TEACHING SOCIAL ENTREPRENEURSHIP THROUGH A MOOC FORMAT

Jeff Plumblee, Dylan Bargar, Claire Dancz, Leidy Klotz, and Amy Landis
CLEMSON UNIVERSITY

Abstract

This paper describes a uniquely formatted course that teaches students the basics of sustainable design, the design process, and introductory business principles through a series of six structured themes. As they learn these concepts, students work in teams to address a societal challenge of their choosing. Learning outcomes are achieved through the combination of shared attributes of xMOOCs and cMOOCs in an active learning environment. This paper presents a description of how the course functions, includes preliminary assessment data on the effectiveness of the course in comparison with more traditional methods, and discusses future directions for the course.

Introduction

Students today show increasing interest in social entrepreneurship but do not have the skill sets to effectively advance their ideas. Online platforms, such as massive open online courses (MOOCs), provide a unique opportunity to engage a wide array of students using minimal resources, and these web-based courses are increasingly becoming integral pieces of academic institutions' long-term strategies (Allen and Seaman 2015). With this in mind, and with the intent to maximize our positive impact, we developed an online course that guides students through the design and implementation process while teaching them the skills needed for success.

The course, "Creatively Applying Science for Sustainability," is open to all students. It teaches students basics of sustainable design, the design process, and introductory business principles through a series of structured themes. Simultaneously, students work collaboratively in teams to address a societal challenge of their choosing. Students are encouraged to practice the technical skills and business principles they learn in a social atmosphere.

MOOCs are often categorized as cMOOCs or xMOOCs. cMOOCs focus on creation, autonomy, and social networked learning, but are criticized as lacking direction. xMOOCs take a more traditional approach and focus on "knowledge duplication" on a large scale (Siemens 2012). We have combined the two, attempting to eliminate common shortcomings while amplifying the positive aspects using an active learning pedagogy.

The course combines the connectivity of a cMOOC with the structure of an xMOOC. This provides the structured foundation and common ground for students to acquire technical skills, but allows the flexibility for the students to build collaboratively in a direction that is most engaging to them while obtaining a deep understanding of the topic. The course described is not designed for success in spite of diversity of thought; this course is designed for success because of diversity of thought.

By the end of the six themes, students have demonstrated course competencies by identifying their challenge, engaging stakeholders, evaluating potential solutions, performing conceptual and detailed design, prototyping, defining a business model, and plotting a path for delivery.

This paper details how the course was operated, including major themes and learning objectives. Preliminary results of the course are presented, and the authors provide discussion on methods to improve the course in future offerings.

The Creatively Applying Science for Sustainability (CASS) Course

The intent of this course was to create a scalable method to teach topics related to sustainability, while developing skills in innovation and design processes using active learning techniques in an online format. Our intended outcomes were to help students develop an acute awareness of the importance of sustainability to modern issues and the skill sets to influence change. Through the course, students would progressively develop abilities to address these problems using sustainable, practical, and holistic approaches. This included the application of discovery-based learning and active learning principles while students solved a specific societal problem.

The objective was to develop experienced, highly skilled students who possessed the unique ability to instigate positive change. Much of the course focused on design and application processes created to give students exposure to challenges common to private and public sectors. The course was intended to be rigorous while also creative, with the goal to develop the sanguine creativity necessary to address many human needs currently unmet in society. We created assessments to evaluate the ability of this course to meet or exceed our objectives. Additionally, students' specific projects illustrated their interests in these topics and their proficiency in developing applicable solutions.

The course was designed to include students of all disciplines and at any academic level within the undergraduate program. The technical concepts are explained without detailed scientific jargon, and concepts are kept at an introductory level to engage non-technical students who are interested in sustainability in science, technology, engineering, and math (STEM). The variety of students in the course was intended to provide a diverse set of student perspectives, creating a unique atmosphere of collaboration and discussion.

Course Content and Student Ventures

The course was designed to train students to creatively apply scientific principles to address societal needs in a sustainable way. The course highlighted and uncovered connections between society's most pressing scientific principles and human-scale issues, including health, mobility, inequality, and access to clean water. Students used the knowledge gained in the course to address one of these issues as their design venture. They worked through six themes, each containing five modules and one design venture module. Modules were designed to take between two and four hours each, and the semester project, referred to as the "design venture," paralleled the themes, with six milestone deliverables (see Figure 1).

