

The question of certification and accreditation of MOOCs “beats at the heart of debates about lifelong learning, particularly in relation to non-formal and informal learning“(Marr, 2013). Accreditation of MOOCs has positioned them in direct competition with traditional universities as in the case of Udacity and Georgia Tech’s Masters in Computer Science program. The brand of each platform was influenced by partnerships with universities and corporations, and a multitude of interests are at stake including: venture capital, non-profit organizations, large corporations, and Universities.
The chart in Figure 4 outlines the scale and complexity of the partnerships that have been established.

**Figure 4.**

Source: Reproduced from [http://chronicle.com/img/photos/biz/MOOC_web_final_wheel03.png](http://chronicle.com/img/photos/biz/MOOC_web_final_wheel03.png)
Coursera

Coursera was founded in the fall of 2011 by Daphne Koller and Andrew Ng at Stanford University (Coursera, 2014). In April, 2012, Coursera announced funding of $16 million in venture capital as well as course offerings by Princeton University, Stanford University, the University of Michigan, and the University of Pennsylvania, free of charge (Coursera, 2014). In May, 2013 another 10 state university systems joined Coursera (Coursera, 2014). Huffington Post reported in an online news article from July, 2013 that Coursera enrollments had surpassed one million students. The Coursera website reported 6,411,340 students enrolled and 602 courses listed in total (Coursera, 2014).

Coursera did not produce course content; instead it provided production guidelines to universities. One unique feature of Coursera was called Signature Track, offering a course certificate and requiring student identity verification. The verification of student identity involved keystroke analysis and webcam photos during exams. Further sophisticated methods of authenticating student identity were being researched (Coursera, 2014).

The certificate issued as part of the Signature Track feature also included a course record with a public link to each student course record. This link included the course mark, completion date, and a statement of verified student identification (Coursera, 2014). The following image shows a sample certificate offered by the Coursera course on Dinosaurs from the University of Alberta. The sample certificate was shown to students to encourage them to pay for the Signature Track Option; it is reproduced in Figure 5.
Analytic data of student activity in MOOCs had also been collected for research, for example, in a Coursera based project called “LASyM: A Learning Analytics System for MOOCs” (Tabaa, 2013). The goal was to use the analytic data to optimize learning, to detect when students needed help, and to customize course material according to individuals’ learning style. The promise of intelligent learning systems capable of adjusting course delivery to fit each particular student, in response to individual course progress, had not yet materialized (Coursera, 2014).
edX

EdX was founded in May of 2012 when a joint announcement of the presidents of MIT and Harvard introduced the not for profit venture. Edx has used analytics and collected student course usage data (edX, 2014) to improve course delivery. The edX platform was funded by donors, rather than investors, as in the case of Coursera and Udacity.

In addition to the online courses, edX hosted a forum called the “X University Consortium” where 30 global institutions members discussed the subject of online learning. Many of the members of the xConsortium planned to offer courses on the edX platform (edX, 2014). The edX website contained a section of research papers on developing the MOOC pedagogy and other relevant topics. Another interesting aspect of edX was the use of open source software to develop the platform; the source code for the entire platform was made available online (edX, 2014). There were 133 courses offered on edX, in more than a dozen subject areas, all in English only.

HarvardX was a major course contributor to the edX platform. Among the xConsortium partners, HarvardX stood out as being the prototype for the edX platform (edX, 2014). An expansion of the members in edX beyond the 32 charter member organizations was announced March 6, 2014 (Newswire, 2104). The new members included a Warren Buffet backed organization called the Giving Foundation, The Linux Foundation, as well as several international partners. The Newswire article mentioned that over 100,000 certificates had been earned by edX students.
Udacity

Udacity was founded in February, 2012 by Sebastian Thrune and Peter Norvig of Stanford University. The initial Udacity course entitled “Introduction to Artificial Intelligence” had over 160,000 students from 160 countries (Udacity, 2014). Udacity created its own courses with an in-house team and strict quality guidelines (Udacity, 2014) and in some cases used a team of instructors. The instructors on Udacity were also more likely to come from industry rather than strictly from the academic world. For example, the course on web development was led by Steve Huffman, co-founder of the website Reddit.com. Another key difference between Udacity and the other two platforms was most of the courses were self-paced. Udacity offered 35 courses, all in English, mostly in the area of computer science and web development (Udacity, 2014).

Udacity courses were offered on the “Free Track” at no cost, or as a “Full Course” priced at $150 a month which included project feedback, online personal coach chat by live text, and a verified certificate. The Udacity website described the free course versus full course as “The difference between enrolling in a full course versus viewing free courseware is like the difference between attending a great class versus simply reading a textbook” (Udacity, 2014).

Udacity offered an exam proctoring service in partnership with ProctorU.com, which had a list of over 300 higher education partnering institutions (Proctoru.com, 2014). Udacity’s mission statement claimed that it was on a mission to change the future of education by bridging the gap between real-world skills, relevant education, and employment. In one experiment, Udacity provided remedial courses to students at San Jose State University for a lower price than in-person courses (Delbanco, 2013).
Other MOOC Platforms not included in this study

The number of websites offering online learning courses was difficult to determine due to the rapidly changing nature of course offerings. The websites below were potential competitors to the three platforms studied in this paper.

**American based**
- Khan academy
- Apple itunes
- Udemy
- Canvasnetworks - instructa
- Various individual free courses from university websites

**International**
- EduKart  India
- Schoo    Japan
- Iversity Germany
- OpenupEd European
- Alison    Ireland
- Veduca   Brasil
- Universite.fr France
- MiriadaX South America

**MOOCs as a Disruptive Technology**

In this section, the theory of disruptive innovation by Clayton Christensen was outlined and applied to MOOCs in the context of the higher education system (Christensen, 2011). The common features of this new category of distance education, MOOCs, were found the Coursera, EDx, and Udacity web platforms. The massiveness and openness afforded wider access to higher learning and at the same time had the potential to disrupt the traditional university system (Christensen, 2012). The highly scalable design of a MOOC reduced infrastructure costs; production costs remained almost the same whether the classes were offered to one student or to a million students (Pate, 2013). This scalability defined the massiveness of MOOCs; all three of the top
platforms were capable of delivering courses to millions of students at a very low cost per student (Pate, 2013). MOOCs benefited from positive network effects. The more students who participated in the course using discussion forums and other social media, the more value was added to the course experience (McAuley, 2010).

