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# Developing a Community of Practice (CoP) through Interdisciplinary Research on Flipped Classrooms

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*This article describes an interdisciplinary research project that resulted from the creation of a community of practice (CoP) for faculty teaching blended and online courses at a small, historically black university. Using a flipped-classroom approach, two modules of a Principles of Biology course were redesigned. Already-created PowerPoints were converted to screencasts and homework was completed in small groups during class. Results showed that students in the flipped classroom performed better on application-type questions but showed no difference on overall test scores or on knowledge-type questions. A survey of student perceptions found that students liked the autonomy to watch content videos anytime, anywhere, and that they enjoyed the more active classroom experience. Students also noted that technical issues sometimes hindered their ability to learn; they missed the opportunity to ask questions in real time; and they did not appreciate the amount of out-of-class work this approach required. Overall, the results indicate that the flipped-classroom model has the potential to increase student learning but that it requires a more thoughtful redesign process than is suggested in popular literature on the subject.*

*Keywords: flipped classroom, Community of Practice (CoP), instructional design, blended courses, teaching, teaching biology, higher education*

## Introduction

Since the time of correspondence studies, the ideal approach to the design of distance education courses was team-based in nature (Diehl, 2013). As distance education has evolved to include the use of online learning environments, the basic premise of course design has not changed. Instead of expecting faculty to become experts in the technical aspects of online course design and content creation (e.g., developing web pages and designing interactive simulations), the team approach to online course design provides faculty access to instructional designers, programmers, web developers, etc. to assist in the

development and teaching of an online course, thereby allowing the faculty to focus on content (Ko & Rossen, 2010).

At many smaller institutions, however, there are fewer resources and design staff, leaving much of the work of course design and development up to the individual faculty member. This can lead faculty to feeling overwhelmed and underprepared for the task of online course design, especially since many who are asked to teach online have no training in basic instructional practices ([Baran, Correia, & Thompson, 2011](#)). Distance education administrators at such institutions have the unenviable task of finding innovative ways to provide faculty support and development opportunities in order to build skill

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levels in designing, creating, and teaching in blended and online environments.

To deal with these challenges, our University's Center for Online Learning adopted a community of practice (CoP) model (Wenger, 1998). According to Wenger (1998), within a CoP framework, more experienced faculty (or those with more expertise in a subject area) can mentor and assist in the development of faculty who are newer to the discipline, thus alleviating the strain of understaffed instructional design departments. The purpose of West Virginia State University's (WVSU's) CoP was threefold: (1) to gather a cohort of interested faculty from a variety of disciplines to discuss and learn about different approaches to blended and online course design, (2) to develop skills and knowledge that could then be shared with the group, and (3) to work together on projects of interest.

Participants in this CoP go through a semester-long training program focusing on online teaching and course design called the Online Teaching Institute (OTI). Upon graduating from OTI, faculty continue meeting monthly to discuss and receive feedback on issues they are experiencing in their blended and online courses.

During these meetings, several faculty members from science fields shared their struggle to find a mode of instruction that would utilize blended and online approaches to teach science but also preserve the integrity of their classrooms. The flipped model of instruction seemed to be especially attractive to science faculty because (1) the transition to this mode of teaching would be relatively easy as they could utilize already-existing lecture materials and (2) they would not have to give up any class time as they familiarized themselves with the format.

However, discussions in the larger, interdisciplinary CoP indicated some skepticism

as to whether a literal translation of flipped classroom (i.e., taking already-existing presentation materials and recording them and using slightly modified homework assignments as in-class activities) would be effective without implementing additional course design modifications such as inquiry- or problem-based approaches.

The result of these discussions was the creation of an interdisciplinary research team which included a biologist, an educational psychologist, and an instructional designer/technologist to study the efficacy of a literal translation of the flipped classroom design on student learning in a general education biology course.

