MOOCs in STEM: Exploring New Educational Technologies

Conference at a Glance

Day 1: June 5, 2014
8:00 -- 8:30 am    Breakfast
8:30 -- 9:00 am    Introduction
9:00 -- 10:00 am   Invited Keynotes
10:00 -- 10:30 am  Break
10:30 -- 11:30 am  Breakout Session 1
11:45 -- 12:30 pm  Lunch
12:45 -- 1:45 pm   Industry Session
2:00 -- 3:00 pm    Breakout Session 2
3:15 -- 3:45 pm    Break
3:45 -- 4:15 pm    Breakout Session 3
5:00 -- 7:00 pm    Reception

Day 2: June 6, 2014
8:30 -- 9:15 am    Breakfast
9:30 -- 10:30 am   Invited speaker talks
10:45 -- 11:45 am  Breakout Session 4
12:00 -- 12:45 pm  Lunch
1:00 -- 2:00 pm    Interest group meetings
2:30 -- 3:00 pm    Break
3:00 -- 4:00 pm    Breakout Session 5
4:15 -- 4:45 pm    Ending session

End of conference for participants

Conveners and Organizing Committee only
5:00 – 7:30 pm    Dinner/ Synthesis and Outline of Next Steps; Organizing Committee Report Writing
MOOCs in STEM: Exploring New Educational Technologies

Conference Agenda

Day 1: June 5, 2014
8:00 - 8:30 am  Breakfast, Loma Prieta Ballroom
8:30 – 9:00 am  Introduction: Don Millard, National Science Foundation, Loma Prieta Ballroom
9:00 – 10:00am Invited Keynotes, Loma Prieta Ballroom

Dr. Mohammed Qayoumi, President SJSU

Yvonne Belanger, Gates Foundation, Are MOOCs the answer? What is the question?

Abstract: For the past two years, a growing number of faculty and institutions have explored the potential of MOOCs to address pressing challenges of increasing access, reducing costs and improving quality. Regardless of whether MOOCs offer solutions to these problems at scale, the phenomena of MOOCs has generated powerful conversations about fundamental questions faced by faculty and institutions and has sparked tremendous creativity and engagement by faculty and institutions with digital learning.

10:00 – 10:30 am Break

10:30 – 11:30 am Breakout Session 1: MOOCs in STEM

Section 1A: MOOCs in STEM Courses
Pacifica Conference Room
Session Chair: Andrew Hsu
Rosie Redfield, Subverting the Genetics Curriculum

Abstract: At the end of 2011, I saw no hope of making our 2nd-year genetics course relevant to the lives of our students; its content was simultaneously mired in classical genetics and targeted to the rare students headed for research careers. Sixteen months later, I began teaching my ideal course to thousands of students around the world. And, sixteen months after that, I'll be teaching this revolutionary new course to our 2nd-year students, for academic credit.

The course is Useful Genetics, presently taught on Coursera. It started with a rant on my teaching blog which became an opinion piece titled “Why do we have to learn this stuff? A new genetics for 21st century students” (Redfield 2012, PLOS Biology 10(7): e1001356. doi:10.1371/journal.pbio.1001356). The resources, platform and audience I needed to make this idea live came in Fall of 2012 when UBC partnered with Coursera - I jumped in with both feet and started developing!

Useful Genetics is a rigorous college-level genetics course that promises students personal genomics but no fruit flies. The material is divided into 11 weekly Modules, each with a large set of challenging practice problems and a graded quiz. In addition
to a midterm and final, the course has four short peer-assessed writing assignments in which students learn to explain genetics issues to friends and relatives. UBC’s new commitment to Flexible Learning created the academic niche for this ready-to-teach course; it will begin in September as an alternative section of our traditional genetics course.

Jeremiah Cohen and George Courtsunis, *MOOC Materials for STEM Classroom Teaching*

Abstract: Students in higher education are often overwhelmed with memorizing concepts and the lack of efficient tools to help them. We developed a novel web-based learning platform that accelerates knowledge retention in higher education through individual and collaborative learning while assisting with metacognitive abilities. Built upon the principles of integrated learning and spaced repetition, this platform abstracts the same learning content into several different modalities including multiple choice, flashcards, matching, review mode, and an animated game. These abstractions are accomplished via a novel database architecture that draws many-to-many (i.e. integrated) connections between “terms” and “facts” within the learning content. With the help of real-time feedback on their mastery of individual and aggregate concepts, students are given encouragement and guidance on what steps to take to more quickly gain competency. As this system tracks every student’s interaction with the content via our application programming interface, we can leverage these data to adapt to each student’s learning style thus creating a personalized system. These data are also useful for educators such as at the David Geffen School of Medicine at UCLA where tutors and faculty currently can track their students’ progress on an individual and aggregate basis. This system is subject-agnostic in that any information that can be represented in a tabular format can be imported including the sciences and languages. So far we have processed millions of data points of student’s learning behavior and would like to share some of these findings at the MOOC conference.