In defining disruptive technology, and how a MOOC fits that theory, Harvard professor Clayton Christensen explained how other lower cost services have emerged as alternatives in other markets like banking, travel agencies, accommodations, mobile telephony, stock brokering, and many others. According to Christensen, “Education has been relatively immune from such disruptive technologies perhaps because of the high cost of entrance (building campuses), the support and loyalty of alumni, government funders and the conservatism and anti-commercial culture of many academics and academic leaders” (Christensen, 2011).

Integration of MOOCs into the university system has happened in an incremental way, but a paradigm shift may occur with further unbundling of research, teaching, testing, and accreditation. Other trends in unbundling appeared, for example, in the reform from course hours as a basis, to merit-based certification of skills (Graves, 2013). By keeping credit only for students on-campus, a university maintained “the scarcity that has defined their business model by limiting access,” according the Taylor Walsh of Princeton University (Walsh, 2011). While some American universities offered "badges" or certificates of completion for MOOCs, only Colorado State University's Global Campus has agreed to provide students full transfer credit toward a CSU bachelor's degree for an introductory computer science MOOC. Students must earn a "certificate of accomplishment" from Udacity, the company supporting the course, showing that they
passed, and then pay $89 to take a proctored examination also offered by Udacity through a secure, physical testing center (Young, 2014).

The question is whether some functions can be unbundled and offered more cost effectively by outside service providers; and whether or not universities will decide or be forced to drop functions, like research, teaching, testing, and accreditation (Anderson, 2012). Competency based credentialing has been transformative, and the US Department of Education was completing a process of accommodating financial aid eligibility to competency based learning (Graves, 2013). According to C.W. Scholz, “The institutions deemed most vulnerable in this revolution are those in the middle, where costs are high but the buffers of reputation and endowments are lower” (Scholz, 2013).

Higher education may be similar to industries like music production and movies, or retail and publishing that have been forced to “drastically re-engineer their processes and products in order to survive competition from net-based alternatives.” MOOCs were considered to be an example of how the Internet has been a profoundly disruptive technology (Anderson, 2012).

**MOOC Pedagogical Elements**

First, a distinction must be made between the pedagogical structure of a cMOOC, which was based on the connectivist approach to learning and building online communities; and the pedagogical structure of the xMOOC model used by the three platforms in this study. The term MOOC in the literature usually refers to an xMOOC and will be used the same way in this paper. An xMOOC was considered as an extension of the classroom (McAuley, 2013) and used a timeline and a syllabus, broken into modules, with quizzes and exams. These online courses had links to resources and
readings, some used exercises and included simulations or other digital tools.

The pedagogy within a MOOC, in terms of learner support and resources, can be framed using an approach described in the “Rubric for Online Instruction” designed in 2009 by California State University. MOOCs provided resource links to learning material outside the course such as readings; and also had internal topic based discussion forums. Students were encouraged to contribute to and read the forum posts. MOOCs Wiki pages were also used to help organize notes on course concepts. In larger urban locations students met in-person using course links to a third party web service called Meetup.com. In some cases MOOC professors or teaching assistants were available for chat sessions on social media sites.

Online organization of MOOCs offered by the top three platforms was designed loosely around the same type of syllabus as in a traditional class. The syllabus contained modules with various sub sections and included video, text, quizzes, and in some cases automatic grading of the quizzes (Udacity, 2014). The syllabus often included problems and homework questions between modules, and the course material was able to be browsed in any order. EdX used a course presentation software application called Courseware, based on a set of MIT standards called Open Course Ware developed when MIT began posting course material online for free beginning in 2002. Instructional design and delivery of MOOCs loosely followed the traditional class where prerequisites were recommended, learning objectives and lectures were presented, then followed with testing and recall. In some cases MOOCs performed an assessment of students with tests and quizzes (Udacity, 2014).
Assessment and evaluations of student performance had been a challenge of MOOCs because of the lack of direct interaction between instructor and student. Instead, peer review of writing assignments and discussion forums with other students provided feedback on student work. Cheating was a potential trouble spot with MOOCs, but new methods of ID verification showed promise. In one system the typing pattern of students was analyzed and gave an accurate identity signature. Also webcam monitoring during exams and other methods were used to verify student identity (Anderson, 2012). In some cases, on-campus exams were used as part of MOOC accreditation (Anderson, 2012).

Innovative use of technology had been the defining factor in advancing the quality of instruction. Some uniquely digital tools were available, including a poetry annotation tool used within a MOOC, a virtual PC for a Computer Science MOOC, as well as puzzles, word clouds, simulations, interesting graphics, and a virtual laboratory. In a MOOC on the subject of design, students each submitted two photos: one example of bad design and one example of good design. The photos were shared among the class and helped to define the impact of design in the everyday lives of students (edX, 2014).

Student behavior in online courses, including how long between quiz responses, and other online activities was often collected (Tabaa, 2013). The analytic use of this student behavior online was one area of research used to improve interventions when students were seen to struggle or dropout (Tabaa, 2013). Student feedback could also be used to customize the course presentation based on each student’s needs and preferences. The potential of student data analytics was still uncertain (Kernohan, 2013).

The authenticity of remote labs and simulations for science learning has been
shown to engage learners and gave the feeling of conducting a real experiment (Sauter, 2013). When media were used to record discussions or experiments, those interactions became converted into media content (Anderson, 2012). However, when interactions were possible as part of a software simulation, the level of engagement improved (Anderson, 2012).

**Video Content in MOOCs**

Video was a critical pedagogical element of online learning, video content “addresses the importance of immediacy in distance learning” (Switzer, 2006). However, not all distance learning courses used video in the same way; and the most common downfall of video used online was to present canned lectures, made worse if the sound, lighting, and video quality were not professional (Gillespie, 1998). The online “ecology of interactions” requires fuller, more explicit instruction than traditional course material and online course design must consider how to enhance communication (Yang, 2005). The focus during course design for online learning should be on “utilizing technology to its fullest” in a way most appropriate to producing the desired learning outcomes (Gillespie, 1998).

Two traps to avoid are the “talking head” and “record the lecture live and send it out” formats in distance learning. Research has shown that these methods of instruction are not effective (Anderson, 2012). This advice has been taken to heart by edX, for example, in the Harvard course “CS50x: Introduction to Computer Science” where the video included music and an introduction featuring the Muppets (edX, 2014). Video can be used in different ways apart from a simple instructional function, including video as an introduction to the course and each module, for transitions, and to wrap up each module.
(Switzer, 2006). Many MOOCs included embedded questions and quizzes in the video content and other media such as text, screenshots, graphics, and illustrations. Video can serve as an “ice-breaker for both instructor and student” (Gibbons, Kincheloe, & Down, 1984; Sensiper, 2000).

