Using a Flipped Course for 2-year College Outreach

Eric Breimer
ebreimer@siena.edu
Computer Science Department, Siena College
Loudonville, New York 12211, USA

Michelle Conway
m.conway@hvcc.edu
Department of Computing and Information Sciences
Hudson Valley Community College
Troy, New York 12180, USA

Abstract

Creating video lectures and in-class activities for flipped courses requires considerable effort. It is natural to secure such content behind closed learning management systems, so the hard work of the author is not used at other institutions. However, 4-year institutions that seek prepared transfer students can benefit from sharing material in a targeted way. This paper describes a pilot project where flipped course material from a web design course at a 4-year college was shared with a similar course at a nearby 2-year college. This course is frequently transferred to the 4-year college and prepares students for upper-level courses. Sharing course material in this way can directly improve the curriculum alignment of 2-year and 4-year programs to create better pipelines that benefit both institutions. This model has potential to increase transfer rates while directly preparing students for advanced courses in 4-year programs. In this paper, we describe the methodology and benefits, share observations and survey results, and outline future plans to expand this project.

Keywords: Flipped Classroom, 2-year College Outreach, Web Design

1. INTRODUCTION

While smaller regional colleges may not have the resources and reach to effectively offer MOOCs (Massive Open Online Courses) (Daniel, 2012), sharing course content on a smaller scale can produce direct benefits. This paper describes a pilot project where flipped course material from a web design course at a small 4-year college was shared with an equivalent course at a nearby community college. This equivalent course is frequently transferred to the 4-year college as it prepares students for an upper-level web application development course and it satisfies requirements at the 4-year college.

Directly sharing video lectures and in-class activities in this type of scenario can make transferring to a particular 4-year college more inviting. But, unlike other forms of recruitment or outreach, this effort can directly improve the curriculum alignment of the collaborating 2-year and 4-year colleges. Students at 2-year colleges directly experience lectures and in-class activities from equivalent courses at a 4-year college. This level of coordination is deeper than what can be achieved by only sharing course syllabi and schedules.

According to (Labov, 2012], 2-year college faculty members would benefit from "opportunities to engage in research that encourages them to explore and assess new pedagogical strategies in the classroom and how these strategies affect student learning." The typical teaching workloads at 2-year colleges hinder the ability of faculty to experiment with new pedagogical strategies. This project can

help 2-year college faculty realize the benefits of the flipped classroom model without the time consuming preparation.

While the scale of the project is not large enough to make conclusive assertions, we describe our methodology, share key observations, present survey results, and outline the next steps in scaling up the project.

2. BACKGROUND

A flipped or inverted classroom, as coined by (Lage 2000], moves passive learning activity out of the classroom so lecture time can be used for more active learning. A common model is to share recorded video lectures online to free up class time for activities and problem solving so students can get immediate help from the instructor (Giannakos 2014 and Maher 2015]. Flipped classrooms have been used in many different fields in higher education including Mathematics (Lockwood 2013], Biology (Moravec 2010], Business Management (Schullery 2011], Industrial Engineering (Toto 2009] and Computer Science (Gehringer 2013].

While video recording and sharing can be done with only minimal technical expertise, creating high quality video lectures can still be very time consuming (Bergmann, 2012]. It is natural to protect the creator's hard work by securing course material with a learning management system that can only be accessed by students enrolled in the creator's course. In fact, such protection may be enforced at colleges that offer online courses.

While MOOCs (Massive Open Online Courses) have introduced a new paradigm for openly sharing course content, the institutions that offer MOOCs tend to be larger universities that can attract the audiences needed to realize benefits (Pappano 2012]. In MOOCs, the topic coverage is often designed to reach the largest audience possible (Macknees, 2010 and Daniel, 2012] and often relies on participant-generated content (Pope 2014]. While the MOOC model certainly has advantages, these advantages are hard to realize for smaller institutions and may not be advantageous if the goal of sharing course content is to improve curriculum alignment.

