Using a MOOC to flip an aviation classroom and improve student performance
Jonathan Velázquez, Ph.D.
Associate Professor
Inter American University of Puerto Rico

Abstract
Research has shown that people are most strongly motivated to learn when they are actively involved and clearly see a need to know. Active learning may embrace a number of inductive educational techniques and constructivists methods one of which is a recent pedagogical model called the flipped classroom. In a flipped classroom, the typical lecture and homework elements of a course are reversed. Readings and lectures are pre-done by students at home, while classroom sessions are devoted to exercises, projects, or discussions. Open educational resources (OERs) and Massive Open Online Courses (MOOCs) support flipping greatly. Teachers who are flipping their classrooms report increased student achievement, greater student engagement, and improved emotional readiness toward learning. This study examined whether or not a MOOC could be used to successfully flip an aviation course and increase student academic performance. The analysis discovered that student participants of the MOOC, and the flipped learning instruction, achieved greater final exam scores than those students who received traditional class instruction. This difference was significant $t(50) = -2.13, p < .05$. The study also revealed a moderate correlation, $r = .36, p < .01$, between a student’s course outcome (pass or fail) and taking the course assisted by the MOOC. The findings of this study suggest that MOOCs, when used to flip an aviation classroom setting, can result in higher student performance and increased passing rate. Further study is recommended in other courses that are supplemented by MOOCs.

Keywords: OER, MOOCs, flipped learning, aviation, student performance

Introduction
Active learning includes a number of inductive educational techniques and constructivists methods where students build their own versions of reality rather than simply absorb accounts presented by their instructors (Prince & Felder, 2006). The flipped classroom employs active learning strategies by reversing the typical lecture and homework elements of a course. Readings and lectures are pre-done by students at home, while classroom sessions are devoted to exercises, projects, or discussions (Educause, 2012). A recent U.S. survey confirmed the growth of the flipped classroom (Bart, 2013). Teachers who are flipping their classrooms report increased student achievement, greater student engagement, and improved emotional readiness toward learning (Flipped Learning Network, 2013; Yarbro, Arfstrom, McKnight, & McKnight, 2014). Many teachers cite the opportunity to improve a student’s critical thinking, problem-solving, and professional skills as the primary motivational factors for investing in flipped learning (Aronson, Arfstrom, & Tam, 2013). Normally, flipped classroom instructors record their own lectures and post them in a learning management system so that students may view these at home on their own pace. However, creating these lectures can prove very time consuming. Furthermore, there is a plethora of good online content. Thus, in other instances,
instructors use Open Educational Resources (OERs) or Massive Open Online Courses (MOOCs) to examine online material and select those adequate for student at-home instruction.

OERs include online videos, podcasts, webinars, and e-books. OER licenses allow free use and re-purposing (Weller, de los Arcos, Farrow, Pitt, & McAndrew, 2015). Both MOOCs and OERs offer latent solutions to many problems facing teachers while sharing high-quality educational materials at nominal price (Farrow, 2016). Ever since the establishment of the UK Open University in the 1970s, open education and learning has vastly spread in all places around the world (Obiageli Agbu, Mulder, de Vries, & Tenebe, 2016).

MOOCs are becoming an alternative for individuals who wish to brush-up on old knowledge or learn new material. MOOCs are accessible and, in most cases, free to the general public. Many people who enroll in a MOOC have the alternative of getting a certificate of completion which may further their career in the long run. In some cases, students enroll in a MOOC, view and download open content, and learn at their own pace without having to complete the course. Finally, it may be possible for traditional university students to supplement an existing face-to-face course with a MOOC to increase academic performance.

In 2016, a university professor of an aviation program in Puerto Rico used a MOOC called Aviation 101, designed by Embry-Riddle Aeronautical University, to flip a classroom and see if student performance would increase. The university course was AWSC 2115 Private Pilot Theory which presents the theoretical knowledge necessary to become a certified Private Pilot. For students of such a course, the information in AWSC 2115 is entirely brand new; thus, using a MOOC to flip this course allowed students to become familiar with course content before arriving to class. The MOOC encompassed nearly all of the university course topics.

Objective

MOOCs are an alternative for university professors who want to supplement their own knowledge but also that of their own classroom students. Research has shown people are most strongly motivated to learn when they are actively involved in their learning process. Utilizing active learning techniques via flipped classroom pedagogical models may help educators promote student learning in today’s institutions. The objective of this study was to determine whether student performance in a typical face-to-face course had improved by flipping the aviation classroom through the use of a MOOC.

Methodology

This research used the basic experimental design consisting of an experimental group, or cohort of students, who were exposed to a stimulus which in this case is the MOOC and the flipping pedagogical technique. The control group, or cohort of students, was not taught with the use of the MOOC. Thus, these students received traditional lectures and were exposed to material during class for the first time. Students were randomly assigned to both groups and both groups were comparable in that they: (1) all met the same determined criteria for matriculation and (2) were instructed by the same professor. Given proper randomization in the assignment of students to the experimental and control groups, there was no need for pretesting (Campbell and Stanley, 1963). Student final exam scores were used for comparison. In addition, their overall
grades, that is, whether students passed or failed the course – passing was defined as achieving a grade of C or better – was also compared.

Importance of Research

The importance of this research is twofold. First, MOOCs have become increasingly important in an era of worldwide access to higher education. Universities are partnering with organizers such as Coursera and Udacity to offer low-cost degrees assisted by MOOCs and some colleges are even incorporating MOOCs into their curricula (Educause, 2013). However, MOOCs represent a considerable time and financial investment (Educause, 2013). Therefore, it is imperative that educators and higher education administrators study ways MOOCs can impact the student learning process. Second, although the flipped pedagogical model is promising, it also warrants further inquiry (Hamdan, McNight, & Arfstrom, 2013). Some research has been done on how the flipped educational model can enhance the learning experience (Flipped Learning Network, 2013). However, very little has been accomplished on how MOOCs can assist the flipped learning technique and less so in the aviation classroom.

