COLUMBIA CNMTL
CENTER FOR NEW MEDIA TEACHING AND LEARNING

The First Year of MOOCs at Columbia University: 2013

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I. Columbia University's First Year of MOOCs

On November 5, 2012, Columbia University and Coursera signed an agreement to deliver massive open online courses (MOOCs) to the world. While experimentation with online education has been going on at Columbia University for decades, the University's exploration of MOOCs began with courses launched in February 2013, and by calendar year's end, Columbia had released and completed eight courses on the Coursera platform. This statistical summary is for those eight 2013 courses involving seven faculty from four schools at Columbia and assisted by numerous educational technologists and media and technology experts at the Columbia Center for New Media Teaching and Learning (CCNMTL), Columbia Video Network (CVN), and beyond.

The Coursera MOOC Platform
Coursera provides Columbia and all partners with a portal to display course offerings (Fig. 1). University staff are responsible for course pages, branding, and managing faculty roles and permissions. Course pages contain course catalog information including a course description, a syllabus, FAQs, course prerequisites, and a promotional video. Session sites contain the course content including the lecture videos, quizzes, surveys, discussion forums, and all other material created for the course. Each course can have only one course page but can have multiple session sites, one for each time the course is offered.

At Columbia, educational technologists, videographers, and staff administrators have teamed with faculty and teaching assistants to design and run the session sites. Faculty in various schools across campus have enlisted the assis-

tance of CCNMTL's staff to assist in the design and implementation of courses. Faculty from the School of Engineering have enlisted the assistance of the Columbia Video Network to provide support and technical expertise. Barnard Professor Perry Mehrling's course was funded and supported by the Institute for New Economic Thinking (INET).