3. MOTIVATION & FOCUS

This project focuses on an introductory course covering the fundamentals of website design and implementation using HTML and CSS. At the 4-year college, this course prepares students for Web Application Development, which is a popular upper-level elective in the Computer Science (CS) B.S. program. At the nearby 2-year college, the equivalent course is required in the Associate of Applied Science (A.A.S.) degree in Web Design and WWW Programming. The course is a pre-requisite for advanced web programming classes, also required for this particular A.A.S. degree. In addition, it is an elective for the A.A.S. in Computer Information Systems (CIS), which is a terminal degree that prepares students for employment but can also be used to transfer to a variety of 4-year programs including the aforementioned CS program.

Each year, approximately 3 students on average transfer the web design course from this particular 2-year college to the 4-year college. In most cases, the students are CIS transfer students continuing their studies at the 4-year college. In rare cases, students at the 4-year college opt to take the courses at the 2-year college (typically over the summer).

Our broad and long-term goal is two-fold: First, we seek to encourage more students to transfer to a 4-year program in Computer Science by exposing them to lecture activities developed at the nearby 4-year college. And second, we seek to improve curriculum alignment so students will be better prepared when they do transfer. The paper focuses on the first goal, specifically measuring the impact on student impression. While we cannot make strong conclusions because our pilot project did not involve a large enough group of students, our observations indicate the promise of this project and will help guide our future work, which involves scaling up and applying the model to other course pairs.

4. PROJECT DETAILS

The web design course at the 2-year college was comprised of 17 students: 6 were in the A.A.S. program, 6 were in the CIS program, 2 were business administration majors, and 3 were non-matriculated or auditing.

We replaced two traditional lectures (50 minutes each) with two *flipped lectures* developed at the 4-year college. The *flipped lectures* were deployed using a publicly available website with an embedded video lecture, sample quiz questions, and links to the lecture slides and resource files. Students were asked to watch the video to prepare for a short quiz and activity

directly related to the video lecture. In class, students completed an HTML and CSS coding activity based on the video lecture. Before watching the first video, students were asked to complete a pre-activity survey. After completing the second and last activity of the semester, students were asked to complete a post-activity survey.

Pre-activity Survey
We surveyed students to measure their interest level in web design, in transferring to a 4-year college and in taking related courses. Figure 1 shows the format of survey questions (deployed with Qualtrics).

Figure 1. Survey question format

Video Lectures
The two video lectures were 36 and 24 minutes long respectively. While the videos were designed to replace a 50-minute lecture, a combination of editing and lack of student interaction enabled the content to be more efficiently presented.

The first video focused on the HTML5 video tag and demonstrated how to embed video and control it using various attributes. The second video focused on CSS3 transforms and transitions and demonstrated how to move, scale and rotate elements using CSS only. The first video primarily used PowerPoint slides and narration with some coding demonstration. The second video primarily used coding demonstrations where students were encouraged to complete the presented examples in preparation for the activity. For each *flipped lecture*, students were given advanced notice so

they could find a suitable time and place to watch the video.

The videos were recorded and edited using Camtasia and embedded on a website using the HTML5 video tag, which coincidentally was the topic of the first video. Figure 2 is the introduction text of the video from the website, which illustrates how we emphasized the quiz.

The 24-minute video below is a demonstration in a Web Design course at Siena College. Below are sample questions similar to the ones we might ask on a quiz or test. The video answers all these questions as well as the ones you will be asked in your class.

Questions

1.　What is the difference between a transform and transition?

2.　List three transform functions.

…

Figure 2. Video introduction text

Quizzes
Both quizzes were deployed using the Blackboard learning management system and included 10 multiple-choice questions. The primary purpose of the quiz was to encourage students to watch the videos, not to differentiate student knowledge. Thus, the questions were mostly informational (not problem solving) so they could be answered somewhat easily by watching the video and taking notes. Figure 3 shows sample questions from the first quiz.