**Secondary Effects of MOOCs**

Secondary effects may include re-use of videos and materials in a MOOC by face-to-face instructors in their own classroom, as well as the effect of having a library of current instructional resources (Stewart, 2013). Students, individually, may use MOOCs to add depth and perspective to a similar face-to-face class, as a parallel source of study material. MOOCs offered the potential to introduce people to a new digital literacy (Stewart, 2013). Other areas of the scholarly infrastructure have been transformed by technology such as the creation of JSTOR, a highly searchable electronic database of scholarly literature. This has changed the way research was done and “has had profound effects on libraries.”(Cooper 2013).

Another online format called a SPOC, or small private online class, was mentioned in the literature (Slate, 2013). A SPOC, it was noted, was another name for “hybrid” or “blended learning.” One article mentioned the success of a SPOC done in partnership with edX at San Jose State University, and that it followed a previous partnership with Udacity and San Jose State University. The resulting SPOC experienced problems with a high student failure rate (Slate, 2013).

As on-demand courses were produced and accumulated this created more available course choices at any time of year for students, similar to the long tail concept of retail (Brown, 2008). In retailing, particularly books and movies, typically 20 percent
of the titles generate 80 percent of the sales and most of the revenue comes with the best sellers. Online retail offered much cheaper costs to offer a “longer tail” of titles, beyond the popular 20 percent of titles. So too in education where traditional schools offered a finite number of courses, while the catalogue of subjects available online has grown each year and offered more choice (Brown, 2008).

**Conclusion**

MOOCs have had incremental impacts on higher learning. As accreditation increases, so does the potential to disrupt traditional colleges and universities by unbundling the functions of these institutions. Two fears were the commoditization of the teaching function; and the separation of teaching, testing, and credentialing. Furthermore, secondary effects of MOOCs have the potential to extend materials for use in face-to-face classes by professors and students. MOOCs provided an alternative place to find study materials and can augment student learning indirectly in face-to-face classes.

New pedagogical elements are emerging such as the use of analytics to detect when students need interventions, digital authentication of the identity of students, and the ability to provide individual learning paths based on student interaction. MOOCs leverage both the growth of the Internet and the trend in Information and Communication Technology towards mobile computing in order to widen access to higher education. As technology improves the quality of human-computer interaction and person-to-person communications, MOOCs could become more capable of delivering quality distant learning.

Video was the core element of content and it was used in different ways in each course. The basic method was to use video to deliver a lecture, in some cases given in
front of a room of students on a campus, but this was the least interactive method. A more interactive course design would use shorter videos to present a topic or concept, in some cases adding interactive quizzes into the video itself.

Another factor in video use within MOOCs was the production quality, ranging from amateur to professional. MOOCs have included appearances by the Muppets, shots on location in Europe, and the use of graphics to explain concepts (edX, 2014). Unique course content was found in several MOOCs, such as an interactive dinosaur bone puzzle, annotation tools, virtual computers, word clouds, and simulations.
METHODOLOGY

Research Method and Design
The design for the study outlined in this paper was based on a content analysis research method. Specifically, the intent was to catalogue the course content found in a sample of MOOCs and to generate an inventory list by browsing each course and noting the materials presented from a student participant point of view. Measurable content such as discussion board activity, the number of syllabus modules, and the number and duration of video presentations were included in the content inventory. Other observations were recorded regarding the quality of the video, number of guest speakers, number of quizzes, and various other elements of the courses. Content analysis has been defined as “The study of recorded human communications such as books, websites, paintings and laws” (Babbie, 2001).

The primary purpose of this study was to provide deeper understanding of the types of courses being offered by MOOCs, and the course presentation used on each platform as found during the period of study. The data collected was analyzed for common themes among the three platforms. A descriptive research method used survey questions to collect MOOC content data that was used to make observations rather than to draw conclusions or make suppositions about possible relationships. Future research may be supported by the findings and observations from this study. Furthermore, teachers, professors, universities, and other stakeholders may benefit from the study. The information collected may allow researchers to add to the observations or to draw
conclusions in future planning and development of online courses or as a historic reference point to this rapidly changing phenomenon in online education.

**Data Collection Instrument**

A survey was developed to measure the pedagogical elements of each course. A total of 69 questions were created, of which 49 had a descriptive response and 20 had a numeric response (Appendix A). The descriptive questions were primarily close ended. Data collection for the study was completed using a Google Docs Spreadsheet. This collection instrument was easy to access from various computers and the data was backed up automatically every few seconds. The spreadsheet allowed the analysis of the data using the built in functions. One researcher collected all the data to ensure the consistency of interpretation.

The collection of data was from the perspective of a student enrolled in a course. A user account for each of the three platforms was created and enrollment in the courses began in January, 2014. Edx had six MOOCs open for enrollment, Udacity had eight, and Coursera had 34 open for enrollment. Based on the limit of six on offer at edX at the point of time of this study, a sample size of six courses per platform was used for each platform, yielding a total sampling size of 18 courses. The six courses were selected by choosing the widest array of subject areas offered on each platform. The three platforms were chosen based on peer reviewed academic articles that declared them to be the leading three MOOC platforms (Pappano, 2012).

**Survey Development**

The survey questions were descriptive and generated by browsing the course content. For example, when a new course element presented itself, a new question was
created to account for that element across all eighteen MOOCs. The survey questions reflected the content of the courses by encountering and listing the elements as each course was traversed. The first section of survey questions, numbered one to fourteen, was comprised of descriptive questions related to course name, duration in days, and other course attributes. This included whether prerequisites were indicated, the estimated workload stated in the course outline, and if a paid option was offered.

Survey questions 15 to 25 were related to the video content, number of videos, duration of each video, and if interactive elements such as quizzes were used with the video content. This section included a question rating the production values and quality of the video on a scale from one to five, followed by an open-ended question asking for examples of the quality. The intent of this section was to discover if the results, when analyzed, would show if platform related themes emerged in the way video was presented.

The researcher did not closely watch the 1492 hours of video, but did watch the first hour of each course. In order to record video durations for the 3175 video clips, each clip was loaded into the web page to reveal the playing time. As a result, the first seconds of each clip were also viewed during the survey of the video content. The final section of survey questions, 26 to 69, consisted of more course description questions, including discussion forum and social media participation numbers, certification options, and other descriptive observations of elements of each course.