## Literature Review

Blended or hybrid learning experiences have been a common part of higher education for the past decade. A three-year study of over 1,000 U.S. colleges and universities found that roughly 46% of four-year undergraduate institutions offered blended courses ([Allen, Seaman, & Barrett, 2007](#)). However, the popularity of the flipped classroom, as brought to national attention by Bergman and Sams (2012), has seen a marked growth over the past year. While there are some slight variations of the model (e.g., [Musallam, 2013](#)), most of the available literature suggests that the basic flipped instructional model consists of recorded lecture materials which are watched by students at home and application-type questions and problems (i.e., the traditional homework) which are worked on in class ([Mangan, 2013](#); Bergman & Sams, 2012; [Topo, 2011](#)) (see Movie 1).

On a surface level, this model appears to be relatively simple to adopt and institute. An instructor needs a computer, screen capture software (such as Camtasia, Screencast-o-matic, etc.), a headset, and a



[Movie 1. The flipped classroom \(Flipped Learning, 2010\).](#)

place to post videos (such as YouTube), and he/she has all the equipment and software needed to get started. In short, the flipped classroom approach has a low cost of adoption, making it relatively easy to implement.

In addition to the low cost of adoption, proponents of this model have provided testimonials and anecdotal evidence suggesting a high level of success in the flipped classroom. Students are more engaged, better able to address questions requiring application of content knowledge, and are more satisfied with the classroom experience in general (e.g., [Mangan, 2013](#); [Springen, 2013](#); [Satullo, 2013](#); [Flipped Learning Network, 2012](#)). Such factors combine to make the flipped classroom very attractive to teachers, faculty, school districts, and universities that are under pressure to initiate changes that increase student learning in their classrooms.

However, the empirical research in this area is still relatively sparse. Of the research that is currently available on the subject of flipped classrooms, findings have been mixed: some researchers are reporting significant learning gains in students ([Tune, Sturek, & Basile, 2013](#); [Mason, Shuman, & Cook, 2013](#)) and some are reporting no difference between the flipped classroom and the traditional model ([Winston, 2013](#)). Because of the relative newness of this specific pedagogical approach and the subsequent need for more empirical research focused specifically on the efficacy of flipped classroom techniques, the purpose of this research project was to (1) determine whether there is a difference in student performance in a flipped classroom versus a traditional classroom setting and (2) gauge student perceptions of the flipped classroom model and its efficacy on their learning.

## Methods

### Participants

The classes chosen for the flipped classroom experiment were two sections of an undergraduate Principles of Biology course taught by one of the researchers ( $n = 99$ ). Of those enrolled,  $n = 88$  completed the experiment (34% male,  $n = 30$  and 66% female,  $n = 58$ ). The comparison group for this study consisted of two sections of the Principles of Biology course from the previous fall semester ( $n = 89$ ). The comparison group was 53% male ( $n = 47$ ) and 47% female ( $n = 42$ ). As this course is a general education, non-majors introductory biology course, the students were not science majors.

### Design

Two sections of the Principles of Biology course taught in fall 2013 utilized the flipped instructional design. Results from learning assessment scores were then compared to data from the previous fall semester. In order to ensure the comparison groups and the flipped groups were similar in terms of prior knowledge coming into the course, ACT Science scores were compared and found to be not significantly different ( $F_{(1,141)} = 0.82, p = 0.3667$ ), suggesting that student groups between the two years had similar backgrounds in science, making them comparable for the purposes of this research. Furthermore, the same book, content modules, visuals, assessments, and instructor were utilized in both the treatment and comparison groups to ensure a similarity of experience.

### Procedure

The first two modules of the course, *Chemistry of Biology* and *Biological Mole-*

cules, were redesigned to support flipped instruction. The videos were recorded in advance using the programs Camtasia and Adobe Presenter. While the same PowerPoint presentations were used in all sections (both flipped and comparison), the screencasts in the flipped group were cut into segments that ran between 10 and 12 minutes to prevent loss of attention due to length of the screencasts (Middendorf & Kalish, 1996). For this same reason, participants were required to watch no more than two videos before each class meeting.

The participants were given an orientation to the flipped-classroom model on the first day of class and were shown how and where to access the videos on the University's learning management system (LMS). The PowerPoint files themselves (without narration) were also posted online to allow the slides to be printed for note-taking purposes. In order to further encourage participants to watch the videos, they were required to take an online quiz covering the assigned videos' material prior to each class.