Section 1B: Development and Learning Issues in MOOCs

Ohlone Conference Room

Session Chair: John Estell

Zach Pardos, *Learning What Works in MOOCs Without A/B Testing*

Abstract: The richness of pedagogical content in MOOC platforms and granularity of tracking logs provides an opportunity to make inferences about the efficacy of content and thereby guide individual students down a more efficient path through the course. Appraisal of the learning value of a resource, with respect to a particular assessment or group of assessments, is built upon on a probabilistic model of student learning that assumes students’ knowledge state is a latent variable and that the transition between latent states is affected by the resources accessed with answers to assessments providing evidence of the current value of the latent state. However, with dozens of potentially relevant resources, crediting the appropriate resource becomes a difficult inference problem. In this demo, we show an interactive visualization that allows the user to investigate the conditions under which confident inference may be achieved.
Len Troncale, MOOC Feasibility for Institutional and STEM Curriculum Invention Across the CSU System: Past and Future Funding

Abstract: This talk reports recent efforts to resurrect both the former Institute for Advanced Systems Studies and the Integrated Science General Education (ISGE) Program that were awarded two National Science Foundation grants for $400,000 in the past years, an $80,000 grant from the CSU, and additional spin-off funds from private Foundations. Current plans involve naming Faculty, Associate, and Student Fellows to a new cross-discipline, cross-College, CSU-wide, Institute named the Institute for the Systems-Integrated Sciences, Technology, Engineering and Mathematics serving all 23 campuses. The purpose of ISISTEM would be to offer distanced-learning, computer-based MOOC-style courses for which there might be too few students on any one campus, but a considerable enrollment across the CSU and beyond the CSU. Courses would have titles like Systems Science, Systems Biology, Earth Systems Science, Systems Science for Sustainability, Systems Chemistry, and Systems Engineering. For example, one hallmark of the new Cal Poly's Master's in Systems Engineering is a core course in Systems Science, the first natural science based such core course for SE internationally. Cal Poly Pomona already has organized a Student Division of INCOSE. Some or all of these courses would do well as MOOC’s because they are widely recognized as “crest-of-the-wave” topics internationally. The talk will summarize this simultaneous organizational and curriculum innovation linking it to funding agencies. For example, an initial proposal for $1M is planned as a third-level NSF grant for ISGE based on the previous grants. Teams are now being assembled for other proposals to NASA, AFRL, DOEnergy, DOEducation, DARPA, and NIH.

11:45 – 12:30 pm Lunch, Loma Prieta Ballroom

12:45 – 1:45 pm Industry Session

Industry Session 1
Session Chair: Ping Hsu
Pacifica Conference Room

Karen Alter, COO, SIPX, Inc., Analytics and Insight About Digital Content Usage for Online Initiatives Based on Real MOOC Data

Abstract: During these early days, MOOCs have created a tremendous amount of interest, ideas, even investment and new academic-oriented companies in the online learning arena. This focus on MOOCs is occurring, in part, because of national and institutional pressures to maintain high academic standards while driving down educational costs. As appetites grow for online tools and digital course materials (for use in MOOCs and related online courses), educational institutions are pondering serious considerations about the effectiveness and efficiency of the potential impact of these new technologies and approaches.

SIPX, Inc. delivers a cloud-based service to help schools manage copyrights, distribute digital course readings, and collect analytics in a wide range of higher-education activities, from MOOCs to LMS platforms. SIPX (formerly the Stanford Intellectual Property Exchange) grew out of years of academic and technology research to improve traditional course materials practices. Within one website, SIPX brings together information on library licenses, with outside data and documents from open-access sources, publisher content, and copyright agent databases. Beyond
improving how instructors can find information on course materials, SIPX manages all e-commerce transactions, from payment collection to royalty distribution (where necessary), while providing deep analytics on content access.

SIPX will discuss real-world content needs, questions and approaches for MOOCs and related digital course initiatives, and share aggregated analytics from MOOCs we have supported to date across different technology platforms. The session will also touch on observations and feedback from faculty, course managers, school leaders and students.

Industry Session 2  
Ohlone Conference Room  
Session Chair: Zach Pardos

Andreina Parisi-Amon, Partnership Manager, Coursera

Coursera is an education platform that partners with top universities and organizations worldwide, to offer courses online for anyone to take, for free. We envision a future where everyone has access to a world-class education. We aim to empower people with education that will improve their lives, the lives of their families, and the communities they live in.