Data Collection

The survey questions were developed after enrolling in the 18 MOOC offerings and exploring the course descriptions of each one. The student accounts were created on
Coursera.org, edX, and Udacity using kewilliams@upei.ca as the user ID. The questions reflected the available information presented in the course outlines. Next, the video from several of the courses was observed and additional questions were generated based on the attributes discovered within the video content. A third section of questions focused on the course materials contained in each course.

A Google Docs Spreadsheet was created and one question per line was entered with columns for each of the 18 courses responses. A second worksheet was used to record the video clip durations, and to calculate the total clip counts per course, as well as averages. Graphs were generated based on the survey question spreadsheet data; and were included in the analysis. Many of the questions had a yes/no response, a specific quantity, or, in a few cases, a descriptive response. The questions were applied to the first course, Introduction to Astronomy on Coursera, and that iteration resulted in the generation of new survey questions to better fit the course elements as they appeared when traversing thorough the course content. Subsequent questions were generated throughout the survey of the courses, and then applied back to the other courses to create an inventory.

The researcher took great care to accurately record the duration of each video, and in the collection of all the survey data, in order to support the integrity of the data and the research project. When duplicate video durations were recorded in sequence, a verification check was made to ensure repeat viewing of the same video did not occur. When rating the production quality of the videos, details were recorded to justify the rating. The rating, on a scale of one to five, was by default scored at three unless a notably positive or negative element was used in the video. Each positive or negative
aspect was noted and used to increment or decrement the rating. Care was taken to record
the date when data collection occurred, and the survey was conducted online. Finally the
researcher reviewed and completed all surveys within a thirty day period, in order to
support consistency in the responses that were entered manually for each question.

**Data Analysis**

The survey design and data collected from the 18 massive open online courses
was intended to address the research questions posed in this paper. An overview of the
analysis phases and the relevance to each of the three research questions is outlined
below. To enumerate the course elements a list of questions was generated by first
traversing the course materials and creating questions as elements were discovered. These
questions were then applied to each course as an inventory of individual course elements.
Analysis of the data collected resulted in ranking each content element from those found
to be present in all 18 courses, to those elements unique to only a particular course.

**Research Question 1**

The first part of the analysis looked at the course elements present in the courses.
This gave information to answer the first research question. The specific question asked,
*What pedagogical/media elements are utilized within the Coursera, edX, Udacity MOOC
platforms in January/February 2014?*

Questions were added to include an exhaustive list of course content items and
any quantitative values associated with them, for example a syllabus was found in each
course and the number of modules in each course syllabus was recorded as well. Many of
the questions were yes/no as to the presence of a course element. The information
collected in the first part was analyzed by each element listed for frequency of occurrence
and then summed for each platform. In some cases, an element was unique to a specific platform in six out of six courses sampled and not present in the other platforms. For example, Coursera displayed a Twitter re-tweet count for each course, while neither edX nor Udacity provided that information. The social media counts provided a particular measurement indicating the popularity of a course on each social media site.

Research Question 2

The second research question, How is video content used in MOOCs? was approached by collecting the duration of each video presented in each course. The analysis included commentary on the video usage, observing if the video was used to deliver a lecture or used in a more granular fashion with video clips to introduce a concept, pose a question, and then answer the question. Other aspects of the video were noted, such as the integration of interactive quiz questions into the video content and also if the videos were downloadable for offline viewing.

A subjective question about the production quality of the video scored from one (worst) to five (best) and defaulted to score of three. A second question noted the exceptional aspects of the video behind the scoring. For example, one video was shot on location in a way relevant to the course and this incremented the score of that video’s quality by one. In another video, a poor quality of audio reduced the score by one from a three to a two.

Research Question 3

The third and final research question was: What uniquely online elements are found in MOOCs? This was examined by noting any course items found that were in a digital format and were not typically part of a face-to-face classroom. The items noted
included: a set of interactive puzzles to assemble dinosaur bones in the correct anatomical order, an online poetry annotation tool, and a virtual computer preconfigured with course tools among others. Word clouds were another unique element used. This was a discovery question, to document uniquely online course elements in the interest of future studies.

The research questions will provide a view at one point in time of the evolution of MOOCs that may be used as a reference in the future - as a benchmark. The study results will be made available to stakeholders for consideration when planning for the development of a MOOC, how they might be integrated into current education strategy, or for other studies in this subject area.
RESULTS

The purpose of this study is to provide deeper understanding of the types of courses being offered by MOOCs, and the course presentation used on each platform as found during the period of study. The process of identifying the course content and how they compare among platforms, especially the use of video content, will contribute to the research that has already been done. The results may also give online course producers, universities, and other stakeholders some useful insights when considering future instructional design, and could provide a reference point to future studies in this area.

To address the research questions, a survey was developed using a Google Docs Spreadsheet to collect the data. Data was collected between January 2, 2014 and February 28, 2014. The survey was used to collect data from six courses on each of the three platforms for a total of eighteen courses, including logging 2,969 video clip durations.

The results section of this paper is divided into three sections; each section addresses the following three research questions:

1. What are the pedagogical/media elements utilized within the Coursera, edX, Udacity MOOC platforms in January/February 2014?
2. How is video content used in MOOCs?
3. What uniquely online elements are found in MOOCs?

Research Question 1

The first research question was aimed at describing the course content found in eighteen MOOCs during the time period from January, 2014 to February, 2014. The first six survey questions described general information about each course including the
course title, date offered, platform name, professor name, and if the course identified as being associated with a university. Other initial survey questions included the date the course was offered, how many days duration, and other general information about each course. This general information provided the basis for all analysis and is shown in Figure 6.