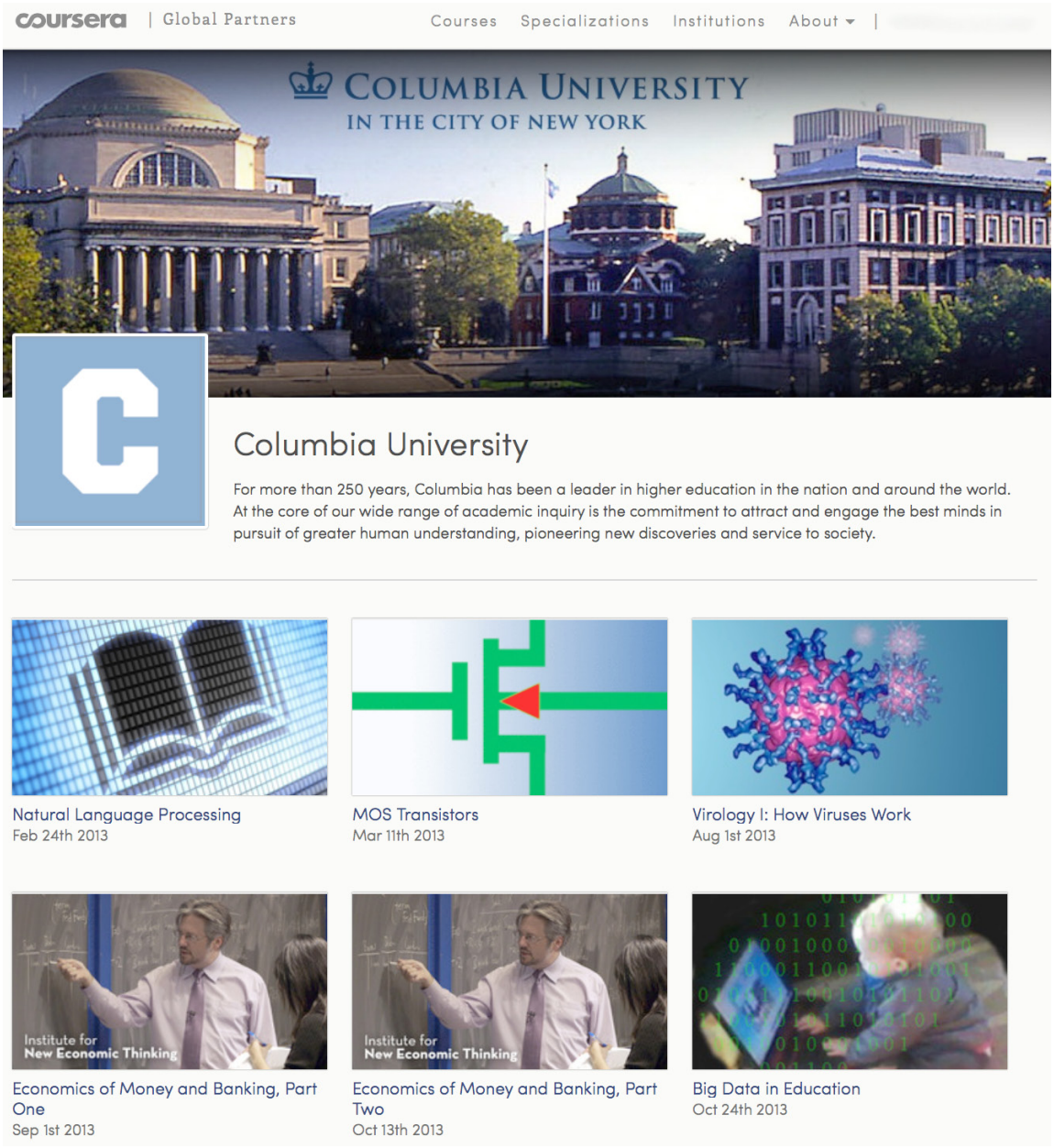

Fig. 1: Columbia University's portal on Coursera (as of December 2013)

II. The Faculty and Their Courses

The Columbia faculty leading 2013 Coursera classes were:

- **Michael Collins**, Vikram S. Pandit Professor in the Department of Computer Science
- **Martin Haugh**, Co-Director of the Center for Financial Engineering, and Professor in the Department of Industrial Engineering and Operations Research
- **Garud Iyengar**, Professor in the Department of Industrial Engineering and Operations Research
- **Yannis Tsividis**, Charles Batchelor Professor of Electrical Engineering
- **Vincent Racaniello**, Higgins Professor of Microbiology & Immunology
- **Perry Mehrling**, Professor of Economics at Barnard College
- **Ryan Baker**, Professor of Cognitive Studies at Teachers College

The School of Engineering launched the first Columbia MOOCs, releasing three courses in the first quarter of 2013. Five additional courses were launched in the second half of the year. All are shown in Table 1, which includes length of course.

Fig. 2: Columbia faculty teaching Coursera courses (as of November 2013)

Table 1: Columbia MOOCs on Coursera in 2013 (by launch date)

Course	Faculty	Dept/School	Launch Date	Length
Natural Language Processing	Michael Collins	Engineering	Feb 24, 2013	10 weeks
Financial Engineering and Risk Management	Martin Haugh and Garud Iyengar	Engineering	Feb 24, 2013	10 weeks
MOS Transistors	Yannis Tsividis	Engineering	Mar 11, 2013	10 weeks
Virology I: How Viruses Work	Vincent Racaniello	Microbiology	Aug 1, 2013	11 weeks
Economics of Money and Banking Part I	Perry Mehrling	Barnard	Sep 1, 2013	6 weeks
Economics of Money and Banking Part II	Perry Mehrling	Barnard	Oct 13, 2013	6 weeks
Big Data in Education	Ryan Baker	Teachers College	Oct 24, 2013	8 weeks
Financial Engineering and Risk Management Part I	Martin Haugh and Garud Iyengar	Engineering	Oct 31, 2013	7 weeks

III. Student Statistics

The 2013 Columbia University MOOCs attracted significant interest, with most courses attracting tens of thousands of participants. Over 400,000 people worldwide signed up for Columbia MOOCs. Lecture videos in these courses were viewed over 5 million times. More than 600,000 quizzes were taken. Over 26,000 discussion forum posts were created. These numbers suggest that there is a high degree of interest in the courses that Columbia provided.

While a high number of individuals enrolled in the courses, many did not stay active. This kind of inactivity seems to be fairly consistent across Coursera, regardless of subject or university; many individuals enroll, but far fewer finish with a Statement of Accomplishment (a certificate stating that the individual has earned a passing grade in the

course). Statistics show, however, that while few attain a Statement of Accomplishment, many more still stay active to a certain degree - numbers that we unpack below.