Industry Session 3  
Costanoan Conference Room  
Session Chair: Michael Schatz

Frank Vahid, Professor of Computer Science and Engineering, University of California, Riverside & Zyante co-founder and CTO,  
*Online teaching: Less talk, More Action*

Abstract: While commonly-used strengths of the web include convenient information delivery like video lectures and include enabling student interactions via discussion boards and peer assessment, another powerful strength is the support of active design, tinkering, and self-assessment. Just as you can’t learn to tie your shoe by just watching others tie theirs and reading about the theory, such “learning by doing” is critical in most STEM subjects. Zyante has developed highly-interactive web-native textbooks-replacements (“zyBooks”) for 8 lower-division Computer Science topics, with new ones in math and engineering underway. A typical offering includes 1,000+ embedded questions for self-assessment, because often students don’t know what they don’t know; about 100 animations of critical concepts, because if a picture is worth a thousand words, an animation may be worth 5,000; and embedded simulators/tools for students to tinker with and develop their own understanding. An important design policy philosophy is a single flow for the student; minimizing the jumping around among sites and tools that hampers learning. Starting in 2012 at the University of Riverside with an introductory computer programming course, the materials have been used in over 100 universities and high schools, by roughly 20,000 students. Instructor/student feedback has been excellent, controlled studies show reduced failure rates and improved grades. The material has been used in traditional courses (enabling flipping the class if desired), online classes, and MOOCs too.

2:00 – 3:00 pm Breakout Session 2: Applications of MOOCs in STEM
Section 2A: 5x10 Interactive Session  
Costanoan Conference Room  
Session Chair: David Craven

Elaine Collins & Julie Spitzer, Creating and Implementing the College Algebra Course with Udacity

Abstract: Dr. Elaine Collins and Dr. Julie Spitzer will discuss their experiences in creating and implementing the College Algebra course with Udacity. In our five slides we will highlight issues with utilizing online resources and creating a MOOC including: planning time, assessment, technology requirements, utilization of materials and updating/maintaining the course. Results of the study will be presented and future directions based on our experiences.

Megan W. Taylor, Imagining STEM Teacher Education 2.0

Abstract: This 5x10 suggests a new vision for secondary mathematics and science teacher preparation, education, and professional development. How can we leverage what we know about the recruitment, training, and retention of highly-qualified professional educators with our emerging knowledge of collaborative, open-access, and digital learning? Specifically, what could be the role of MOOCs in:

- Developing innovative, online courses that focus on the best instruction and content for K-12 mathematics and science teacher education (rather than the best known instructors or best known universities);
- Employing the best of current technologies to bring teacher educators together and engage them in instructional design work to develop these courses;
- Ensuring the courses cover valuable, research-based material (“touchstones”) recognized by relevant experts in mathematics and science education, but doing so in ways that facilitate local experience and practice;
- Giving members of existing teacher preparation and professional development organizations a seat at the design table, ultimate access to the designed courses, and flexibility to tailor online learning experiences to local contexts; and
- Ensuring the courses prepare teachers for the dynamic classrooms of the 21st century

Section 2B: MOOCs in STEM Laboratories  
Pacifica Conference Room  
Session Chair: Julie Libarkin

Kemi Jona, A Solution for Supporting Laboratory Experiences in STEM MOOCs

Abstract: Remote online labs provide a promising solution for supporting laboratory experiences in STEM MOOCs. Since the development of remote lab technologies has largely preceded the emergence of MOOCs, they were not designed to accommodate the massive enrollments in these courses. In this talk, I present the progress we have made to date in improving remote lab functionality in three specific areas: (1) mobile access for students; (2) enhanced instructor tools for authoring and feedback; and (3) learning analytics. I also describe some early experiments in adapting remote labs to a MOOC environment and identify several key challenges.
that must be addressed to successfully scale up to meet the demands of providing laboratory experiences within MOOCs.

3:15 – 3:45 pm      Snack Break

3:45 – 4:15 pm      Breakout Session 3

**Session 3A: Flipping the Classroom in Engineering Classes**
**Pacifica Conference Room**
Session Chair: Ping Hsu

Perry Cook, *Getting Artists up to steAm: Teaching Computer Science to Art School Students*

Abstract: We describe the first formal programming curriculum, based on the ChucK and Processing languages, developed specifically for undergraduate art students. Developed under NSF grant #1140336, the project generated a new ChucK text book ("Programming for Musicians and Digital Artists, Creating Music With ChucK" Manning Publishing), and a MOOC ("ChucK 101") offered on Coursera in the Fall of 2013. Our first MOOC offering garnered 45000 registrations, 13000 participants who watched one or more video modules, a total of 9035 assignments submitted and graded, and 800 completions of all assignments including a final art/programming project. The age range of completing students spanned from retired people to 8 years old, and the geographical reach was (of course) global. In creating this curriculum, we sought to develop new and engaging instructional approaches to the incorporation of STEM learning into arts education, and to teach art students to create technology-driven art. We applied the metrics we developed under the NSF grant to measure that our MOOC students were actually learning difficult CS topics ranging from variables, arrays, and libraries, to objects and classes. The user-input and networking functions built into ChucK allow students to create digital real-time “instruments” and orchestras using their computers, aiding in retaining student interest and participation. Further details on the success of teaching core concepts, additional demographics, case studies, and more courses under development will also be reported.