4. Which is a disadvantage Shockwave Flash video?
　a) Requires browser plugin
　b) Uses more CPU/Power to play
　c) Uses proprietary technology
　d) Not open source
　e) All of the above

5. Which is an advantage of using HTML5 video?
　a) Does not require a browser plugin
　b) Lets the browser/device choose best codec
　c) Works with open source creators and editors
　d) All of the above

Figure 3. Sample Quiz Questions

The first quiz was made available at the start of the class period. Students were instructed to complete the quiz and then start the activity immediately.   While this setup helps the instructor verify that students are completing the quizzes individually, it reduces the amount of time for the activity during the class.

The second quiz was made available on Blackboard prior to the start of class and students were required to complete the quiz before coming to class.   This setup enables students to re-watch the videos to directly answer quiz questions, which we hoped would further encourage students to watch the videos.

Activity
Students were directed to the in-class activity instructions through a link on the course's Blackboard site that was not made available until the start of the class period.

For the first activity, the instructions guided students through a 4-part coding activity focusing on the HTML5 video element and various attributes.   Much of the code was available to the students in the instructions so they could copy and paste code fragments to help them focus on the big picture and not the nuances of the syntax.

The second activity guided students in using CSS transforms and transitions to achieve specific visual effects. Figure 4 shows an excerpt of the second activity instructions to illustrate the level of coding. The eight-part activity included three parts that students were encouraged to code in the video.   Thus, students who followed the instructions in the video could complete the in-class activity faster. The change in strategy was to give students further incentive to watch the videos carefully and complete work outside of class. Also, this strategy enables well-prepared students to finish early, so the instructor can focus on helping struggling students at the end of the class period.

Post-activity Survey
At the end of the semester and approximately one week after the second *flipped lecture*, students were asked to complete a survey with identical questions to the pre-activity survey. The purpose of the survey was to measure if the *flipped lectures* had an impact (positive or negative) on the students' impressions of specific topics. The questions (shown in Tables 1-8) addressed both general interest levels and interest in studying specific topics that the

flipped lectures touched upon in varying detail. For example, we asked about interest in studying *digital video production*, which was mentioned but was not the focus of either activity. To contrast, we asked about interest in studying the development of *interactive websites with CSS and JavaScript*, which is more closely related to the focus of the second activity. Our hope was that student impressions of the primary topics might improve while impressions of the ancillary topics might not change.

Part 4 - transform: scale

1.   Save part3.html as part4.html

2.   Change the transform for the div from a **skew** to a **scale** by using the following code:

```
transform: scale(0.9);
```

3.   When hovering over the div change the scale as follows:

```
div:hover {
  background-color: white;
  transform: scale(1.1);
}
```

4.   Save the web page

5.   Open the web page in either Chrome or Firefox.

Figure 4. Sample activity instructions.

5. OBSERVATIONS

First Flipped Lecture
As the students were beginning the activity, they were informally asked what they thought of the video lecture.   The first video was mildly received. Many students commented that it was informative but one student commented that the narration was monotone and the video (36 minutes) was too long and boring. One student admitted that he did not watch the video but was still able to complete the in-class activity.

Students had little trouble performing the in-class activity. The instructions guided students through the coding of an HTML5 video element and the addition of attributes to the HTML5 video tag. Much of the code was available to the students in the activity so they were able to copy and paste the code from the instructions on the website to their editor.   This enabled the students to complete the activity quickly.   A small snafu in the assignment – a shark image not being available – resulted in the students

having to find their own shark image on the Internet to display as the poster attribute for the video element. All the students were able to complete all four parts of the activity well before the end of class.

Second Flipped Lecture

Before the second in-class activity, the students were again asked for their feedback on the video. The students liked this video better: they described it as "cool" and "interesting." One student commented that he liked learning something specific, such as turning text into a button, as the video demonstrated. Again, some students did not like the "monotone" delivery of the instruction. One student said they muted the video and listened to music because it was too boring.