Student participation for all courses followed a pattern similar to the graph shown in Figure 3.

In the graph, each blue bar represents one lecture. Its height shows the number of individuals in the course who viewed it in video. The graph data does not tell us how long the video was viewed; it only tells us how many individuals clicked to view it. This graph, for example, shows 60 video lectures (5 videos per week, with a course length of 12 weeks). What we find across this graph is fairly similar to the others we analyzed: a large number of video views occur in the first week, followed by a significant yet lower number of views in week 2, followed by a gradual drop-off until the end of the course.

Looking at the graph, it is important to note that the number of individuals who viewed videos during the last week of the course is much higher than the number of individuals who earned Statements of Accomplishment. Many individuals are staying active for reasons other than earning the certificate.

For our purposes, then, we define four levels of student engagement:

- First, we call students who browse a course offering but end up not participating in any course activities **"browsers."**
- We define a second level of engagement, **"samplers,"** as students who are "active" going into the second week

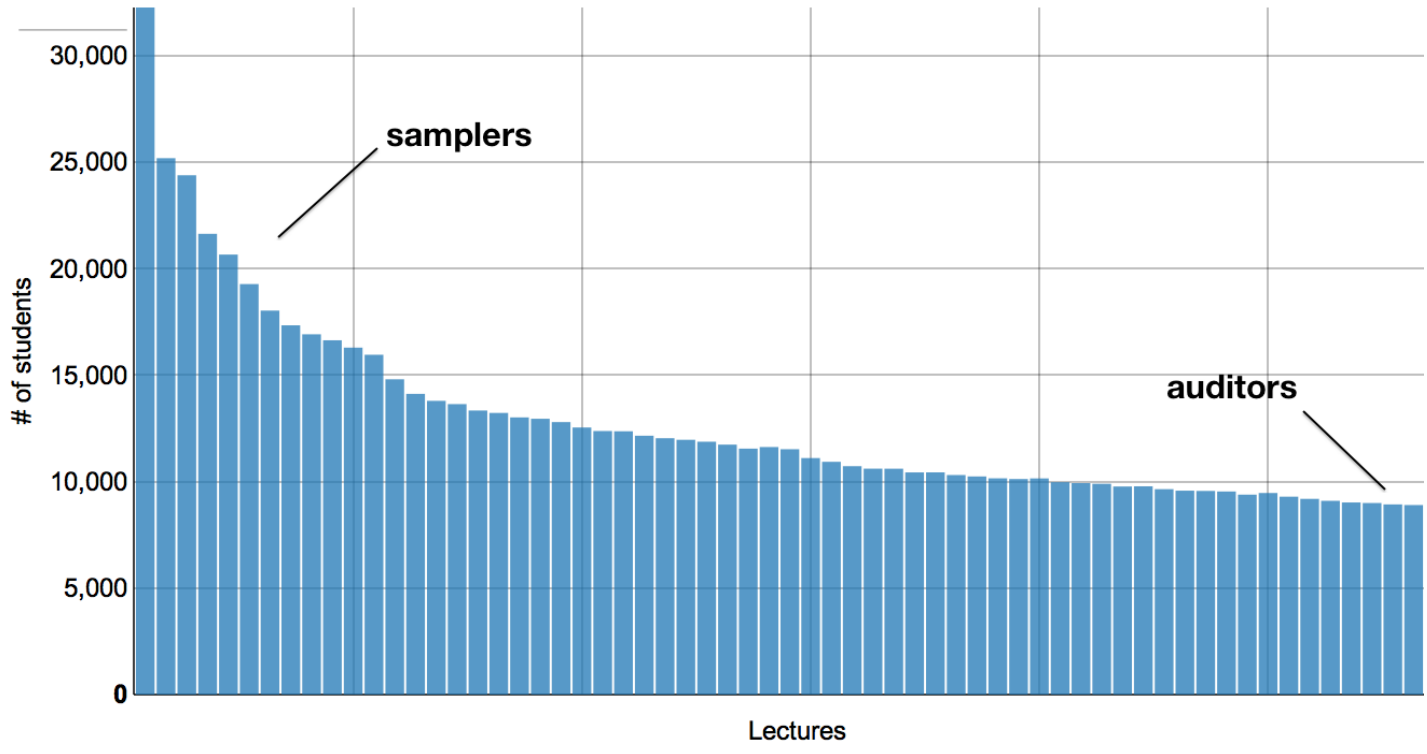

Fig. 3: Graph shows typical drop off of lecture viewing

of the course, meaning that they have at minimum viewed some of the video lecture materials. By this point, samplers are able to determine the character and difficulty level of the course while getting a sense of the teaching style and approach of the instructor. Indeed, many students drop out at this point.