Laura Sullivan-Green, *Student Satisfaction in a Flipped Classroom Model in an Upper Division Soil Mechanics Course*

Abstract: This work evaluates student satisfaction with a flipped classroom. The flipped classroom model is currently being tested in an upper division soil mechanics course at San Jose State University. One segment of the course uses short lecture videos, while activities are collaboratively done in class. Student satisfaction and achievement will be evaluated through student surveys, instructor reviews, and test scores over two semesters. The test scores and instructor reviews will be compared to scores from previous semesters where traditional lecturing was employed. A critical evaluation of the method and the implementation will be conducted and followed by suggestions and ideas to improve the success of the method in this setting.

**Session 3B: MOOCs in STEM**
**Ohlone Conference Room**
Session Chair: John Estell
Jesse Schreier, MOOCs and High School Students
[Presentation Streamed through WebEx]

Abstract: MOOCs and High School Students. In April, 2013, Brown University - Continuing Education developed an open introductory engineering course that ran on the ‘Canvas Network platform. It was created to help high school students learn more about the field of engineering through direct engagement in the design process. There are no lectures. The course has run 4 times with an enrollment of over 4,000 students. This session will review the project and share lessons learned.

Brad Hyatt, Flipping the Classroom in a Construction Planning & Scheduling Course
[Presentation Streamed through WebEx]

Abstract: There are three trends that provide the promise of engaging students in this digital age of learning. These trends include creating and sharing online video lectures, flipping the classroom, and gamifying online content. But what happens when there is no efficient content, platform, and/or tools to implement these trends for a specific course? The answer is to create your own gamified MOOC.

The “Construction Planning & Scheduling” course at California State University, Fresno has been redesigned over the past three years. The initial redesign focused on ‘flipping the classroom’ by recording lectures for students to watch outside of the classroom so that class time could be used for active learning. This resulted in better engaged students in the classroom. However, it did not ensure that students were engaged outside of the classroom and prepared for class activities.

Thus the current focus of the course has been to create a better online course experience that encourages more engagement and thus better preparation for the class activities. This was accomplished on a personal Wordpress enabled website using a learning management plugin called LearnDash. The addition of a second plugin named BadgeOS helped to gamify the course. Ultimately, this created an open and online course in which anyone in the world could enroll (i.e., the potential to be massive). The initial results of this effort have been a significant increase in activity out of class and a better prepared student for each class period.

Session 3C: Web Applications in MOOCs
Costanoan Conference Room
Session Chair: David Craven

Cynthia Liao, Co-Founder, Wisely

Abstract: Wisely, a web application that aims to build social and collaboration features is designed to fill the current void with the aim to improve student motivation and enhance the online learning experience. Please see our work-in-progress at www.projectwisely.com. Thus far, we have been working in collaboration with MOOC students, professors, administrators and the MOOCs themselves to experiment with multiple features. My team and I are currently backed by Next 36, an entrepreneurship development program in Canada.
5:00 – 7:00 pm   Reception. The session will include a sign-up area for interest groups, scheduled for Day 2.
MOOCs in STEM: Exploring New Educational Technologies
Conference Agenda

Day 2: June 6, 2014
8:30 - 9:15 am  Breakfast, Loma Prieta Ballroom

9:30 – 10:30 am  Invited speaker talks, NSF funded MOOC projects

Invited Session 1
Pacifica Conference Room
Session Chair: Zachary Pardos

Elaine Collins, Associate Dean, College of Science, SJSU & Eva Schiorring, RP Group, SJSU-Udacity online partnership and evolution of the online courses

San José State University (SJSU) and Udacity partnered to pilot three online courses spring 2013 with an enrollment of a broad range of participants (e.g., students from SJSU, community colleges and high schools). The courses were delivered through Udacity's MOOC platform. In these pilot courses (Math 6L [Developmental Math], Math 8 [entry-level College Algebra], and Stat 95 (entry-level Statistics), enrollment was limited to 100 per course, for a total of 300 students taking the course for credit. SJSU's Institutional Effectiveness and Analytics Office and Udacity collaborated with the Research and Planning Group for California Community Colleges (RP Group) to conduct research examining students' performance and experience in the three pilot courses. The study includes an analysis of student academic outcomes and surveys designed to document participants' satisfaction with their instructor, the MOOC technology, an array of MOOC supplemental/support services and their online interaction with other students.