Some students completed parts 1, 2 and 8, which they were encouraged to do in the video, and only had to complete parts 3 through 7 in class. Most students had to complete all eight parts during class. In general, students could easily follow along and cut and paste code fragments from the instructions, refresh the web page, and see the result. The students were now more familiar with the format and had less general questions about how to start and complete the assignment. As in the first activity, a few students completed all the instructions quickly, but most students took longer to finish the entire assignment. In the 50-minute class, the first student was done in 25 minutes and the last student finished as the class was ending.

6. SURVEY RESULTS & ANALYSIS

Based on previous studies (Giannakos 2014], we hope that students' attitudes towards the subject area will improve when they participate in engaging activities that help them better understand the subject area. To ascertain whether our *flipped lectures* had an impact on students' attitudes, we crafted survey questions that directly asked about interest level in "web design" (Tables 1), in "making own website" (Table 2) and in areas of advanced study that were directly referenced (Tables 7 and 8). We also asked questions tangential to the presented topics (Tables 5 and 6). While the first flipped lecture mentioned digital video production and encoding/decoding, these topics were not the focus of the lecture, in-class activity or the course in general. We expected that students' interest in these peripheral areas would not positively change. Finally, we asked questions to measure impression changes related to career interest (Table 3) and transferring to a 4-year school (Table 4).

Out of 17 students, 13 completed the survey before the first video was shared and 14 completed the survey at the end of the course. While the number of participating students is not large enough to make strong assertions, we were nonetheless encouraged by the results and wanted to share the details.

The first question (see Table 1) indicated that students' interest in "web design" had increased. Before the activities, 3 students indicated *somewhat interested* but after the activities, all 14 students indicated either *interested* or *very interested*. Again, while the scale of this study is not large enough to draw conclusions, these results are indicative of the kind of improvements we hoped to see.

Responses	Pre	Post
(1) Not Interested	0	0
(2) Somewhat Interested	3	0
(3) Interested	6	7
(4) Very Interested	4	7
Total Responses	13	14
Mean	3.08	3.50

Table 1. Interest in web design

Table 2 shows a similar improvement when asking about interest level in "making own website." Two students indicated *not interested* and *somewhat interested* before the activities but afterwards, all 14 students indicated *interested* or *very interested*. Note that the two activity topics were chosen because they show some of the more interesting and interactive things you can add to a website, i.e., video and interactive animation.

Responses	Pre	Post
(1) Not Interested	1	0
(2) Somewhat Interested	1	0
(3) Interested	6	6
(4) Very Interested	5	8
Total Responses	13	14
Mean	3.15	3.57

Table 2. Interest in making own website

Table 3 shows that the activities had no significant impact on students' interest in "career

related to web design." It is unlikely that two activities would change students' impressions of something as deep as career choice and we did not expect this area to change.

Responses	Pre	Post
(1) Not Interested	1	1
(2) Somewhat Interested	1	2
(3) Interested	7	6
(4) Very Interested	4	5
Total Responses	**13**	**14**
Mean	**3.08**	**3.07**

Table 3. Interest in career related to web design

Similar to career choice, it is unlikely that two flipped lectures would have a significant impact on student's interest in transferring. However, Table 4 shows that the activities had a modest impact on students' interest in "transferring to 4-year college." Students were told that the flipped classroom materials were developed at the nearby 4-year college and the lectures referenced that participating in this class and activity would prepare them for advanced study. It is possible that the activity may have given students increased confidence that they could handle coursework at a 4-year institution.

