

Delivering a Hyflex Statics Course in a Flipped Classroom Model

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Abstract

In the Fall semester of 2020, the University of Mary Hardin-Baylor's approach to educating amid the pandemic was to offer courses in the HyFlex model. In this model, students were free to choose between in-person, synchronous online, and asynchronous modes of course delivery. Moreover, students could freely switch modalities without notifying the professor. This paper presents the experience of delivering a HyFlex Statics course to second-year engineering students. This Statics course was notable because it switched from a traditional model to a flipped model midway through the semester. The reason for the switch was an observed underperformance of the class in comparison with past semesters. The effect of this switch to a flipped model is discussed in the context of student perceptions and student performance. Issues that arise when offering a flipped course within a HyFlex delivery model are also discussed. A survey of student reaction to the change to a flipped model is presented, and follow-up interviews are offered as a case study. Finally, lessons learned from this difficult and chaotic semester are presented.

Introduction

In the Fall semester of 2020, the University of Mary Hardin-Baylor (UMHB) instituted a HyFlex¹ instructional model for most courses. This model was implemented to give students flexibility during the COVID-19 pandemic and to accommodate reduced classroom capacity that accompanied social distancing measures. Students had the choice to attend classes face-to-face, synchronously online, or asynchronously online. Professors were to design their courses to offer similar learning experiences for each modality.

During this semester, the UMHB engineering program offered two sections Engineering Mechanics: Statics, both under the HyFlex model. Due to limitations on time and resources at the beginning of the semester, the courses were taught in a traditional, lecture-based model. Most class periods were spent introducing new material to the students. After the first exam was given and graded, it was determined that student performance was not satisfactory, and changes needed to be made to the course. The lecture-based model was abandoned in favor of a flipped classroom.

The flipped classroom involves directing students to engage in independent learning activities before class, facilitated by instructional videos or reading assignments. Class time then features students solving problems or holding discussions in groups. Research has shown that a flipped course generally increases student achievement^{2,3} and student perception of the course⁴.

The focus of this paper is to examine student perception and achievement in a flipped class in the context of a HyFlex delivery model. Flipping the classroom was a change that was born of necessity, and not intended to be an experiment. However, it provided an interesting lens to examine how students respond to the flipped classroom and the increase in active learning and group work that accompanies it while dealing with the HyFlex related obstacles to group work. Each modality of the HyFlex class brought unique challenges and barriers to group interaction. This paper looks at student perception of the obstacles separately in each modality.

HyFlex Model

The primary feature of the HyFlex model is to combine synchronous online and face-to-face components (“hybrid”) in a single course and allow students to choose when and how they attend (“flexible”)⁵. It is defined by courses that enable flexible participation for students, where they can attend face-to-face classes or complete online learning activities without attending class.⁵ At the University of Mary Hardin-Baylor, HyFlex was mandated for all classes that could reasonably fit the model. Three modes of participation were to be offered: face-to-face, online synchronous, and online asynchronous. Students were free to choose their preferred modality for any given class period. One feature of the HyFlex class is that every mode of participation should have equivalent learning experiences. Each mode of participation has the same assignments (called Academically Related Activities), and completion of the assignments serves as evidence of attendance of the class.

Face-to-Face Modality

Students that chose to attend a class face-to-face were subject to the pandemic protocols imposed by the university. They must always maintain a six-foot separation from other people. Masks were required for all members of the classroom except the instructor. In this particular Statics class, the instructor had special accommodations which separated him from the in-person students. The instructor taught from an adjacent classroom with a window allowing a sightline into the students’ room. Audio and video were streamed between the two rooms to facilitate communication.

Online Synchronous Modality

Each class session was broadcast via Zoom feed to students attending synchronously online. Zoom allowed two-way audio and video feeds between the instructor and each student. Audio from Zoom was broadcast such that face-to-face students could hear them, but online students had difficulty hearing the face-to-face students. During periods of group work, the “breakout room” feature of Zoom was used. Small groups of students would have their own feed with shared audio and video. These feeds were independent of the instructor, who could observe the breakout rooms only by joining them one at a time.