- We define a third level of engagement as **"auditors,"** those students who are active through to the last week of the course. These students are likely to have an strong interest in the subject matter, but will not complete the work necessary to receive certification.
- The fourth and final level of engagement, **"SoA Earners,"** represent the cohort that earn a "Statement of Accomplishment" or a "Statement of Accomplishment with Distinction."

Table 2 summarizes student engagement at these four levels for the eight courses in 2013.

Table 2: Student engagement in 2013 Columbia MOOCs

Course	Browsers	Samplers	Auditors	SoA Earners (w/distinction)
Natural Language Processing	64,117	15,042 24% of Browsers	6,442 43% of Samplers	1,160 (908) 8% of Samplers
Financial Engineering and Risk Management	108,708	19,608 18% of Browsers	9,856 50% of Samplers	2,809 14 % of Samplers
MOS Transistors	25,896	5,563 22% of Browsers	2,724 49% of Samplers	94 2% of Samplers
Virology I: How Viruses Work*	38,124	13,724 36% of Browsers	5,360 39% of Samplers	1,615 (1,042) 12% of Samplers
Economics of Money and Banking Part I*	50,697	18,016 36% of Browsers	7,038 3 9% of Samplers	2,450 14% of Samplers
Economics of Money and Banking Part II	15,313	4,882 32% of Browsers	3,336 68% of Samplers	1,952 40% of Samplers
Big Data in Education	46,607	6,111 13% of Browsers	3,591 59% of Samplers	638 (570) 10% of Samplers

Financial Engineering and Risk Management Part I	61,447	12,845 21% of Browsers	5,665 44% of Samplers	1,563 12% of Samplers
Totals	**410,909**	**95,791** **23% of Browsers**	**44,012** **46% of Samplers** **10.7% of Browsers**	**12,281 (2,520)** **28% of Auditors** **13% of Samplers** **3% of Browsers**

Table 2 shows that while over 400,000 students initially enrolled in courses, 95,000 of them stayed to sample the material at the second week. The auditors, totaling 44,000 students, stayed active throughout the length of the entire course, and 12,281 of them performed all the work necessary to receive—and did receive—a Statement of Accomplishment from the instructor.

IV: Tool Statistics

MOOCs usually provide minimal student-instructor interaction, offering students instead a self-paced (asynchronous) model that allows them to advance as they learn the material. The self-paced model usually features videos in 6- to 10-minute chunks that can be paused and replayed as many times as necessary. Videos can be played at slower or faster than normal speeds and typically feature English captions. While much course content is in video form, each course can also have a number of webpages -- not unlike a typical learning management system (LMS) -- to hold syllabi, supplemental readings, assignments, and other course content.

Coursera's platform offers a number of features: video, in-line video quizzes, quizzes, peer-to-peer grading, discussion forums, and information pages. Students are assessed frequently, typically during each video lecture (in-line video quizzes), after each unit (quizzes), and in summative exams (final). Coursera champions a pedagogy of "mastery learning," offering students multiple attempts at quizzes until they reach as close to a perfect score as possible. To accommodate multiple quiz attempts, instructors are urged to create banks of quiz questions so that quizzes can be randomized at the question level and at the multiple choice options level. In addition, all correct and incorrect answers should include helpful feedback to improve student learning.

The tables below represent the following features Columbia elected to use on the Coursera platform for its MOOCs in 2013: video lectures, quizzes, and discussion forums.

A. Video Lectures

Table 3 shows lecture video activity in the courses. To fully make sense of the numbers, a list of definitions is provided here:

Total Streaming Views - the sum of the total number of times each video lecture has been streamed.

Total Downloads - the sum of the total number of times each video lecture was downloaded to a student's computer.
Unique Videos Watched - the number of unique lecture viewings totaled across students (both streaming and downloaded).
Number of Participants - the number of (unique) students who have watched at least one video since the start of the class (either streaming or downloaded).