During class meetings, when lectures would typically be held, the participants were instructed to break into small groups and were given application-type problems to work through while the professor provided guidance as needed. At the end of each class, the groups were called upon to answer each of the problems they had collectively worked through, and the professor clarified answers or provided the correct answers to reinforce or correct learning. At the end of the two modules, participants submitted a study guide assignment which encompassed all the material from the videos, and the professor provided final clarification of material covered in both modules.

The two modules culminated in a final assessment of participant learning which consisted of 40 multiple choice

questions and four short answer questions. The multiple choice questions were divided into those that tested knowledge/comprehension ( $n = 28$ ) and application/synthesis ( $n = 12$ ), as defined by the exam question bank associated with the textbook.

In addition to the final assessment, participants were asked to complete a brief survey via [surveymonkey.com](http://surveymonkey.com) that measured participant perceptions of the flipped-classroom model. This survey included questions dealing with the ease of use, their personal preferences, and their beliefs about their own learning using a flipped-classroom model. The survey included both closed and open-ended questions to allow a full range of participant responses. Participants were given extra credit for completing the survey.

## Results

### Results of Participant Performance

#### Test Scores

Statistical analyses of quantitative test data were conducted using SAS statistical software using a mixed model ANOVA (Proc Mixed). Though there was no significant difference in test scores overall ( $F_{(1,172)} = 0.06, p = 0.8079$ ), participants in the flipped-classroom did perform significantly better on the application/synthesis multiple choice questions ( $F_{(1,167)} = 4.28, p = 0.0402$ ) (see Figure 1). There was no significant difference between scores on the knowledge/comprehension multiple choice questions ( $F_{(1,167)} = 0.13, p = 0.7171$ ).

### Results of Participant Survey

The online survey was sent to all participants ( $n = 99$ ) due to the fact that while a participant may not have taken the final assessment, they were all exposed to

the flipped-classroom approach. The response rate for the survey was 78% ( $n = 77$ ). Demographic questions indicated that survey responders were 73% female ( $n = 51$ ) and 27% male ( $n = 19$ ) with 9% not responding ( $n = 7$ ). Age of respondents broke down as 50% ( $n=35$ ) between 18 and 20 years of age, 44% ( $n = 31$ ) between the ages of 21 and 29, 6% ( $n = 4$ ) over 29 years of age, and 9% ( $n = 7$ ) not responding.

**Participants' thoughts on the efficacy of flipped classroom.** Participants were asked to rank their level of agreement with several statements regarding flipped classroom using a Likert-type scale of 1 – Strongly Disagree to 5 – Strongly Agree. Overall, participants indicated satisfaction with the format tending to average above the midpoint in the scale on all items related to instructional format, including items such as *I think I learned more as a result of this method* and *I felt more engaged in class when the classroom was flipped* (see Figure 2).

**The role of the textbook.** Additionally, participants were asked to identify when they read their textbooks in relationship to the videos. Results indicated that 33% of participants ( $n = 24$ ) read the textbook after watching the videos, thus suggesting that the videos acted as an advanced organizer for participants. Additionally, 31% of participants ( $n = 22$ ) claimed they did not read at all (see Figure 3).

**Results of open-ended questions regarding the flipped- classroom.** Participants were also asked to respond to two open-ended questions, namely (1) *Please describe what you LIKED or thought was EFFECTIVE about the flipped classroom method* and (2) *Please describe what you DID NOT LIKE or thought was INEFFECTIVE about the flipped classroom method*. Thematic analysis of these responses showed five major themes related to the flipped classroom: learner autonomy, active class-

room, loss of real-time response, technology problems, and more work in the class.

**Learner autonomy.** One of the major themes that emerged from the participant responses was the idea of learner autonomy, or being in control of when, where, and how frequently to access video content for the course. Typical responses for this item included, *I thought the flipped classroom method was effective because I could watch it on my own time. I enjoyed the fact that I could rewind parts that I did not understand and I could rewatch the videos if necessary*).