Responses	Pre	Post
(1) Not Interested	3	3
(2) Somewhat Interested	5	3
(3) Interested	1	3
(4) Very Interested	4	5
Total Responses	**13**	**14**
Mean	**2.46**	**2.71**

Table 4. Interest in transferring to 4-year college

Tables 5 and 6 show a slight but insignificant decrease in students' interest in courses related to "digital video production" and "video encoding/decoding," which is what might be expected in a larger scale experiment considering that these topics were only peripherally mentioned in the first flipped lecture. Tables 7 and 8 show a slight but insignificant increase in students' interest in courses about "advanced web development" and "developing interactive websites with CSS and JavaScript. In general, we would hope that a larger scale study would indicate a positive and perhaps significant change for these questions.

The second flipped lecture mentioned how the activity would help prepare students to develop more advanced and interactive websites with CSS and JavaScript.

Responses	Pre	Post
(1) Not Interested	4	4
(2) Somewhat Interested	3	4
(3) Interested	2	2
(4) Very Interested	4	4
Total Responses	**13**	**14**
Mean	**2.46**	**2.43**

Table 5. Interest in course about digital video production

Responses	Pre	Post
(1) Not Interested	4	4
(2) Somewhat Interested	2	4
(3) Interested	5	4
(4) Very Interested	2	2
Total Responses	**13**	**14**
Mean	**2.38**	**2.29**

Table 6. Interest in course about video encoding/decoding

Responses	Pre	Post
(1) Not Interested	1	1
(2) Somewhat Interested	5	3
(3) Interested	2	4
(4) Very Interested	5	6
Total Responses	**13**	**14**
Mean	**2.85**	**3.07**

Table 7. Interest in course about advanced web development

Responses	Pre	Post
(1) Not Interested	0	0
(2) Somewhat Interested	3	3
(3) Interested	3	2
(4) Very Interested	7	9
Total Responses	**13**	**14**
Mean	**3.31**	**3.43**

Table 8. Interest in course about developing interactive websites with CSS and JavaScript
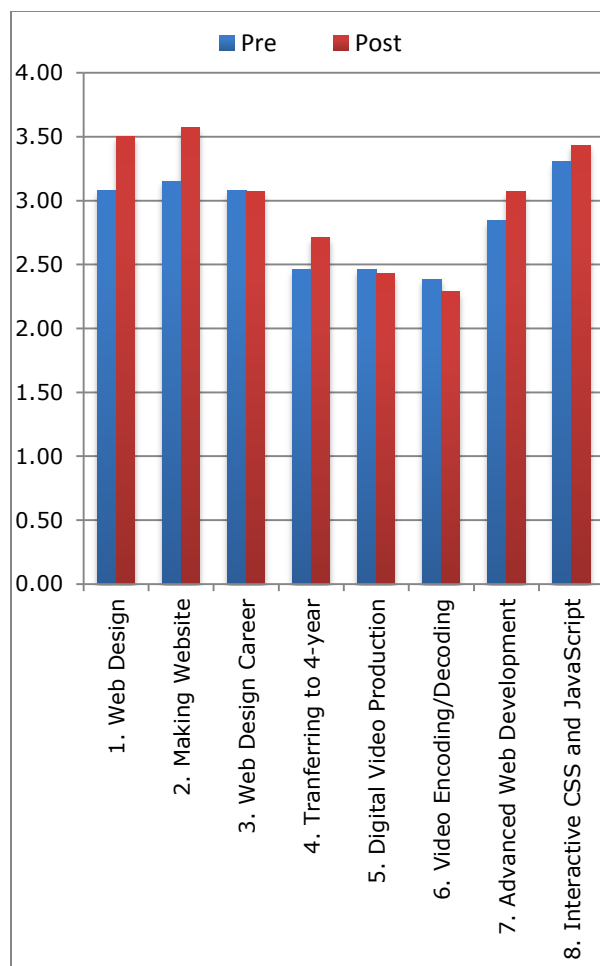
Figure 5. Comparison of interests:
Axis indicates Very Interested (4) to Not
Interested (1)

Finally, Figure 5 summarizes the mean values of the survey results shown in Tables 1 to 8. Note that the most significant changes are on questions that ask about the subject area and the primary activities, i.e., designing and making websites, whereas the least significant changes are on questions that ask about tangential topics. In general, our hope is that a larger scale study with more flipped lectures and more participants will be consistent with these preliminary results. It would be very promising if students' interest in the actual topics covered increased while their interest in the peripheral topics did not change.