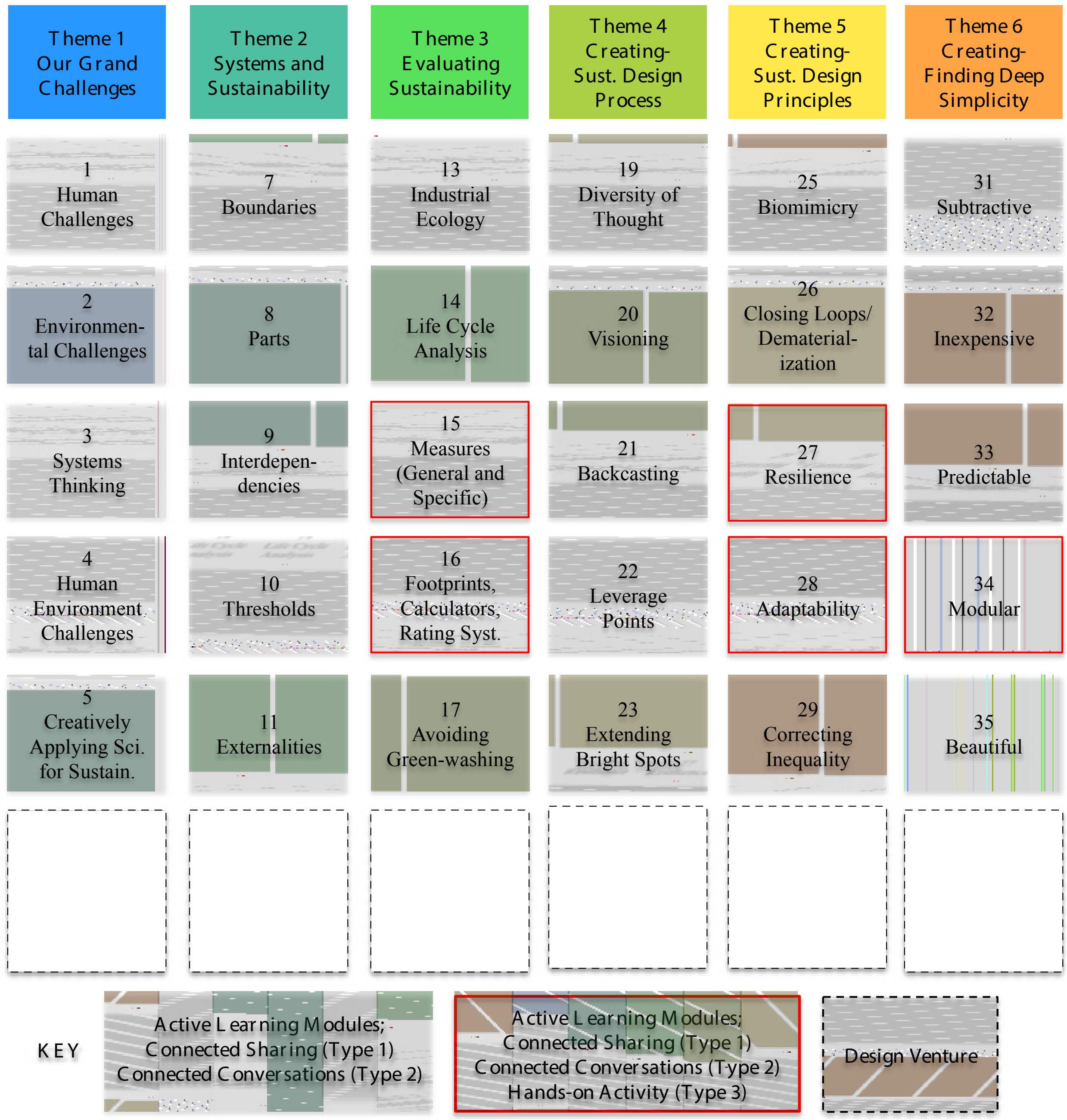


Figure 1. Creatively Applying Science for Sustainability (CASS) Course Structure.

The pilot CASS MOOC covers topics of sustainability and design through 36 modules: five content modules and one design venture module within each of the six themes. All 36 modules require student participation through two active learning types: connected sharing and connected learning. Fall 2015 pilot students also participated in an additional third type of active learning: a hands-on, at-home activity, in the five modules outlined in red.