Table 3: Video activity in 2013 Columbia MOOCs by course

Course	Total Streaming Views	Total Downloads	Unique Videos Watched	Number of Participants
Natural Language Processing	536,292	1,628,210	1,093,572	31,031
Financial Engineering and Risk Management	616,189	1,444,874	1,138,759	53,834
MOS Transistors	103,001	408,190	289,077	13,151
Virology I: How Viruses Work	442,268	449,765	492,388	22,101
Economics of Money and Banking Part I	704,699	963,938	1,034,226	29,021
Economics of Money and Banking Part II	246,669	370,652	389,152	7,249
Big Data in Education	144,856	278,870	234,280	18,351
Financial Engineering and Risk Management Part I	241,981	419,207	371,655	25,876
Totals	**3,035,955**	**5,963,706**	**5,043,109**	**200,614**

B. Quizzes

Tables 4-6 show quiz activity in the courses. To fully make sense of the numbers, a list of definitions is provided here:

Total Submissions (quiz, homework, exam, survey, video) - the sum of the total number of times each quiz (of type "quiz," "homework," "exam," "survey," "video") has been attempted.
Unique Submissions (quiz, homework, exam, survey, video) - the number of unique quiz submissions across stu-

dents (of type "quiz," "homework," "exam," "survey," "video").
Number of Participants (quiz, homework, exam, survey, video) - the number of unique users submitting at least one quiz (of type "quiz," "homework," "exam," "survey," "video").

Table 4: Total quiz submissions by type in 2013 Columbia MOOCs

Course	Total Submissions (quiz)	Total Submissions (video)	Total Submissions (survey)
Natural Language Processing	29,327	303,613	2,183
Financial Engineering and Risk Management	252,808	371,992	3,103
MOS Transistors	7,444	50,334	3,408
Virology I: How Viruses Work	115,176	611,053	1,806
Economics of Money and Banking Part I*	48,132	354,545	9,839
Economics of Money and Banking Part II	31,320	97,597	2
Big Data in Education	14,375	34,074	535
Financial Engineering and Risk Management Part I	105,338	125,177	0
Totals	**603,920**	**1,948,385**	**20,876**

Table 5: Unique quiz submissions by type in 2013 Columbia MOOCs

Course	Unique Submissions (quiz)	Unique Submissions (video)	Unique Submissions (survey)
Natural Language Processing	8,099	114,670	2,170
Financial Engineering and Risk Management	37,262	170,912	3,083
MOS Transistors	3,941	24,992	3,375
Virology I: How Viruses Work	55,178	163,101	1,784

Economics of Money and Banking Part I	23,722	201,768	9,694
Economics of Money and Banking Part II	13,586	62,431	2
Big Data in Education	6,515	14,220	534
Financial Engineering and Risk Management Part I	16,738	60,303	
Totals	**165,042**	**812,397**	**20,642**

Table 6: Number of participants in quiz submissions by type in 2013 Columbia MOOCs

Course	Number of Participants (quiz)	Number of Participants (video)	Number of Participants (survey)
Natural Language Processing	3,813	12,131	2,170
Financial Engineering and Risk Management	10,417	16,936	3,083
MOS Transistors	2,071	3,555	2,445
Virology I: How Viruses Work	12,820	12,916	1,784
Economics of Money and Banking Part I	6,859	13,298	9,693
Economics of Money and Banking Part II	2,817	2,715	0
Big Data in Education	1,554	6,772	534
Financial Engineering and Risk Management Part I	5,746	7,291	0
Totals	**46,097**	**75,614**	**19,709**

C. Discussion Forums

Tables 7 and 8 show discussion forum activity in the courses. To fully make sense of the numbers, a list of definitions is provided here:

Total Threads - the total number of threads ("topics") in the forums across all sub-forums.
Total Posts - the total number of posts across all threads.
Total Comments - the total number of comments across all posts.
Total Votes - the total number of votes (both up and down) cast in the forums.
Total Reputation Points - the total number of reputation points currently held by the students. Students obtain reputation points when their posts are voted up (or down) by other students in the forums. For each student, his/her reputation is the sum of the square root of the number of votes for each post/comment that he/she has made.
Number of Participants (posting, commenting, voting) - the number of (unique) users who have performed said action -- posting, commenting or voting -- at least once since the start of the session.