Invited Session 2
Costanoan Conference Room
Session Chair: Michael Schatz

Rique Campa, Associate Dean in the Graduate School and Professor of Wildlife Ecology at Michigan State University, MOOC –Supported Learning Communities for Future STEM Faculty: Multiple Paths to Advance Evidence-Based Teaching Across the Nation

Abstract: The prosperity of U.S. society in a global economy depends upon a competitive, college-educated workforce. Yet our society faces challenges in STEM undergraduate education namely the uneven quality of teaching, low enrollment and retention, and the misalignment between classroom experiences and student achievement. The nation has invested in understanding undergraduate learning and developing evidence-based, high-impact teaching practices however, research shows most faculty teaching does not incorporate these findings. Propagation and persistence of evidence-based, high-impact teaching methods requires aligned changes in the educational system and along the development of faculty careers.
Since 2003, the NSF-funded Center for the Integration of Research, Teaching, and Learning (CIRTL) has focused on the preparation of future STEM faculty to be excellent teachers and researchers. Nearly 80% of STEM PhDs are granted at 100 research universities, allowing for a highly targeted intervention before graduates transition into faculty positions at the 4,200 U.S. universities and colleges. Building on three core ideas – teaching-as-research, learning communities, and learning-through-diversity – the CIRTL Network of 22 major research universities developed, implemented, and evaluated programs that prepare future faculty to implement evidence-based, high-impact teaching.

We are developing two MOOCs and three associated online learning modes that prepare future STEM faculty to implement and advance evidence-based, high-impact teaching practices. To meet this goal, we are leveraging the expertise across the CIRTL Network and the core ideas and research findings to: 1) Develop two MOOCs, open to all, that prepare future STEM faculty to implement and advance evidence-based, high-impact teaching practices; 2) Develop and implement within the CIRTL Network two modes of implementation of these MOOCs in addition to open participation; and 3) Evaluate future faculty participation and their learning of evidence-based, high-impact teaching practices across the implementation modes. The design of our MOOCs aligns with findings of cognitive science and discipline-based education research about student learning. Our MOOCs will be open-source, with materials released under a Creative Commons license allowing easy reuse and repurposing. In addition, to the traditional, open to all mode of delivery, we are developing MOOC-Supported Learning Communities that will allow STEM participants to engage in the MOOC and attend regular facilitated meetings as local, department and university-based cohorts. These cohorts will meet weekly to achieve common learning goals. The second mode, Blended Learning Courses, will use individual learning modules deconstructed from the MOOCs that instructors can combine to design their own desired learning experiences for training future faculty. We anticipate these implementation modes will enhance the growth of preparation in the use of evidence-based, high-impact teaching practices in STEM education and provide a positive impact on the cultural attitudes of STEM faculty to implement evidence-based instruction.

Invited Session 3
Ohlone Conference Room
Session Chair: Ken Connor

Mika Seppala, Florida State University, University of Helsinki, and WEPS, LLC, *Traditional Teaching, Flipped Classrooms, and Online Instruction* [Presentation Streamed through WebEx]

Abstract: Online tools in education have transformative power. They have already changed students, who read less and play more. Our instruction must also change. Technology and content developed for MOOCs can be used to improve all instruction. Even those opposing massive open online courses should pay attention to what is happening; they can also benefit of this in a fundamental way.

First WEPS open online course was delivered, at the University of Helsinki, in fall semester of 2004. The WEPS calculus courses have now been in production for 10 years. In this talk I will describe the development and discuss how the full potential on online courses could be realized. For a sample course, see https://myweps.com/moodle/course/view.php?id=251.
For a presentation delivered via video for a meeting in Barcelona, see https://www.youtube.com/watch?v=s3RcLM8EloY.

10:45 am - 11:45 am  Breakout Session 4: MOOC Materials for STEM Classroom Teaching

Section 4A: MOOCs in STEM
Ohlone Conference Room
Session Chair: Ken Connor

Arek Goetz, *Evaluating an Online Large Calculus Course*, Individual Presentation

Abstract: I will share my experience with online calculus which I developed (calculus.sfsu.edu). The class is offered worldwide and it carries San Francisco State University credit. The format is between a small online class and a MOOC.