Preliminary Pilot of Active Learning in CASS MOOC

The course was piloted as a flipped classroom on the Canvas platform (https://canvas.instructure.com/courses/953852). Active learning involves constructing meaning from direct experience and actively involves the learner in a real (rather than abstract) experience (Cantor

1995, Itin 1999). Active learning in the pilot CASS MOOC takes three forms:

1. Students access and share online content related to real experiences in student life (connected sharing).
2. Students participate in meaningful online conversations prompted by the instructors (connected conversations).
3. Students participate in real, hands-on experiences outside the classroom (hands-on activities) (see Figure 1).

Students performed individual assignments at home (based on the course's Canvas platform) and in class, students worked on group activities or their design ventures. All assignments were turned in via the Canvas platform, and the in-class atmosphere was very social and discussion-oriented.

In each module within the course, students participate in individual activities, connected activities, and provide contributions to the self-organizing system. The individual activities include watching videos, reading articles, and performing research. Connected activities include tasks such as posting to the course's Canvas forum, tweeting epiphanies they have during assignments, or responding to someone else's post on the Canvas forum. Contributions to the self-organizing system include activities such as posting videos of how the student completed an assignment to be used as an example in the future, retweeting a favorite relevant tweet from a classmate, and sharing posts or information on platforms outside of the Canvas forum.

Example CASS MOOC Module: Human Challenges (Active Learning Types: Connected Sharing and Connected Conversations)

"Human Challenges" is the first module within Theme 1 (Our Grand Challenges) and serves as an introduction to the course material and challenges to be addressed within the course. Individually, students review web-based lists of challenges that humanity faces. As part of the Canvas forum, students succinctly argue which challenges they perceive as most important, and which will impact them the most at the age of fifty (*connected sharing*). Additionally, students engage using a common "hashtag" on Twitter's social media platform to answer the question: "Which challenge impacts you most right now, and why," post a picture on Twitter, review one another's posts, and retweet their favorite tweet (*connected conversations*). The module, as assigned to students, is depicted in Figure 2.

1- Human Challenges
Health and well-being, shelter and mobility, peace and security, happiness and fulfillment – our challenge is to provide these for human beings now and forever. In this module, we will reflect on the biggest systematic barriers to humans being able to meet their needs (e.g., inequality, working hours, right to demonstrate or vote, land grabbing, corruption), including how we are personally influenced by them.
Individual learning:
Review the Millennium Development Goals, Sustainable Development Goals (https://en.wikipedia.org/wiki/Sustainable_Development_Goals (links to an external site)) and/or any similar credible list of challenges facing humanity. (If you use another list, please share with the class).
Connected sharing:
Post to the discussion forum your answers to the following questions in no more than 100 words total. (Unless otherwise noted, posts should be less than 100 words; bulleted lists are ok; use a tone and level of professionalism you would use in an email to a co-worker; try to make the biggest statement with the fewest words. It's doable - the Gettysburg Address was only 273 words. But the short length will require some time and thought - Mark Twain once began a letter apologizing for its length because he didn't have enough time to make it shorter.)

- Which challenge do you think is most important, and why?
- Which challenge do you think will impact you most when you are 50 years old, and why?

Connected conversations:
Tweet your response to the following question. (Throughout the experience, you will be asked to tweet some of your ideas--it's time to sign up for a twitter account if you don't already have one). Using Twitter means whatever you share will need to be short, but it can still be thoughtful. On all of your tweets, add the hashtag "#Sci4Sus" at the end so your classmates can find them and to help advertise the experience more broadly. My twitter is @leidyklotz.

- Which challenge impacts you most right now, and why? Take your own picture representing this challenge and include it with your tweet.

Check another students' post for thoughtfulness (will be automatically assigned).
Review the tweets and retweet your favorite.

Figure 2. CASS MOOC module example: Human Challenges.

Example CASS MOOC Module: Modular (Active Learning Types: Connected Sharing, Connected Conversations, Hands-on Activity)
"Modular" is the fourth module within Theme 6 (Creating - Finding Deep Simplicity) and serves as an introduction to modular designs. Individually, students begin this module by watching a video on modularity and then apply modularity to their design. Students then share their thought process by developing a video (connected sharing). Students are then asked to choose their favorite video and prepare for a discussion supporting their favorite video choice (connected conversations). Finally, students are given instructions for a hands-on activity, to be conducted at their home, through which they consider modularity while actively disassembling an object (hands-on activity). The module, as assigned to students, is depicted in Figure 3.