**Figure 6. List of 18 Massive Open Online Courses in this study**

<table>
<thead>
<tr>
<th>PLATFORM</th>
<th>COURSE NAME</th>
<th>SCHOOL AFFILIATION</th>
<th>DATE OFFERED</th>
<th>DURATION IN DAYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coursera</td>
<td>Introduction to Astronomy</td>
<td>Duke University</td>
<td>December 2, 2013</td>
<td>77</td>
</tr>
<tr>
<td>Coursera</td>
<td>Creative, Serious and Playful Science of Android Apps</td>
<td>University of Illinois at Urbana-Champaign</td>
<td>December 2, 2013</td>
<td>70</td>
</tr>
<tr>
<td>Coursera</td>
<td>Constitutional Struggles in the Muslim World</td>
<td>University of Copenhagen</td>
<td>December 2, 2013</td>
<td>70</td>
</tr>
<tr>
<td>Coursera</td>
<td>Information Security and Risk Management in Context</td>
<td>University of Washington</td>
<td>December 11, 2013</td>
<td></td>
</tr>
<tr>
<td>Coursera</td>
<td>Dino 101: Dinosaur Paleobiology</td>
<td>University of Alberta</td>
<td>January 6, 2014</td>
<td>63</td>
</tr>
<tr>
<td>Coursera</td>
<td>Linear Circuits</td>
<td>Georgia Institute of Technology</td>
<td>January 6, 2014</td>
<td>28</td>
</tr>
<tr>
<td>EdX</td>
<td>AI12.1x Poetry in America: The Poetry of Early New England</td>
<td>Harvard University</td>
<td>October 31, 2013</td>
<td>56</td>
</tr>
<tr>
<td>Platform</td>
<td>Course Title</td>
<td>Institution</td>
<td>Start Date</td>
<td>Duration</td>
</tr>
<tr>
<td>----------</td>
<td>--------------</td>
<td>-------------</td>
<td>------------</td>
<td>----------</td>
</tr>
<tr>
<td>EdX</td>
<td>AI12.2x Poetry in America: Whitman</td>
<td>Harvard University</td>
<td>January 15, 2014</td>
<td>70</td>
</tr>
<tr>
<td>EdX</td>
<td>CS50x Introduction to Computer Science</td>
<td>Harvard University</td>
<td>January 1, 2014</td>
<td>35</td>
</tr>
<tr>
<td>EdX</td>
<td>HDS1544.1x The Letters of the Apostle Paul</td>
<td>Harvard University</td>
<td>June 1, 2014</td>
<td>16</td>
</tr>
<tr>
<td>EdX</td>
<td>MCB80.1x Fundamentals of Neuroscience, Part 1: The Electrical Properties of the Neuron</td>
<td>Harvard University</td>
<td>November 4, 2013</td>
<td>35</td>
</tr>
<tr>
<td>EdX</td>
<td>PH201x Health and Society</td>
<td>Harvard University</td>
<td>November 12, 2013</td>
<td>56</td>
</tr>
<tr>
<td>Udacity</td>
<td>Introduction to the Design of Everyday Things</td>
<td>NA</td>
<td>on-demand</td>
<td>5</td>
</tr>
<tr>
<td>Udacity</td>
<td>Tales from the Genome</td>
<td>NA</td>
<td>on-demand</td>
<td>NA</td>
</tr>
<tr>
<td>Udacity</td>
<td>Introduction to Physics</td>
<td>NA</td>
<td>on-demand</td>
<td>NA</td>
</tr>
<tr>
<td>Udacity</td>
<td>Introduction to Programming</td>
<td>University of Virginia</td>
<td>on-demand</td>
<td>NA</td>
</tr>
<tr>
<td>Udacity</td>
<td>Web Development</td>
<td>NA</td>
<td>on-demand</td>
<td>21</td>
</tr>
<tr>
<td>Udacity</td>
<td>How to Build a Startup</td>
<td>NA</td>
<td>on-demand</td>
<td>NA</td>
</tr>
</tbody>
</table>

It can be seen from Figure 6 that the Udacity courses had two unique differences
from Coursera and edX. The first was that five out of the six Udacity courses examined had no university affiliation, in contrast to the other twelve courses from Coursera and edX that all declared an affiliation. In the case of edX all six courses were affiliated with Harvard University, even though Harvard was not an exclusive partner of edX. The second observation was that only the Udacity platform offered courses on-demand without deadlines or a concurrent face-to-face counterpart course. The other MOOCs studied were scheduled with a start date and ran concurrent with a face-to-face class on-campus. The Udacity course durations varied from five days to 84 days, as described in the course syllabus. Udacity differed from the other platforms in that four of the Udacity courses did not list a timeline in the syllabus, but instead indicated they were intended to be self paced.

This study reviewed the course elements found within the platform websites for each of the 18 courses, and in some cases where course content was located on social media or other websites linked to the course. In Figure 7, the course elements found to be present in all eighteen courses were listed first, then in descending order according to the number of courses using the element.

**Figure 7. Course content found in the 18 courses in the study**

<table>
<thead>
<tr>
<th>Presented in English?</th>
<th>All 18 courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free of charge?</td>
<td>All 18 courses</td>
</tr>
<tr>
<td>Online Quizzes?</td>
<td>All 18 courses</td>
</tr>
<tr>
<td>Syllabus</td>
<td>All 18 courses</td>
</tr>
</tbody>
</table>
A syllabus was one of the common course elements found in all 18 MOOCs, with

<table>
<thead>
<tr>
<th>Feature</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link to other online learning resources?</td>
<td>All 18 courses</td>
</tr>
<tr>
<td>Email used?</td>
<td>All 18 courses</td>
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<tr>
<td>Videos?</td>
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<tr>
<td>Online Discussion Forum?</td>
<td>All 18 courses</td>
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<tr>
<td>Intro/orientation video?</td>
<td>14</td>
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<tr>
<td>Quizzes embedded in course videos?</td>
<td>12</td>
</tr>
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<td>Other downloadable course files?</td>
<td>11</td>
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<tr>
<td>Wiki used for course information?</td>
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<td>Guest speakers?</td>
<td>7</td>
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<td>Assigned readings?</td>
<td>6</td>
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<td>Homework assignments?</td>
<td>6</td>
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<td>Certificate given?</td>
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<td>Exam?</td>
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<td>Voice over slides?</td>
<td>4</td>
</tr>
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<td>Major Project?</td>
<td>3</td>
</tr>
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<td>Peer graded assessments?</td>
<td>3</td>
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</tbody>
</table>
the structure of the courses based on sections within the syllabus. The website design was organized in syllabus sections. In all the MOOCs there were tabs to navigate through the sections and subsections of each course. Each of these sections contained videos, notes, links, quiz questions, and sometimes end of section problem sets. Another element consistently used in all 18 courses was a discussion forum, giving students a chance to pose open questions, and to comment on concepts from the course.

One limitation in measuring the activity of the discussion forum was the inconsistent design of each course discussion forum, some of which were moderated by teaching assistants. The topics posted were ranked in differing ways:

1) Using number of topic views
2) Using number of comments per topic
3) Using the number of likes per topic

Due to these different topic rankings, accurate course comparisons were not possible among courses that used different ranking systems. The ranking systems were largely consistent on each platform, making possible a comparison of the discussion forum activity within each platform. The exceptions were a few courses that opted out of the platform discussion system, and instead used third party websites for discussion forums. The courses that used third party websites for discussion forum activity could not be accurately compared with any of the other courses - because different forum activity measurements were presented.