7. DISCUSSION & FUTURE WORK

Based on our observations, we felt the in-class activities were more important than the out-of-class videos in terms of yielding positive impressions. While some students expressed

that the videos were boring and too long, they commented positively about the overall flipped lecture experience. In a course that involves programming, in-class coding activities may be the most vital component of the flipped model. Struggling students greatly benefit from the instructor help that can be offered in class. Strong students enjoy being able to finish activities at their own fast pace. The flipped classroom model may be particularly well suited for 2-year colleges where the gap between struggling and strong students can be very wide.

The in-class activities are important in helping the instructor differentiate the programming ability of each student to offer students more individualized help. When students complete coding assignments outside of class, they often get too much help from other sources (Internet and peers) and never learn to code independently, which is important to be successful in advanced courses. When students get appropriate help and guidance from an instructor, their confidence and independence with respect to programming can increase, which may be the most important factor in increasing students' impressions.

Some instructors might be reluctant to incorporate activities into class time because it takes away valuable lecturing time, but the flipped model give instructors another way to deliver lectures. While our experience and observations confirm that students may have poor impressions of video lectures, traditional lectures can also be received poorly. While students might avoid watching video lectures, similarly, traditional lectures can be skipped. It is important to understand that the value of the videos is not that they are superior to traditional lecturing but that lecture time can now be used for more engaging and high impact learning. A common pitfall in developing flipped lectures is an emphasis on developing quality video lectures at the expense of developing quality in-class activities.

Based on our observations and experiences, students like when a video lecture demonstrates a particular task they can replicate. In presenting concepts and information, videos may not be perceived as being any better than reading the textbook, unless the videos are expertly edited with outstanding narration that not all instructors can produce. We learned that a video cannot be too long or the students will not watch it or will only watch a portion of it. Unlike face-to-face lecturing where an instructor

may naturally pause to ask or answer questions, video lectures give students few breaks. Many students need to be able to ask questions as they watch and listen to a lecture; they need to be able to slow down a lecture and have it explained in different ways when they do not understand. Some students may feel that video lectures are not as helpful or effective as traditional lectures. Thus, we recommend a mixed approach where only a portion of class sessions is replaced with the flipped lectures

In courses that teach introductory programming, whether in a high-level language like Java or a markup language like HTML, there is no shortage of exercises and activities that can isolate concepts and convey information. The practice that a student will get from a well-designed activity with the instructor ready to assist, debug and explain concepts one-on-one is beneficial to all students, but especially those struggling the most.

Activities need to be long enough so that strong students will take at least half the class to do the work, otherwise it may discourage struggling students to see many peers finishing early. Even the strongest students should not be able to complete the activity too quickly. This can be achieved by replacing code snippets that can be "cut and pasted" with high-level descriptions and links to documentation and resources. Thus, students have to write code their own code more independently, which increased activity completion times. Then, the instructor can share code snippets with student who are struggling to accelerate progress and completion time.

As mentioned earlier, this was a pilot project that will be expanded to additional courses and sections in subsequent semesters. Students in an introductory Java programming course will be engaging in flipped classroom activities in the Fall 2015 semester.

A promising, yet inconclusive, survey result came from the question on student interest in transferring to a 4-year college. We considered that two flipped lecture experiences would not be enough to impact students' interest level in this area but our survey results indicate this possibility. In a larger-scale experiment, we will include additional questions about students' interest in 4-year colleges to better understand changes in impressions. If a student is interested in transferring, the activities could impact their interest level in transferring to the particular 4-year college that helped develop the

flipped lectures. We will ask about students' educational plans and the reasons for them. If a student is not planning on transferring, we would like to know whether it is because of financial reasons, confidence that a two-year degree is sufficient, or concern that a four-year program will be difficult to complete. The response will be open-ended to help us discover other reasons. Finally, we will ask about which specific videos and activities had the biggest impact on students' enjoyment, satisfaction and confidence.