34- Modular

Like designs that are more predictable, designs that are more modular encourage distributed decision-making and problem solving in part because they are more easily customizable by user. If your design is modular, it can start small and become big. We will make our designs more sustainable by making them more modular.

Individual learning:

Watch this Complexity Lab video on modularity https://www.youtube.com/watch?v=DuK4dKH0zOA&list=PLsJWgOB5mIMDxrvzexu1BhfBFygW9gby0&index=14 (As you will notice, modularity is similar to what Whitesides calls "stackability" in his TED talk.)

Apply modularity to your design.

Connected sharing:

Develop and post a video showing your thought process in doing the connected learning activity. The objective is to show your classmates how it was done.

Connected conversations:

A prize will be given for the video your classmates find most helpful and we will use it to help future citizens in the experience. Choose your favorite video and prepare to discuss why this video is your favorite with your classmates.

Hands-on activity:

A. Discover how disassembly, end-of-life, sustainable metrics, and modularity relate. You will time yourself in an active disassembly of the object you selected using common household tools and record metrics during the disassembly.
B. Disassemble your object.
    a. Take a selfie of yourself and the object you selected during disassembly.
    b. Record metrics during disassembly, provide feedback on the ease-of-disassembly.
C. Re-assemble your object.
    a. Record metrics during re-assembly, provide feedback on the ease-of-re-assembly.
D. Critique the materials and/or hardware used to construct your object by addressing:
    a. How would you alter the design to increase its capacity for disassembly? Positively impact the product's end-of-life? Increase its sustainably?
E. Determine two NEW purposes/adaptations for the object you disassembled.
F. Identify the components that enable this object to be modified and document whether the two new purposes have components in common. What, *if anything*, leads to modularity?

Figure 3. CASS MOOC module example: Modular.

CASS MOOC Design Venture

Students chose a wide variety of challenges to address within the design venture, including local and international issues, with topics ranging from methods to decrease tarmac wait time to sustainable tree houses.

The design venture structure is outlined in Figure 4. Students work through the six milestones in tandem with the six themes. First, students identify their challenge and (optionally) form teams. They must perform background research to understand the challenge, its impact on society and stakeholders, inherent cultural or ethical considerations, and relevant cause-and-effect relationships. For Milestone 2, students further refine Milestone 1, define minimum requirements for success, define constraints, create a best-case scenario, and develop criteria with which they can evaluate solutions. In Milestone 3, students brainstorm and define their optimal solution. Next, students begin design and solicit feedback from stakeholders, peers, and experts. In Milestone 5, students begin refining a prototype, consider operations and maintenance, generate a basic business model, and continue improving their solution based on Theme 5's modules. Finally, for Milestone 6, students present their solution, reflect on their experience, and develop a path forward.