Table 7: Discussion forum activity in 2013 Columbia MOOCs

Course	Total Threads	Total Posts	Total Comments	Total Votes	Total Reputation Points
Natural Language Processing	1,228	4,712	3,509	7,954	2,455
Financial Engineering and Risk Management	1,154	5,887	4,047	13,125	2,389
MOS Transistors	282	867	314	1,006	270
Virology I: How Viruses Work	947	4,123	1,939	8,688	2,132
Economics of Money and Banking Part I	807	3,927	2,657	5,350	1,993
Economics of Money and Banking Part II	475	1,975	1,768	3,621	1,391
Big Data in Education	590	2,423	1,346	2,900	1,206

Financial Engineering and Risk Management Part I	467	2,499	1,298	3,422	888
Totals	**5,950**	**26,413**	**16,878**	**46,066**	**12,624**

Table 8: Number of participants in discussion forum activity in 2013 Columbia MOOCs

Course	Number of Participants (posting)	Number of Participants (commenting)	Number of Participants (voting)
Natural Language Processing	1,274	688	1,621
Financial Engineering and Risk Management	2,049	998	2,719
MOS Transistors	284	114	329
Virology I: How Viruses Work	1,450	576	1,323
Economics of Money and Banking Part I	1,142	462	916
Economics of Money and Banking Part II	435	174	413
Big Data in Education	692	338	629
Financial Engineering and Risk Management Part I	1,101	451	948
Totals	**8,427**	**3,801**	**8,898**

V. Conclusions and Plans

Based on 2013 statistical data, faculty interviews, and the day-to-day administration of the MOOCs, CCNMTL has been able to uncover several trends and patterns, leading to a few broad conclusions that we hope to use to improve the teaching and learning experience.

The "typical' Columbia MOOC student does not exist.

There does not seem to be only one reason to take a MOOC, or one type of MOOC participant. Statistics show that a high percentage of students enroll in Columbia MOOCs yet have no substantial engagement within them ("Browsers"). Statistics also show, however, that a sizeable percentage of students return to the course at the start of the second week ("Samplers") and stay involved for various periods of time. Statistics also indicate that there are numerous students who are active all the way up the last week ("Auditors"), yet do not partake in the requirements for certification. Finally, a small percentage of students do stay active throughout the entire course and participate in all of the activities required for a certificate of completion ("SoA Earners").

Perhaps success criteria for these MOOCs should be determined by more than certificate earnings numbers alone. There seem to be many types of students enrolled in online courses for myriad reasons.

Video lectures are a vital part of the MOOC experience.

Video lectures are a popular part of the Coursera experience, with millions of views and downloads throughout the length of the course. Coursera MOOCs are allowing Columbia faculty to take their course content on a kind of "global test drive," in that they provide an opportunity for them to create different types of video lectures and receive extensive feedback on them from the thousands of students inside and outside the University who are watching, analyzing, and subsequently commenting on them.

Evidence of faculty improving video lectures through MOOC student feedback is found, for example, in Virology 1; the posts from students in the discussion forums prompted Professor Vincent Racaniello to add more annotations to several of his lecture videos, as students were not sure what part of the diagram, slide, or chart was being discussed. These improved video lectures have now been incorporated back into his Columbia classroom.

There is a relationship between MOOCs and the "flipped classroom" model.

The Coursera MOOCs have allowed both teachers and staff to see the power of digitizing and distributing lecture materials in order to free up time for other activities. Several faculty have begun experimenting with "flipping" their Columbia courses; providing lecture videos prior to class, and then using class time for deeper exploration of lecture material, problem-based learning, group work, and discussion.

One instructor, Perry Mehrling, ran his Barnard Economics course concurrent with his Coursera course. His Columbia students were expected to enroll in the MOOC and watch the video lectures in the MOOC before class; class time was then spent discussing the video lectures and looking at the material more deeply.

MOOCs can build communities.