In summary, a review of the extant literature found no published studies that have examined if the flipping instructive technique, using a MOOC, can enhance student academic performance in aviation sciences. A MOOC may allow an instructor to flip a classroom and achieve higher levels of learning.

The specific research questions of this study were:

1. Will there be a significant difference in final exam scores between students experiencing a flipped course (with the aid of the MOOC) versus those students undergoing traditional class lectures?
2. Is there any significant correlation between taking the course with the MOOC and passing the course (receiving a grade of C or better)?

The research hypotheses stated that there was a significant difference in final exam scores between these two groups of students and a significant relationship between student performance and flipping an aviation course through the use of a MOOC. The null hypotheses were:

\( H_01 \): There is no statistically significant difference in final exam scores between students experiencing a flipped course (with the aid of the MOOC) versus those students undergoing traditional class lectures.

\( H_02 \): There is no relationship between a student’s course outcome (passing or failing) and taking the course assisted by the MOOC.

Results

Seventy students initially participated in this research; however, due to attrition, not all students took the final exam. Of the 52 who completed the course, 33 participants were MOOC group and 19 were not in the MOOC group. Student participants of the MOOC, and the flipped learning instruction, achieved significantly higher final exam scores (\( M = 79.68, SD = 10.52, SE = 2.41 \)) than those who received traditional class instruction (\( M = 72.63, SD = 12.00, SE = 2.09 \)), \( t(50) = -2.13, p < .05 \).
The university course used for this study requires that students reach an overall grade average of C or higher in order to pass and progress toward flight training. Including the (n) 70 participants who started in the study a moderate correlation was found, $r = .36, p < .01$, between a student’s course outcome (pass or fail) and taking the course assisted by the MOOC (See Figure 1).

![Figure 1. Relationship between taking the MOOC and course success.](image)

Regarding the students (control group) who did not supplement the course with the MOOC, a total of 25 failed. However, 21 successfully passed the course. Finally, of the students that took the MOOC (experimental group), only four of them failed while a total of 20 passed.

**Discussion**

Flipping a course with technology is never an easy task for both the course instructors and the students. First, instructors must relinquish a degree of control (Honeycutt & Garrette, 2013). Also, teachers invest time and effort planning and reviewing the results of the pre-work and delivering a course through the use of active learning pedagogical techniques. On the other hand, students have more responsibility for learning anytime courses integrate active learning. Moreover, if flipping is involved, students must do the necessary pre-work. This high degree of learning autonomy does not sit well with all students. Although the number of failing students in the experimental group was very low, this reason might help explain why some students who used the MOOC, and experienced the flipping learning process, did not pass the course.

Still, the findings of this study suggest that MOOCs, when used to flip an aviation classroom setting, can result in higher student performance and increased passing rate. The *Aviation 101* MOOC allowed the instructor to receive feedback from all student quizzes and tailor the course
appropriately to engage in active learning strategies. This *a priori* chance, the instructor used to flip the classroom, is precisely called Just-in-Time-Teaching (JiTT). JiTT is a pedagogical strategy that uses feedback between class sessions and work that students do at home, to prepare for the subsequent class meeting (Prince & Felder, 2006). *Aviation 101* allowed students to test themselves with built-in quizzes for all major topics (e.g., aerodynamics, aircraft systems, weather, and airspace) after a and in-depth video presentation. Because most people are visual learners (FAA, 2008), the *Aviation 101* lessons were excellent in that regard. Students would send their quizzes to the instructor so that he could adjust the lessons accordingly. The objective was to target higher order thinking skills (HOTS) or engage in active learning during class time. HOTS consist of analysis, synthesis, and evaluation (FAA, 2008).

Another active learning strategy used was one called guided discussions. According to Honeycutt and Garrett (2013), flipping allows for more in-depth discussions that allow judging, analyzing, and creating. The instructor reported that this technique was very welcomed by students. It seems that today’s students prefer having an active conversation in class versus listening to a constant lecture. This last technique worked greatly during team-based or cooperative learning.

Other constructivists methods employed with the experimental group were inquiry-based, problem-based, and discovery learning. All of these pedagogical strategies involve some form of exploration by the students to answer questions or solve real-world problems presented by the course instructor or by the students themselves.

**Conclusion**

The objective of this study was to determine whether student performance in a typical face-to-face course had improved by flipping the aviation classroom through the use of a MOOC. The results make a case for the use of MOOCs (and OERs) to flip an aviation classroom. Overall passing was improved and the differences in final exam scores were statistically significant. When students work with an instructor, in a flipped environment, they learn to think more critically, connect with others more successfully, and have a better appreciation for the topic.

Future studies should continue to explore ways OERs and MOOCs increase academic achievement, particularly in aviation sciences. Teaching aviation has an impact on the world on many fronts (e.g., economic, environmental, political, and social). Instructors can employ technology wisely (i.e., MOOcs and OERs) to increase student learning. In the end, all benefit from higher levels of learning.

**Acknowledgements**

This research was made possible because of the *Aviation 101* MOOC developed by Embry-Riddle Aeronautical University (ERAU). The author thanks Dr. Kenneth P. Byrnes (from ERAU) for allowing the use of the *Aviation 101* name for research purposes at the Inter American University of Puerto Rico. "Using a MOOC to flip an aviation classroom and improve student performance by Jonathan Velázquez is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License."
References