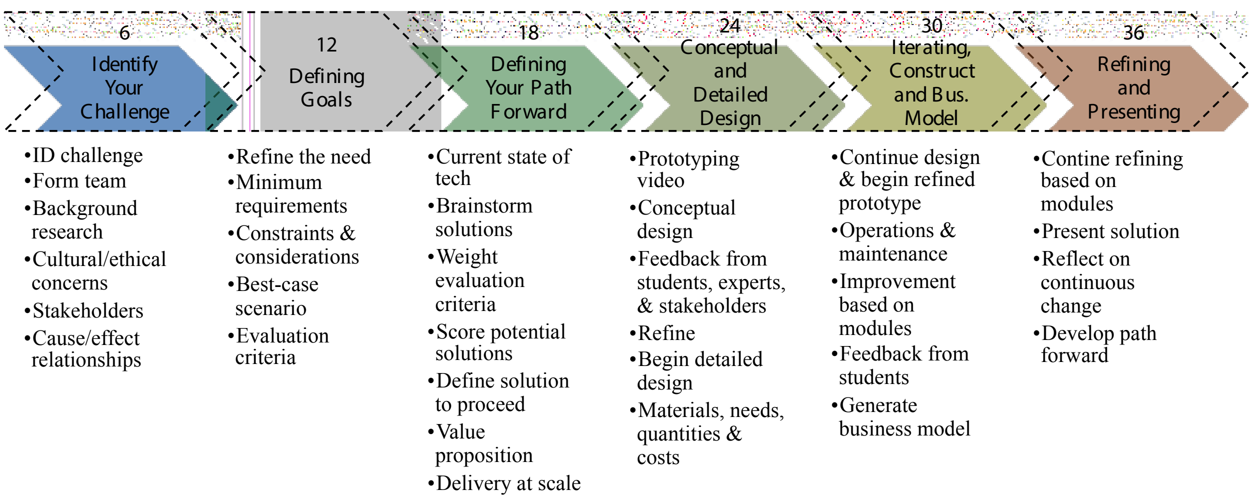


Figure 4. CASS design venture structure.

Example CASS MOOC Design Venture

One group chose to attempt to address two issues simultaneously: Haiti's infrastructure is largely built with poor quality materials, and many areas within Haiti do not have a mechanism to collect and dispose of solid waste.

Their goal was to explore whether any waste products could be used as an additive to concrete to strengthen concrete masonry units (CMUs), one of the most common construction materials in Haiti. The team worked with Clemson Engineers for Developing Countries, a student organization actively working in Haiti, to help define the problem and connect students with Haitian stakeholders. Students partnered with a faculty member in civil engineering to provide insight on suggested materials and feasibility. The students were able to determine what types of garbage were available in large quantities in Haiti, gain a basic understanding of what types of materials could/could not strengthen concrete, and have plans for testing strength of CMUs with different waste materials included. Students also realized that their project would face a number of implementation challenges, such as the risk that Haitians may not adequately value the higher strength block and there is no central garbage collection or incentivization for collecting waste.

Assessment of Learning Outcomes and User Experiences

The CASS MOOC was assessed using post-course assessment surveys and post-activity surveys. This survey research was approved exempt under IRB protocol #2015-254 at Clemson University. Students took the anonymous digital survey on their own at home during the last week of the semester. The post-course assessment survey questions included both open-ended and single-response questions. Survey questions were used to collect population demographics, cognitive and affective outcomes on the importance of skills for a professional engineer based on Bielefeldt's Engineering

Professional Responsibility Assessment (EPRA), and knowledge and perceptions of sustainability and National Academy of Engineering (NAE) Grand Challenges for Engineering throughout their undergraduate career (Bielefeldt 2012; Antaya 2015; and National Academy of Engineering 2016). A total of 72 students participated in the course and modules. The post-course survey response rate for Fall 2015 was 35%.

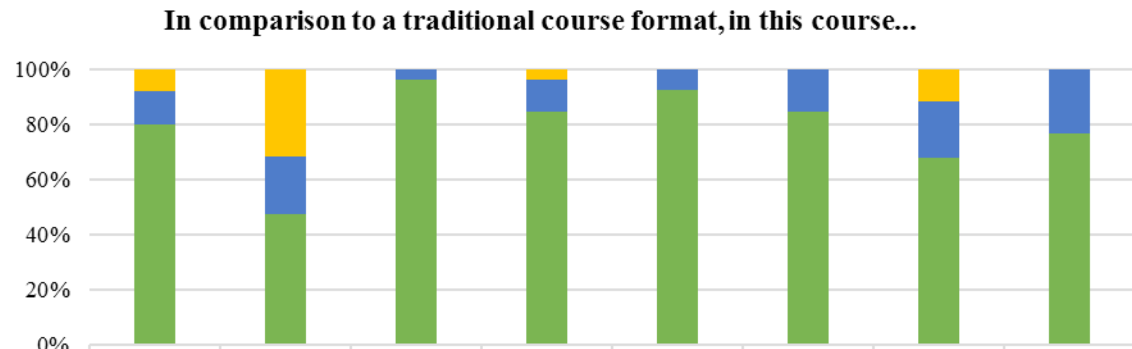
The post-activity survey questions, shown in Table 1, included both open-ended and single-response questions. All students took the anonymous digital survey on their own at home after completing each of the three hands-on activities. Survey questions were used to collect population demographics, learned information, and perceptions of the hands-on activity and preferences for repeating the activity in the future. A total of 72 students participated in the course and modules. The post-course survey response rate for Fall 2015 Energy Measures activity was 56%, Infrastructure Resilience was 40%, and Modularity was 31%.