Larry Lagerstrom, *MOOCs and Online Learning at Stanford*

Abstract: The Department of Electrical Engineering at Stanford University has a long history of teaching large-enrollment master’s level and advanced undergraduate courses with broad appeal and applicability. At present twelve such courses are offered, each with annual enrollment of more than 80 students. Another dozen or so courses have somewhat smaller enrollments. These courses are taken by Electrical Engineering students as well as students from other departments within the School of Engineering. Many of the courses also make up the core of a professional development program. In order to test the learning efficacy of online education, develop a set of best practices, and provide more flexibility to students, the Department created a program to develop online versions of several of these courses. The program is experimenting with different formats, including traditional classroom teaching supplemented with online material, flipped classrooms, tutored online education, and MOOCs. Initial course offerings include digital signal processing, digital image processing, convex optimization, and quantum mechanics. Instructors are given great latitude in the design of their courses. They also have access to significant instructional design and multimedia resources. Student learning patterns, outcomes, and satisfaction are being measured both quantitatively and qualitatively. This work-in-progress presentation will report on the mid-point results of the EE Online program, reviewing the types of courses developed, the challenges encountered, and the assessment of learning patterns and outcomes.

Section 4B: 5x10 Interactive Session
Pacifica Conference Room
Session Chair: Zachary Pardos

Chris Tseng, *Assessment of a MOOC Class in Computer Science*

Abstract: Students took online class from selected MOOCS course as prepared and posted by the instructor. An online quiz after each online lesson was conducted to assess students’ learning outcome. The instructor met with the students in class after the online activity to focus on the content that students need more help on. The rest of the class time was used for Q&A and additional drill on problem areas as identified by the online quiz outcome.
A survey on students’ preference and rating of various hybrid online lessons was conducted at the end of the class. We found the majority of the students welcomed the 1 to 1 (1 in-class lesson followed by 1 online lesson) hybrid learning approach most. The instructor, however, found the 2 to 1 (2 in-class lessons followed by 1 online session) to be most efficient. Other kinds of students’ feedback in this survey will be shared in this presentation.

Sarah Eichhorn, *A Precalculus Course: From to Classroom to Online to MOOC*

Abstract: Starting from a traditional face-to-face Precalculus course, we designed an online course and then a MOOC. We used common student performance assessments across these three course delivery modalities and have used these assessments to study student learning outcomes for students utilizing various learning materials. The same instructional videos and assessments have been used for UCI online courses, University of Maryland flipped courses, and Coursera MOOC courses. We will share how student engagement with the course materials varied across these delivery platforms and what we have learned about the key indicators for student success in each format.

Melissa Loble, *Open Online Course with AMC and University of California-Irvine*

Abstract: In October 2013, Canvas Network produced an open online course in conjunction with AMC Television Network and the University of California - Irvine that introduced more than 60,000 participants to college-level learning of math, physics, life and social sciences. With this endeavor, a new audience was introduced to STEM fields through the lens of a popular television program. This session reveals data and insight gained through that experience. Presenters propose that the multidisciplinary format and the pop culture connection made learning a success for students with little or no prior college experience.

- Data shows that a general audience finds academic value in a college course when connected to everyday activities and pop culture
- Multi-disciplinary courses successfully engage course participants in subjects they might not otherwise explore or invest time in learning
- A pop-culture connection in a free online course makes college-level learning accessible for participants with little or no prior college experience

Section 4C: STEM MOOC Classes
Costanoan Conference Room
Session Chair: Ping Hsu

Adrienne Williams, *Assessment of a Preparatory Course in Biology*

Abstract: Our assessment of failure rates in UC Irvine’s introductory biology between 2005 and 2011 indicates a strong negative correlation between SAT scores and student performance. Under-represented minority students (URMs) and women are more likely to have low SAT and no AP biology and this contributes to the higher failure rate in these groups. When asked to create an introductory biology MOOC for UC Irvine, we elected to create a pre-freshman “preparation for introductory biology”
MOOC that would give pre-UCI students free practice in critical thinking before their first college class begins.

The Preparation for Introductory Biology MOOC was prepared and taught through Coursera in Summer 2013. Incoming students who had chosen to enroll in Introductory Biology (Bio 93) were invited to participate in the online course, along with the general public. The course contained standard biology content on membrane transport, protein synthesis and localization, and neurophysiology. Students could also complete optional writing assignments associated with primary scientific literature for a “Distinction” certificate. About 550 people completed the MOOC with Distinction. Over 130 of them were pre-UCI students who went on to pass Bio 93 at rates higher than the class average.

While these results are promising, we are still discussing the best ways to control for high motivation without using a randomized control trial. Issues of scalability, sustainability, and textbook copyright issues are also important.

Pong Chu, Low-Cost Universal Lab Platform for Computer Engineering Curriculum

Abstract: The laboratories are an essential part of a computer engineering curriculum. Hands-on experiments and projects reinforce the key theoretical concepts, help student’s problem-solving skills, and encourage creativity and imagination. Many courses in the curriculum contain a lab component, including digital systems, computer organization, embedded system, and senior capstone project. Traditionally, the school provides lab equipment, prototyping components, computers and software tools. However, recent advancement in FPGA (field programmable gate array) makes it feasible to construct an inexpensive universal lab platform and perform the experiments off sites.