**Active classroom.** The second theme that presented itself was the idea of the active classroom. Participants indicated that they enjoyed working on problems in class, some saying that *...it was great to do the homework in class because I had already seen the videos and PowerPoint, so if I had any questions I could ask them. Lecturing in the classroom just gets boring, but when we engage in the class and work together, I feel like it was easier to learn*.

**Loss of real-time response.** Statements such as *I did not like not being able to communicate and ask questions* represent a theme found in open-ended responses that indicated to the researchers that the loss of real-time interaction while watching the videos was uncomfortable for some participants.

**Technology problems.** While technical problems were not common, for those students who did experience them, they appeared to negatively impact their perceptions of learning. While difficulties ranged from Internet connectivity to computer hardware and software, the general trend was that having any technical problem at all decreased the comprehension and overall satisfaction with the format. This is not unexpected as overcoming technical support issues is part of any blended or online course.

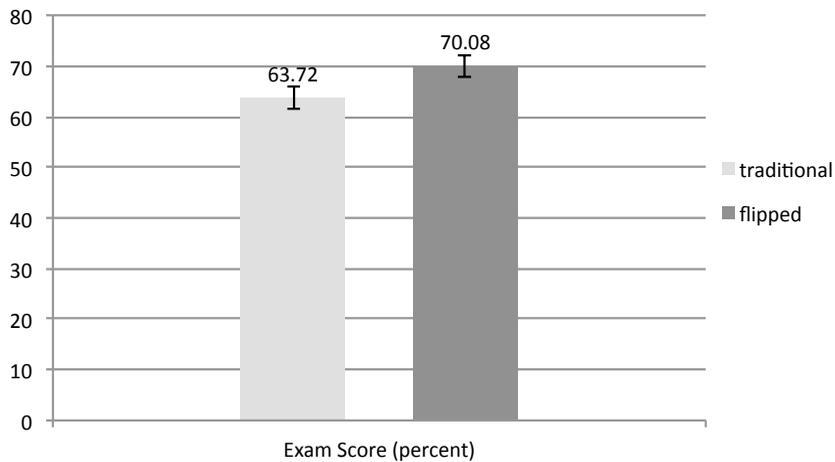


Figure 1. Mean scores on application questions.

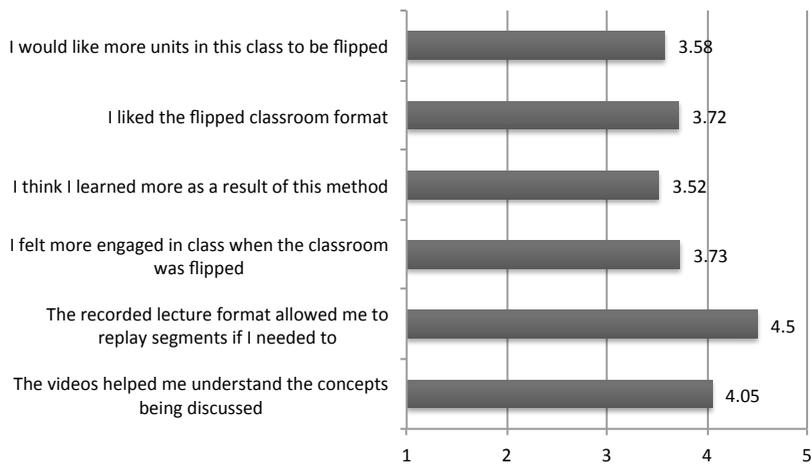


Figure 2. Mean scores of Likert-type questions.