Discussion forum metrics were collected from each course, but in some courses the discussion numbers were expressed on a different basis using different metrics. For example “Forum discussion threads” was only presented in three courses, while “Top
thread views” was presented in fifteen out of eighteen courses. The discussion forum was hosted within each platform, except for one edX course entitled “CS50: Introduction to Computer Science” because CS50 used an external discussion forum hosted on reddit.com. Since each platform had used different discussion forum formats, difficulty arose when comparing across platforms.

The range of “Top thread views” ran from 287 in the edX course *Poetry in America: Whitman*, up to 52,700 in the Udacity course *Introduction to Programming*. The viewing ratings were observed to be highest across Udacity discussion groups and lowest in the edX discussion groups, but since the discussion forums were structured differently no specific comparisons are valid. Other factors confounding the comparison were that each course was in a different stage of completion, each course was of a different duration, and in the case of Udacity the “on-demand” courses had more time to collect views. The numbers showed that online discussions were an active part of the MOOC course experience.

Email was used in various ways, but the most common function was to welcome students to the course. Other common email uses were to make announcements of the progress of the course, when new materials had been posted, or when deadlines loomed. The exception to this announcement email pattern was the Udacity platform because it had no group deadlines since most of the courses were self paced. Email was used by Udacity most often to announce new discussion forum activity.

Videos were used in all 18 MOOCs, but not in the same way. In some cases video was used to introduce a section of the course, to give a general course overview or to describe the way the course would progress. Lectures were presented in the videos, in
some cases very short lecture clips and other cases longer lectures. The video sometimes used embedded quiz questions, and would pause for the response from the student. More in depth analysis of the video use is included in the next section (research question 2).

A wiki is a web application used to allow people to read, edit, and add to content in collaboration. A wiki was used in eight of the eighteen courses, but in a few cases wikis were only used lightly, as in Poetry in America: Whitman from edX where the wiki had no activity. On the other hand, the wiki was a central part of the course, Tales from the Genome, on Udacity.com used to reference much of the course content including the syllabus, a master vocabulary, and other resources.

Guest speakers appeared in seven of the eighteen courses in this study. Many courses had more than one guest speaker and most often the speaker was an expert and spoke about the area of their expertise. In Tales from the Genome, on Udacity.com, several guests were interviewed as representatives of genetic traits including a set of twins, a red haired person, and a lactose intolerant person. The edX courses in the study used guest speakers more often compared to the other two platforms.

Certificates were a course element included in some courses but not others. One example was the certificate from Dino 101: Intro to Paleobiology, on Coursera. Two paid options from Coursera were offered: Coursera’s Signature Track option for $60 or the ability to take two proctored exams on the campus of the University of Alberta for a course credit for $316. Some courses offered certificates signed by the professor for a fee, or a certificate from the platform such as included in the Signature Track on Coursera, for a fee.

One example of peer reviewed work from the Design of Everyday Things, on
edX, had an assignment requesting two photographs from participants – one of a poorly designed object in their life, and one of a well designed object. The results were then available to view by all participants and open to comments from the class. This allowed a peer review element in terms of feedback from comments; and also allowed the theme of “good versus bad design” to be explored as a group. Another edX course, entitled Health & Society, also used photo submissions from participants to be reviewed by the class.

Textbooks were not used in all eighteen MOOCs - neither in printed or in digital form. Instead, many of the diagrams and illustrations typically found in a textbook were found integrated throughout the video content. Problem sets and questions were integrated into the course content rather than at the end of a text chapter. The syllabus ordered each course by sections, in a similar way as a textbook - with chapters, and with the problem sets and questions often appearing at the end of each section. None of the courses studied indicated the need for purchasing a printed textbook. That textbook cost was avoided in the MOOCs included in this study.

EdX included course enrollment numbers for two of the courses, which can be compared to the only other platform that presented course enrollment numbers, Udacity. The edX enrollment numbers are about 10 times less than the six reported by Udacity, and in one case about 100 times less as shown in Figure 8. Comparison of enrollment numbers was further confounded by the ‘on-demand’ Udacity courses that continued to accumulate enrollments, unlike Coursera and edX courses that halted enrollments at the conclusion of the course.

Figure 8. Comparison of Course Enrollment Numbers*
Research Question 2

Video content composed the majority of all content in each course and was fundamental to the design and delivery. The use of video in the courses studied varied in several ways, beginning with the total duration in minutes of video used in each course. Since the limitations of a semester schedule were not imposed on MOOCs, they were free to be presented in longer and shorter formats. The shortest course was *Introduction to the Design of Everyday Things* from Udacity, it contained only one hour and thirty-eight minutes of video content. Udacity also presented the course with the longest duration of
video content in this study at 16 hours and twenty-two minutes, a MOOC entitled *Tales from the Genome*. The average video duration of each set of six courses by platform, expressed in minutes, was:

**Average duration in minutes of video content by platform**

- 490 minutes average per course for the six Coursera courses.
- 471 minutes average per course for the six edX courses.
- 530 minutes average per course for the six Udacity courses.

The Coursera and edX courses contained very similar video content in terms of duration. The Udacity courses were about 15 percent longer in total video duration. The average duration of video presented in each of the 18 courses was 487 minutes (eight hours and seven minutes). The quantity of video content did not reveal any significant differences among the three platforms. The comparisons were also dependent on the course length and the nature of the video presented. Figure 9 compares the duration of video content among the 18 MOOCs.
The use of video in each course varied widely in terms of the number of video clips included in each course. At the low end, a course entitled *Poetry in America: Whitman* had only 26 video clips; at the other extreme, a course entitled *Tales From The Genome* presented 654 video clips. It was observed that the six courses from Udacity used more than 200 video clips per course indicating a different style of presentation compared to Coursera and edX courses where less than 100 video clips per course were presented, as seen in Figure 10.
Except for three courses, found in the middle of the pack, the courses tended to use either a few video clips of long duration or else they used hundreds of very short clips. The average video clips used per course for each platform were for Coursera 47, edX 68, and Udacity 413. The Udacity platform had very short video clips in all six courses studied and stood apart from Coursera and edX in this aspect of course design. The Udacity format of short clips required more student interaction in order to progress through the course, since each clip required a mouse click to proceed. Also, the presentation rhythm of Udacity courses tended to follow a repeating cycle of:

1) A short video clip explaining a concept
2) A short video clip posing a question about the concept
3) An embedded multiple choice response
4) A short video clip with the correct answer
5) Repeat to step 1)

In the Coursera and edX courses the videos were more often a lecture or mini lecture from a professor. The resulting video clips tended to have longer durations, as Figure 11 indicates. The average video clip duration for each platform was: Coursera 13:96, edX 9:40, and Udacity 1:36 expressed in minutes and seconds.