FPGA is a device that contains “generic logic,” which can be configured to perform specific hardware functions. As technology advances, many inexpensive but capable FPGA prototyping boards become available. It costs about the same as a textbook and thus can be purchased for personal use. Because of the configurability, it is possible to use the same FPGA board to meet the needs of courses listed above and to conduct the experiments remotely at students’ homes. This approach involves the following tasks:

- Select a proper FPGA board and parts
- Select proper software tools
- Determine the testing equipment
- Establish a mechanism for technical help and support
- Set up procedure to evaluation (i.e., grade) student’s work
- Develop experiments and projects with the above constraints

While this setup is no match for real on-campus lab facilities, it allows students to perform substantial amount of lab work in a remote site.

12:00 – 12:45 pm  Lunch, Loma Prieta Ballroom

1:00 – 2:00 pm  Interest group meetings in Loma Prieta Ballroom
2:30 – 3:00 pm  Break, Loma Prieta Ballroom

3:00 – 4:00 pm  Breakout Session 5: MOOCs in STEM

Session 5A: MOOCs in STEM
Pacifica Conference Room
Session Chair: Michael Schatz

Michael Lerner, *Achieving Laboratory Learning Outcomes in an Online Chemistry Course*

Abstract: For several years, Oregon State University (OSU) has offered a fully online, asynchronous general chemistry sequence aimed at non-science majors, a hybrid sequence aimed at science majors, and a hybrid organic chemistry sequence. About 10-15% of our students are currently enrolled in online sections and student interest and enrollments continue to grow faster than in our on campus sections. Successfully developing and managing the lab components of these sequences requires a range of strategies. We’ve learned and are learning how to proceed after carefully considering our learning objectives, gaining direct experience with a range of solutions, and instituting a suite of assessment methods to gauge outcomes. Based on these experiences, we have recently added a graduate course about including distance science lab instruction in the curriculum that provides direct experience on the capabilities, strengths and weaknesses of learning modes such as virtual labs, hands-on lab packs, kitchen science and remote access experiences. In this talk, I’ll present the history, experiences and learning objectives for our chemistry labs, along with assessment strategies and data on student satisfaction and success. I will also focus on an interactive virtual lab approach that is being developed by an OSU-industry collaboration.

Galen Picket, *Using an Interaction Tool in an Online Physics Laboratory Course*

Abstract: The great opportunity presented by a MOOC is not one of efficiency, but one of flexibility in promoting the instructor-student interaction. I will present ongoing work at CSU Long Beach in developing an (efficient) interaction tool, Social Homework by edudotonline.com, and in applying this tool in a fully online version of our introductory physics with laboratory courses.

Session 5B: MOOCs in the Classroom
Ohlone Conference Room
Session Chair: Andrew Hsu

Donna Ziegenfuss, *Using a MOOC as a Faculty Development Tool and/or Learning Community for STEM Faculty Teaching Flipped Classes*

Abstract: This presentation will discuss the progress thus far of an NSF-funded collaborative faculty development grant project where STEM faculty from a community college and public research university are enrolled in the open MOOC as students. The purpose of the training course is to provide support and resources for faculty who are learning how to use new technology tools, MOOC tools, as well as flipped classroom strategies to transform their STEM classroom teaching. The
MOOC is structured in three parts so that: (1) faculty read relevant educational literature on the pedagogy of teaching in the flipped classroom as they design and develop instruction and classroom materials; (2) try out their ideas, concepts, and course materials in their own real classroom; and (3) reflect on and share their experiences with other faculty also participating in the flipped classroom community. Faculty participating in this MOOC course are supported by three campus support units including: the library, the LMS and Teaching and Learning with Technologies support group, and the Center for Teaching and Learning Excellence.

Data and lessons learned about the MOOC course pilot format, course content, and the STEM learning community component will be presented. Participants who attend this session will have an opportunity to discuss their own institutional faculty development efforts and provide additional feedback for the presenters who are in the process of creating the first full semester flipped classroom MOOC course.

Jeremi London and Cynthia Young, Toward a Research Agenda Around MOOCs in Engineering Education: Feedback from Two NSF-Funded Workshops (Work in Progress)

Abstract: MOOCs are a recent phenomenon that, some believe, will transform higher education. With their low cost and potential to reach a large number of students, MOOCs have the potential to broaden access to education at all levels at any time in any place at any pace. MOOCs have infiltrated higher education at such a rapid pace that there has been little time for large groups of educators to have meaningful discussions about how MOOCs can be leveraged to support student learning. In response to this need, a set of NSF-funded workshops targeting engineering faculty are being held at four conferences in 2014 – namely, ASME Engineering Education Leadership Summit 2014 (in March), Electrical and Computer Engineering Department Heads Association conference (March), American Society for Engineering Education (June), and Biomedical Engineering Society Annual Conference (October). Each workshop is moderated by a NSF Program Officer and brings together a panel of experts on MOOCs, online learning, and engineering content to discuss the potential for MOOCs in engineering education. In addition to stimulating conversations and research collaborations among faculty, insights from this series will lead to the development of a NSF research agenda on the role of MOOCs in engineering education. As of the time of this conference, two out of four of the proposed workshops will have passed. This work in progress will include highlights from discussions that took place at the first two workshops.