Conclusion

While this course will be offered online in the future, the pilot was structured as a flipped classroom to provide additional structure and support to maximize opportunities for student success and to help instructors identify challenges and concerns in real-time. Because the course was designed to be wholly online, having instructors facilitating the course did not significantly improve the clarity of the course, and may have actually created more confusion at times. The pilot did help identify areas in which clarity could be improved, and also helped highlight subjects that students perceived as particularly low or high value. These high value subjects will be expanded upon where possible, and perceived low value subjects will be reframed to underline their importance or will be decreased in scope if they are also perceived as low value by instructors.

The pilot included a post-course cross-sectional assessment of the students' experience. The online survey asked the student seven Likert-style questions comparing their experience to a traditional course format (Likert 1932). Because the pilot was a blended learning format, it may not be fully indicative of the results of a wholly online experience. Also, the pilot was primarily advertised by word of mouth within the civil engineering department and did not attract the diversity that we had hoped; of the 25 respondents, 80% identified as undergraduate seniors based on credit hours, and 76% of the respondents were majoring in civil engineering. In the future, we will increase diversity by more broadly advertising the course within Clemson University, as well as offering the course to a wider audience outside of the university. Additionally, though the results indicate strong positive trends, the pilot survey only included 25 respondents and results are not statistically significant.

Eighty percent of students surveyed felt that the quality of their learning experience was at least somewhat higher than in a traditional course format. Ninety-six percent felt that the amount of interaction with other students was higher than in a traditional course format. Ninety-two percent felt that the quality of interaction with the instructor was at least somewhat higher than in a traditional course format. Full results can be seen in the bar chart below.



	The quality of my learning experience …	The intensity of my learning experience …	The amount of interaction with other students…	The quality of interaction with other students…	The quality of interaction with the instructor…	The quantity of interaction with the instructor…	The motivation to participate in class activities…	My comfort level participating in class activities…
Decreased	8%	32%	0%	4%	0%	0%	12%	0%
Neutral	12%	21%	4%	12%	8%	15%	20%	23%
Increased	80%	48%	96%	84%	92%	84%	68%	76%

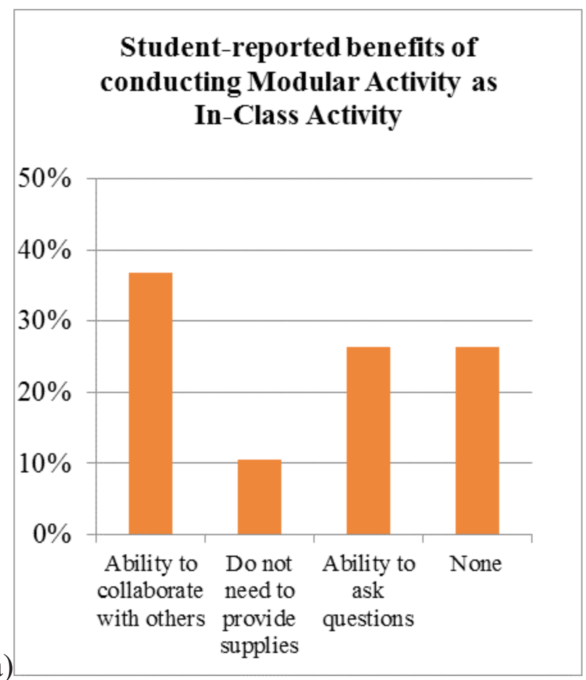
Figure 5. Post-course survey assessment results, Fall 2015.

COG (C) AFF (A)	QUESTION	POSSIBLE RESPONSE
n/a	1. Based on credit hours, you are a:	Undergraduate -freshman, -sophomore, -junior, -senior
n/a	2. What is your current major, if you have declared one?	Open-Ended Response
c	3. In one sentence, please summarize YOUR major take-away from the Activity.	Open-Ended Response
c	4. Identify the component(s) of the Activity that made it a success.	Open-Ended Response
a	5. What change(s) would you make to improve the Activity?	Open-Ended Response
c	6. Did you work with a partner on the Activity? (select ONE)	No, I worked alone, Yes, I worked with 1 other person, Yes, I worked with 2+ people
a	7. What are the benefits of conducting the Activity as an in-class activity?	Open-Ended Response
a	8. What are the benefits of conducting the Activity as an at-home activity?	Open-Ended Response
a	9. Would you personally learn more from the Activity as in-class activity or an at-home activity?	Open-Ended Response
a	10. Would you recommend the Activity to future sessions of this course? Why or why not?	Open-Ended Response

Table 1. Post-Activity Assessment Survey, Fall 2015.