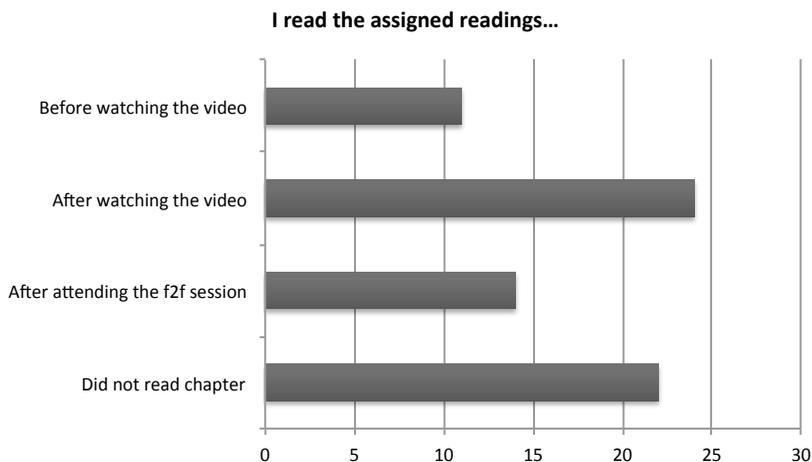


Figure 3. Counts of responses to question regarding when/if textbook was read.

**More work for participants.** Finally, participants indicated that they did not like the fact that the flipped-classroom design required more work from them outside of class. A representative response from this theme was: *I did not like spending so much time out of class working for the class.* While participants considered this a negative of the flipped classroom, the researchers felt this was actually a positive outcome of the flipped-classroom model.

## Discussion

The results of this study seem to indicate that the flipped-classroom model has some promise as a teaching method, as participants did score significantly higher on the application portions of the learning assessment. Participants also seem to enjoy the level of autonomy they have when the course content is posted online and accessible when needed as well as the ability to play back the videos as often as needed to understand the concept. Participants also seem to enjoy the change in the nature and quality of the face-to-face components of the course as they get to spend it engaging in active learning experiences. In addition, while participants did not like the idea of having to exert more effort outside of class in the flipped classroom approach, from an instructor standpoint, participant reports of increased effort on course-related content was welcome, and might be a way to improve participant study behaviors.

However, the learning gains found are not as high as anecdotal reports suggest (e.g., [Flipped Learning Network, 2012](#)). While the flipped classroom model did lead to significant increases in test scores on application-type questions, there were no significant differences in knowledge-type questions or in overall test scores. This

seems to indicate that simply flipping the class without the inclusion of other proven teaching practices such as inquiry- or problem-based approaches does not yield the greatest gains in student learning. It also might indicate that, as with so many other issues related to student content knowledge, the skill of the teacher might be a greater determinant of student learning gains than the flipping itself; however, more research is needed in these areas to determine the individual factors that lead to greater learning gains in a flipped environment.

The responses that participants provided regarding how and when they accessed textbook materials were especially interesting and suggest that the videos could be acting as an advanced organizer for the denser textbook materials. If this is the case, then the use of a quick overview video with the specific purpose of guiding reading might lead to better reading comprehension and thus greater learning gains. Further, the fact that an almost equally large number of participants did not read at all suggests that perhaps a more thoughtful evaluation of the role of textbook, and textbook alternatives, is needed in order to ensure students understand its relevancy to the course. More research on the interaction between video and textbook resources should be done to further delineate how best to interweave those two resources to optimize student learning.

There are some limitations to this study that require us to examine the findings of this research in the proper context. As the groups in this study were not randomly selected, generalization to the larger population of college students (or even college students in flipped biology courses) might be unwise. Additionally, given the amount of time that had passed between the flipped group and the comparison group (one aca-

demic year), there could be timing affects that made the groups perform differently. Further research in this area utilizing more robust research designs is warranted in order to arrive at more conclusive results about the efficacy of the flipped classroom model.

## Conclusions

Research on the flipped classroom is only beginning, and, while studies on equivalency with traditional instruction are needed, more research on how and when to effectively implement this teaching strategy is the logical next step in flipped-classroom research. While this research shows that a flipped classroom can increase student learning, it does not identify which specific factors within the flipped-classroom model lead to greater learning gains in students, and further research in this area can help clarify for educators how best to incorporate this approach in their own classroom. In the end, the findings of this research seem to indicate that the flipped-classroom approach may not be the panacea for science instruction many wish it to be, but rather one more tool for a skilled instructor to use in his/her efforts to support student learning.

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