Figure 11. Bar Graph Comparing Duration of Video Clips from each Course

Video production value rankings were based on lighting, sound, and graphics. In some cases an entertainment factor was found, for example, in CS50: Introduction to Computer Science, Muppets along with dancing presenters gave a look and feel similar to Sesame Street (entertaining and informative). The video player in many of the courses
allowed playback to be faster or slower, so if a student found the professor talked too fast, the speed of the video delivery could be adjusted. The video also included quiz questions embedded within the video player and multiple choice response choices.

**Research Question 3**

The HarvardX MOOC from edX, *AI2.2x Poetry in America: Whitman*, used a poetry annotation tool; this permitted any student to create notes on the poems in the course. These notes were shared with the class, resulting in observations about each word, line, or stanza as to the structure and meaning. The annotation tool faced several technical problems where some students’ annotations were lost at one point during the course, but apart from the glitches, the annotation tool provided interesting group interactions and was an effective way to share insights.

Another annotation tool called Poetry Genius Tool, was used for *The Letters of Paul* MOOC on edX. The poems in the syllabus could be marked up, line by line, with student’s notes. The notes could then be viewed by all students in the class. The professor included dozens of poems in the course and gave specific instructions on how to annotate the poem, for example, looking for structure in the poem and themes or other poetic devices.

Word clouds, a visual map created from transforming a body of text into a graphic image, appeared in a few MOOCs. The resulting image conveyed a sense of the importance of each word based on the frequency of use within the text. Figure 12 shows an example of a word cloud, created with the free website service of [www.wordle.net](http://www.wordle.net), based on the text of this article itself – from the Methodology section.
An example of a course that used a word cloud was *Tales from the Genome*, on the Udacity web platform. Within a discussion about genetic traits, students were asked to submit five words about how they would describe themselves. The students’ words were combined and then used to generate a word cloud to reflect back the results to all the course participants. This provided an interactive method of rapidly compiling a large number of responses into a graphic, the word cloud, to use as a discussion point. Word clouds provided a tool to interact with a very large group to provide a quick summarized response from across the entire group.

A puzzle was used to learn the anatomy of several species of dinosaurs in the *Dino 101: Dinosaur Paleobiology* MOOC on the Coursera.org web platform. Course participants were presented with a graphic puzzle, and had to drag and drop using their
mouse pointer to assemble a set of disjointed bones into the proper anatomically correct form. When closely oriented into the correct position, each bone snapped into place then the next piece of the puzzle would be attempted until the entire skeleton was built. Interactive puzzles showed a new way to engage learners not typically found in the traditional face-to-face classroom.

A virtual computer preconfigured with course tools was used in the edX course, *CS50x: Introduction to Computer Science*. The virtual computer used a free hypervisor platform called VMware, downloaded by participants. The virtual computer, referred to as the “appliance” within the course, was downloaded and then ran in the VMware program. The appliance was preconfigured with the course tools used to code and compile assignments in the course, and was also capable of collecting and communicating student data back to the edX website periodically. The Udacity course *Introduction to Programming* used the BlueJ coding environment (Bluej website, 2014), a free downloadable software development tool designed for teaching programming in Java. The BlueJ tool was created in 1999 by a PhD student in Australia and then subsequently funded by Sun Microsystems to promote the teaching of Java programming.

Meetings in-person, called meetups, were organized by course participants and occurred most often in larger cities like Boston or Toronto, according to statistics from the Coursera.org website. A third party website called Meetup.com was used by all three platforms to organize student meeting in-person. This was unique to MOOCs and afforded the same face-to-face interaction that classrooms provide, restoring the face-to-face component missing from online education. In less populated regions meetups did not
happen. For example, in the Maritime Provinces, Halifax was one of the few places listed in Meetup.com as having any activity.

CONCLUSION
The growing media coverage of MOOCs and the potential of online learning being offered for free by prestigious universities was the catalyst for this research. As a result, the study investigated the course content found in MOOCs in an attempt to understand what sets them apart from other online learning formats. The role played by the web platforms was another area of interest, more specifically, what differences might be found among the three platforms in terms of course content. The review provided a glimpse into MOOC offerings from Coursera, edX, and Udacity at one point in time, in a way that did not appear to have been previously examined. The results of this study will be available to stakeholders to gain deeper insights into the design, integration, and planning of future education programs.

Research Question 1

Research question one asked, “What pedagogical/media elements are utilized within the Coursera, edX, Udacity MOOC platforms in January/February 2014?”

The results of this study provided the following answers relevant to question one:

The following elements were found present in all 18 MOOCs:

- Syllabus based sections
- Free option
- Online Quizzes
- Links to other online learning resources
- Email
- Video clips
- Online Discussion Forums
Other course elements were present only in some of the 18 MOOCs:

- 14 included Introduction video
- 12 embedded quizzes into video content
- 11 provided other downloadable course files
- 8 used wiki for course information
- 7 included guest speakers
- 6 included assigned readings
- 6 included homework assignments
- 6 included a certificate option
- 4 included an exam
- 4 used voice over slides
- 3 had a major project
- 3 used peer graded assignments

Udacity stood out from the other two platforms in the following ways:

- Most of the Udacity courses were self paced and available on-demand, unlike the Coursera and edX courses that had a start date and a schedule.
- Udacity had industry leaders leading courses in five out of six courses, Coursera and edX used university professors to lead courses.

**Research Question 2**

The second research question, *How is video content used in MOOCs?* was approached by collecting the duration of each video presented in each course.

All three platforms had similar levels of video content:
• 490 minutes average per course for the six Coursera courses
• 471 minutes average per course for the six edX courses
• 530 minutes average per course for the six Udacity courses

Overall average of duration of video content in all 18 courses was 487 minutes, or 8 hours and 7 minutes.

The average video clip duration, in minutes, for each platform was:

• Coursera  13:96 minutes
• edX       9:40 minutes
• Udacity   1:36 minutes

Udacity stood out from the other platforms in several ways:

• Udacity courses used numerous short video clips (average of 413 clips per course), whereas Coursera and edX used fewer clips of longer duration (average of 47 clips per course for Coursera, 68 for edX).
• Udacity’s short video clips tended to follow a cycle of:
  ▪ Present a concept
  ▪ Pose a question about it with embedded quiz question
  ▪ Answer the question
  ▪ Repeat
• Udacity offered the shortest and longest courses, unlike Coursera and edX
that had courses of roughly the same duration (in terms of video content hours).