Coursera's discussion forums have shown that strong communities can form in the MOOCs through the exchange of ideas, opinions, and perspectives. Enrollees, with a wide array of knowledge and expertise, assisted in the forums along with faculty, TAs, and staff. Based on the observations of these forum interactions, CCNMTL has become better able to help other faculty use online discussion in more effective ways.

Future Plans

CCNMTL, after building several Coursera courses and analyzing the 2013 statistical data, will experiment further with MOOC production across various platforms in 2014. The Center will be trying out several new approaches in order to improve the way courses are delivered and interacted with. The Center plans to compare the 2014 results to 2013 results through participant surveys, faculty interviews, and more statistical data generated and aggregated across all courses.

Here are some of the ideas that CCNMTL plans to explore for MOOCS in 2014:

- It seems that a large percentage of students enroll just to see what the course looks like, and what the course has to offer. Two ideas suggest themselves:
  - On the "Course Page," an example video lecture could be provided, allowing enrollees to sample what course content will look like.
  - On the "Course Page," an example quiz could be provided, allowing enrollees to sample what a course assessment would look like.
- Courses may be more effective if they are between 3 and 9 weeks in length, as courses running in the 10- to 15-week range may be too long to sustain student interest and engagement. CCNMTL will experiment with course length.
- Faculty and staff might consider "chunking" videos to lengths between 6 and 9 minutes, as research indicates this to be the timeframe that most viewers will devote to watching a particular video segment.
- Faculty and staff will explore myriad types of video formats and styles for lecture material, utilizing tablets, slides, white screens, animations, and more.
- Faculty who create lecture videos utilizing slides (PowerPoint, Keynote) should be careful not to make them extremely text-heavy, as this can sometimes lead to cognitive overload. If slides are used, a diverse mixture of images, charts, graphs, bulleted lists, and textual material should be considered.
- CCNMTL plans to help other faculty create and use lecture videos in their Columbia classes, similar to what has been done in the MOOCs, and assist in finding innovative ways to use the freed-up class time that the videos may generate.
- All parties involved in Coursera MOOCs will work towards the creation of a standard set of surveys. This will provide Columbia with the ability to better analyse the data, enabling all involved to create better courses.
- Inline quizzes will be embedded into the video lecture every few minutes in order to actively engage students.
- Inline quizzes will be rigorous enough to keep the student engaged.
- Inline quizzes will have more supportive explanations built into them to help guide the student towards mastery of the material.
- Some discussion forums will begin with a prompt from the instructor, while other forums should be completely open for anyone to start. A thoughtful mix of both instructor-led discussions and student-led discussions can lead to a more open community of learners and contributors.
- CCNMTL will explore all possibilities of tool integration for the its MOOCs. If a tool exists that can support an instructor in their teaching, it will be embedded into the learning environment.
- CCNMTL will explore course creation in all subject areas at Columbia, and how MOOC platforms could cater

to the different strengths of different departments.

- Live sessions through tools like Google Hangouts will be explored and integrated into courses, allowing students, TAs, and faculty to periodically connect in real time.

Columbia's first year with MOOCs was filled with discoveries, innovations, and the learning of many lessons. We plan to take all of that into 2014 and beyond, as we push towards raising the bar on MOOC creation, as well as online learning in its myriad forms.

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About the Author

Michael Cennamo has served as an educational technologist at Columbia University's Center for New Media Teaching and Learning since 2008. His primary interest is in creating blended learning environments for Columbia faculty and thinking about new ways to teach and create community online. Michael also engages with Columbia faculty across campus through CCNMTL's faculty development series, rewirED, which he co-created in 2012, and he is working towards an Ed.D in Educational Technology from Columbia's Teachers College. He would like to thank CCNMTL staff members Maurice Matiz, Lucy Appert, Peter Kaufman, and Courtney Lockemer for their helpful comments and support.

About CCNMTL

The Columbia Center for New Media Teaching and Learning (CCNMTL) was founded at Columbia University in 1999 to enhance teaching and learning through the purposeful use of technology and new media. In partnership with faculty, the Center supports efforts ranging from basic course website management to advanced project development. CCNMTL also extends the scope and reach of its work with strategic initiatives that engage educators, researchers, librarians, partner institutions, and the community in the reinvention of education for the digital age. CCNMTL is part of the Columbia University Libraries/Information Services. For more information, visit http://ccnmtl.columbia.edu
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