While we could have shared traditional lectures and out-of-class assignments to help improve curriculum alignment, students would not be directly exposed to video lectures developed by and delivered by a different faculty member. In sharing traditional lecture slides and homework, the source and authorship of the content is not obvious to the learner. But, video lectures can be developed that make it clear to students that what they are learning will help them in a continuation course at a very specific 4-year institution. The model gives 4-year institutions that seek transfer student motivation to share high quality video lectures in a targeted way.

We believe our model of sharing flipped course content produces many benefits with very few disadvantages for the participating institutions. As we expand our flipped classroom project, we hope it will encourage more students to transfer. Our future study will help us determine whether our shared activities have made an impact on students and their education goals.

9. REFERENCES

Bergmann, J. & Sams, A. (2012). Flip Your Classroom: Reach Every Student in Every Class Every Day. International Society for Technology in Education.

Daniel, J. (2012). Making Sense of MOOCs: Musings in a Maze of Myth, Paradox and Possibility. Journal of Interactive Media in Education, 2012(3), Art. 18.

Gehringer, E.F. and Peddycord,III, B.W. (2013). The inverted-lecture model: a case study in computer architecture. Proceeding of the 44th ACM technical symposium on Computer science education, New York, NY, USA, 489–494.

Giannakos, M. N., Krogstie, J., & Chrisochoides, N. (2014). Reviewing the flipped classroom

research: reflections for computer science education. In Proceedings of the Computer Science Education Research Conference (CSERC '14), Erik Barendsen and Valentina Dagiené (Eds.). ACM, New York, NY, USA, 23-29.

Labov, J. B. (2012). Changing and Evolving Relationships between Two- and Four-Year Colleges and Universities: They're Not Your Parents' Community Colleges Anymore. CBE Life Sciences Education, 11(2), 121–128. doi:10.1187/cbe.12-03-0031

Lage, M. J., Platt, G. J., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *The Journal of Economic Education, 31*(1), 30-43.

Lockwood, K. and Esselstein, R. (2013). The inverted classroom and the CS curriculum. Proceeding of the 44th ACM technical symposium on Computer science education, New York, NY, USA, 113–118.

Mackness, J., Mak, S. and Williams, Roy (2010) The ideals and reality of participating in a MOOC. Proceedings of the 7th International Conference on Networked Learning 2010:. University of Lancaster, Lancaster, pp. 266-275.

Maher, M., Latulipe, C., Lipford, H., and Rorrer, A. (2015). Flipped Classroom Strategies for CS Education. In Proceedings of the 46th ACM Technical Symposium on Computer Science Education (SIGCSE '15). ACM, New York, NY, USA, 218-223.

Moravec, M., Williams, A., Aguilar-Roca, N. and O'Dowd, D.K. (2010). Learn before lecture: A strategy that improves learning outcomes in a large introductory biology class. CBE life sciences education. 9(4), 473–481.

Pappano, L. (2012). The Year of the MOOC. New York Times, Published Nov. 2, 2012.

Pope, J. (2014). What Are MOOCs Good For? Technology Review. Retrieved on June 11, 2015 at http://www.technologyreview.com/review/533406/what-are-moocs-good-for/

Schullery, N.M., Reck, R.F. and Schullery, S. (2011). Toward solving the high enrollment, low engagement dilemma: A case study in introductory business. International Journal of Business, Humanities and Technology. 1(2), 1–9.

Toto, R. and Nguyen, H. (2009). Flipping the work design in an industrial engineering course. Proceedings of the 39th IEEE international conference on Frontiers in education conference, Piscataway, NJ, USA, 1066–1069