- The video production in some courses included an entertainment factor:
  - Muppets
  - Dancing
  - Outdoor and foreign locations
  - Props
  - Graphics
- The video player allowed for slower or faster playback
- The video content was often available to download for offline use
- Subtitles were available in a few courses

**Research Question 3**

The third and final research question was: *What uniquely online elements are found in MOOCs?* This was examined by noting any course items found that were in a digital format and were not typically part of a face-to-face classroom.

Unique course elements found in some of the 18 MOOCs include:

- Two different online poetry annotation tools
- Word clouds used to summarize group responses
- Interactive puzzles to learn anatomy of dinosaurs
- Virtual computer preconfigured for a computer science course
- Meetings in-person using Meetup.com

**Observations**
A review of the literature relating to MOOCs showed that this new form of online learning had the support of prestigious institutions such as Harvard University and Stanford University, who have formed partnerships with the web based platforms Coursera, edX, and Udacity. The research also suggested the partnerships allowed innovation beyond what was possible within the university institutions. The platforms created a new group culture more like a startup organization while avoiding resistance from operating within the established institutions. Furthermore the MOOC platforms had the potential to disrupt the current business models of traditional universities especially at the less prestigious end of the spectrum. Harvard professor Clayton Christensen notes that this was a rare case of disruptive innovation being led by the current market leaders.

The research indicated the appeal of MOOCs resulted from the free or low cost, the convenience they offer, and the open access allowing anyone with Internet access to enroll in a MOOC. The high quality of the course materials was another key factor adding to the popularity of MOOCs. A meta-study by the US Department of Education stated the effectiveness of online learning was equal to or greater than face-to-face classes. The research showed accreditation of individual MOOCs had occurred in several university systems and also that a complete program offering a masters degree in computer science had been offered in partnership with Georgia Tech.

The popular press reported that MOOC enrollments had increased and that millions of students had enrolled in various MOOCs. Deloitte Technology Predictions called for MOOCs to become even more popular in 2014. The popular press had also reported MOOCs have had financial impacts in the area of corporate training and professional development.
This study provides a detailed examination of the course element found in the web platforms Coursera, edX, and Udacity. The results of this study showed that the sample of 18 MOOCs shared common course elements: a syllabus, video lectures, quizzes, online discussion forums, and email. A closer look at the video elements used in the 18 MOOCs studied revealed a different instructional design by Udacity in comparison with the other two platforms. Udacity also differed from Coursera and edX in other ways such as not using university professors exclusively to present courses. Unlike Coursera and edX, Udacity did not always have a course affiliation with a university. The 18 MOOCs included in this study showed Udacity tended to be more aligned with industry - and used presenters from the private sector rather than professors.

One interesting observation was the findings on course elements used in MOOCs that were not usually part of a face-to-face classroom course. These uniquely digital course elements included virtual computers preconfigured for coursework, visual simulations and puzzles, online annotation tools that shared group work, and computer evaluated quizzes. It was also noted that some course functions were unbundled, whereby certain processes such as proctoring of examinations were provided by third party sources.

**Practical Implications**

Analysis of the findings from this study may offer practical information to stakeholders in higher education who are designing MOOCs, or any other online course. Gaining an improved understanding of how MOOCs were designed may give insights into how traditional universities could develop their own MOOC strategies. Additionally, this understanding may demonstrate ways in which online learning can be used to
enhance current programs to reach more students; or to accommodate MOOC credits within current programs. The results may be interesting to various other stakeholders such as students, policy makers, and corporate training and development organizations.

The study provides potentially pertinent information regarding the instructional design of MOOCs and could be used to establish parameters in the instructional design of any course. The information may help identify design trends among MOOCs; as well as differences between the MOOC web platforms. Understanding the approaches taken by Coursera, edX, and Udacity could factor into a plan to partner with one of the platforms from the point of view of a not for profit organization, investor, or university. Finally, academic institutions might gain a new perspective and richer understanding of what MOOCs have to offer and why they might be an important force to consider in future planning.

Future Research

As Information and Communication Technology continues to improve and facilitate access to information, online learning may have a stronger chance of being an even more effective means of reaching students. As technology evolves, future studies could examine the evolution of online learning by looking at the new methods that evolve to educate students. In particular, a future content analysis of online courses could be conducted to extend the methods used in this study and provide a longitudinal comparison.

Other studies of MOOCs could also focus on student demographics, student experiences as MOOC participants, and whether or not MOOCs are more effective in some subject areas than others. For example, computer science seemed to be a better fit
for online course delivery when compared to other course subject areas. Another question of interest might be to investigate the best way to integrate MOOCs into a course program. Finally, since the aim of this study was to gain a better understanding of MOOCs, it would be beneficial to include more MOOCs from other web platforms, and in other languages, to allow a broader global view of MOOC course content.

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Content analysis of Coursera, edX, and Udacity course platforms

2014


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Appendix A – MOOC Content Analysis Survey
1. Platform Name?
2. Course name?
3. Date collected?
4. Course Description?
5. Instructor Name?
6. University associated?
7. Date offered?
8. Duration in days?
9. Language presented?
10. Workload estimate hrs/week?
11. Prerequisites declared?
12. Prerequisites required?
13. Free of charge?
14. Paid option?
15. Intro/orientation Video?
16. Duration of Intro Video?
17. Number of video clips?
18. Duration of each video clip?
19. Total duration of video clips?
20. Format of video clips?
Production quality of video (lighting,

21. sound, presenter engaging (scale 1-5)

22. Examples of video production quality?

23. Videos of quiz answers explained?

24. Quizzes embedded in video?

26. Downloadable audio?

27. Downloadable transcript?

28. Downloadable slides?

25. Downloadable video?

29. Online Quizzes?

30. Assigned readings?

31. Syllabus included in course?

32. Number of syllabus sections/lessons?

33. Exam in course?

34. Project competition?

35. Homework assignments?

36. Major Project?

37. Peer graded assessments?

38. Link to other online learning resources?

39. Number of guest speakers?

40. Voice over slides?

41. Other downloadable course files?
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64. Facebook group links?
65. Google+ group links?
66. Twitter group links?
67. Course survey given?
68. Course survey results available?
69. Number of students enrolled?