In Fall 2015, pilot students self-reported the benefits of conducting the hands-on activities as in-class or at-home activities. Figure 6 depicts the common themes among students' written responses for the Modular Activity in which students disassembled and reassembled an object of their choice while exploring sustainability, metrics, and modularity and their reflection on whether the activity should be (a) in class or (b) at home. Thirty-seven percent of students who responded reported that the greatest benefit in conducting the activity in class is the ability to "collaborate with others" followed by the "ability to ask questions" and "do not need to provide supplies," both reported at twenty-six percent. Twenty-six percent reported that there was no benefit to conducting the activity in class. In comparison, only eleven percent reported that there was no benefit to conducting the activity at home. "Personal control over supplies and interest" was reported to be the greatest benefit to conducting this activity at home at forty-seven percent, followed by "increased learning on own" and "personal control over time and space," both reported at twenty-one percent.

(a)



(b)

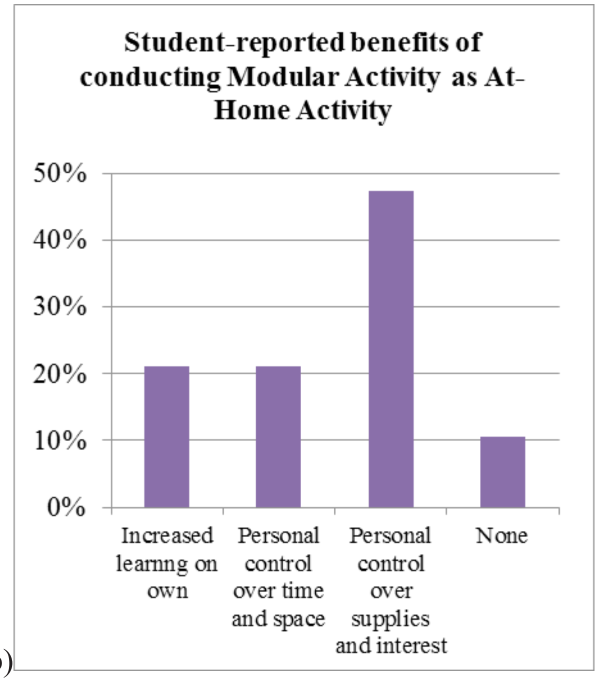


Figure 6. Post-activity assessment results, Fall 2015. Students' self-reported benefits of Modular Activity as (a) in-class or (b) at-home activity.

Future assessment will include both pre- and post-course assessment and exploration into the benefits of hands-on learning in class and at home to gain a better understanding of the cognitive outcomes of the course, as well as any changes in the affective outcomes due to increases in student diversity and migrating to a fully online format.

References

Allen, I. E, and J. Seaman. 2015. "Grade Level: Tracking Online Education in the United States." Babson Park, MA: Babson Survey Research Group.

Antaya, C. L. 2015. "Integrating Sustainability Grand Challenges and Active, Experiential Learning into Undergraduate Engineering Education." PhD diss., Arizona State University.

Bielefeldt, A. 2012. "Assessing Engineering Students' Understanding of Social Responsibility from Undergraduate and Graduate Education into Professional Life." National Science Foundation, Grant #1158863.

Cantor, J.A. 1995. "Experiential Learning in Higher Education: Linking Classroom and Community." ASEE-ERIC Higher Education Report 7.

Itin, C. M. 1999. "Reasserting the Philosophy of Experiential Education as a Vehicle for Change in the 21st Century." The Journal of Experiential Education 22(2): 91.

Likert, R. 1932. "A Technique for the Measurement of Attitudes." Archives of Psychology 22:140.

National Academy of Engineering. 2016. "Grand Challenges for Engineering." http://www.engineeringchallenges.org/cms/8996.aspx.

Siemens, G. 2012. "MOOCs are Really a Platform." July 25. http://www.elearnspace.org/blog/2012/07/25/moocs-are-really-a-platform/.