Session 5C: Flipped Classrooms & MOOCs
Costanoan Conference Room
Session Chair: Julie Libarkin

Khosrow Ghadiri, Ping Hsu, Sutee Suijitparapitaya, Effective Strategies for the Flipped Brick Classroom Using Online Cloud Content

Abstract: A major area of improvement in public higher education is to raise the curriculum and achievement standards by enhancing the course content and providing cutting edge instruction. Students need more than ever to acquire advanced technical skills to be competitive in the global economy. Currently the low passing rate of students in core, technically challenging courses creates a bottle neck
effect prohibiting advancement in their degrees. Educators must assist students to overcome gaps in preparedness, technical abilities and achievement. Technology employed to enhance the face-to-face (brick) classroom teaching has the potential to increase student engagement and success. Even the most well-intentioned and talented faculty cannot address the unique needs of each student in the brick classroom. It is possible to use technology to individually present content to meet the student needs. A core electrical engineering course, EE098 Introduction to Circuit Analysis, has had a traditionally low passing rate at San José State University. Improvement of student success in this course is imperative, especially because all engineering majors are required to pass the course in order to advance in their degrees.

San José State University implemented a two-year pilot study using a blended model of learning by merging content from an on cloud MOOC (Massive Open Online Course) with in-class, team-based instruction as part of a required sophomore-level electrical engineering circuit theory course with annual enrollment of about 500. Students were required to watch edX video snippets and complete cloud exercises and homework (including virtual laboratory experiments) before coming to each class. Students work in teams to solve problems collaboratively with the help of the instructor and TAs in the brick class. This pedagogy is referred to as team-based, flipped classroom model. The central objective of this pilot was to examine how adaptation and later adoption of the new edX’s MIT 6.002x (Circuits and Electronics) MOOC content in a flipped model of teaching may improve student learning in a credit-bearing college course. Multiple objects for this pilot included: (1) to improve the department’s typical student passage rate over seven years of 65% for EE098 course; (2) to improve students’ retention rate; (3) to shorten students’ time-to-degree; (4) to improve the quality of the content of the course; (5) to reduce the prerequisite contribution for successful passage of subsequent course; (6) to customize students’ learning experience, (7) to smooth the transition from a traditional mode of classroom teaching to an on-line mode of teaching, and (8) to incorporate team-based learning for peer-to-peer instruction to enhance students’ collaborative critical thinking.

Anamarija Frankic and Rrezarta Hyseni, *Coasts and Communities, A Comparison of Noncredit MOOCs and Credit MOOCs*

Abstract: In the past two years, UMass Boston made its first steps in the field of massive open online courses (MOOCs) by developing and offering three of them. One of these, Coasts and Communities, an environmental science course from the School for the Environment, was just redesigned and expanded to also serve as a 1-credit undergraduate coastal environmental lab course, targeting high school graduates and new potential students. Members of the team that designed and produced the two courses, instructors from the School for the Environment and instructional designers from the College of Advancing and Professional Studies, will share their experience with this uniquely challenging collaborative process. We will compare the two offerings of the course: first time as a free open course without credit, second time open course with a 1-credit option, and share discoveries and lessons learned, both technical and pedagogical. We will discuss design and development processes involved in putting the courses together while attempting to apply best practices in online learning, focusing on what the particular challenges of labs are: how to make them inspiring and fun by using ‘gamification’ and visual rewards like open badges to guide and reward student learning. We will also present how we dealt with the challenges that follow the delivery and assessment of lab courses and how they translate in an online environment.
4:15 pm  Ending session, Loma Prieta Ballroom

*End of conference for participants*

Day 2: Conveners and Organizing Committee only
5:00-6:00 pm  Dinner/ Synthesis and Outline of Next Steps, Engr 285
6:00-7:30 pm  Organizing Committee Report Writing, Engr 285
Notes
Conference Wireless Access

We have established a guest account for the use of the participants in this conference. Please use the following user ID and password.

User ID: moocstemconf
Password: xsvG21BO

Speaker Ready Room

There are computers and a projector available in the Alamden Room. There will be staff available to assist you with your presentation.

Map of Upper Level in SJSU Student Union