Online Asynchronous Modality

Every class session was recorded using the Panopto lecture capture application. The recording included a video feed of the Zoom window as well as a separate window with the feed of the video screen where the lecture notes were displayed. Recordings were uploaded to the Learning Management System automatically, and usually appeared within the day of the lecture. Asynchronous students could hear the audio feed of the online synchronous students within Zoom but could also not hear the audio of the face-to-face students.

Flipped Classroom Model

The flipped classroom has become a widely used pedagogical model for engineering courses. Typically, flipped classes require students to learn content before class. Common modes of pre-class instruction include recorded lecture videos, videos available on the internet relating to the topic of the class or assigned readings. The scheduled class times are spent primarily applying the previously learned material by working problems or engaging in a variety of active learning activities. The flipped model of this Statics course is detailed here.

Pre-class Preparation Activities

Students were given preparation activities prior to every class. These activities typically included a reading assignment, a recorded lecture video covering the theory of the material, a recorded video solution of an example problem, and a pre-class quiz to assess preliminary understanding. Students were allowed a single retake of the quiz if completed before class time.

In-class Active Learning Activities

The 50-minute lecture sessions generally began with a short five-minute recap of the video lecture. Students were then assigned to groups and given several problems to be worked as a team. The groups were limited to a maximum size of three. In-class students were teamed with others present in the classroom, while synchronous online students worked in breakout rooms within Zoom. Asynchronous online students were expected to work as an asynchronous team by contributing solutions to a discussion board.

Group work was inhibited by the restrictions imposed due to the COVID-19 pandemic. The in-class teams were forced to maintain six-foot separation and could not exchange any materials. The teams that met in Zoom breakout rooms could hear each other and could see the webcam feeds of their teammates when webcams were activated. Asynchronous teams had perhaps the worst experience, as faculty were not allowed to mandate a synchronous meeting amongst them outside of class time. Interaction between these team members was very limited. Collaboration on a discussion board is far from the ideal of students interacting with each other as they solve problems as a team.

In an attempt to anticipate these challenges, the instructor of the course used a class period to train the students how to collaborate in the given circumstances. Good communication practices were offered, and students were encouraged to verbally communicate their work as they went through a problem. Additionally, a rule was established that webcams must be on when students were working in Zoom breakout rooms.

Post-class Mastery Activities

A selection of homework problems from the book was assigned after each class for students to work through on their own. These assignments served as the weekly “Academically Related Activities” required by the HyFlex model in lieu of attendance. They also allowed the students to assess their mastery of the material outside of the group context.

Survey Construction

At the end of the semester, but before final grades were assigned, a survey was distributed to all students in both class sections. The purpose of the survey was to assess student perception of the flipped class, particularly in relation to the traditional structure that was used at the beginning of the semester. The survey was constructed with two sections, one given to every student, and one that was specific to the modality of HyFlex that the student reported to have participated in the most often. Table 1 shows the questions given to every student, and Table 2 shows the questions given to in-class synchronous students, the online synchronous students, and the asynchronous students, respectively.

Number	Question
Q1	What modality of CruFlex did you most often use in Statics?
Q2	Overall, did you prefer the class before or after the switch to in-class group work?
Q3	How much do you agree with the following statements?
Q3a	Group work helped me understand the material in the class
Q3b	I was more inclined to attend synchronously because I would be working with my classmates
Q3c	My overall engagement with the class increased as a result of the change to more group work
Q3d	My grades improved after the switch to more group work

Table 1. Survey Questions Given to the Each Class Member

	Face-to-Face
Q4	How much do you agree with the following statements?
Q4a	Distancing from classmates during group work hampered my learning
Q4b	Working with classmates in person was better than working in Zoom breakout rooms
	Online Synchronous
Q5	How much do you agree with the following statements?
Q5a	Zoom breakout rooms allowed me to successfully work in a group
Q5b	Working in Zoom breakout rooms was better than working in person
	Online Asynchronous
Q6	How much do you agree with the following statements?
Q6a	I was able to find groups to work with outside of class time
Q6b	Working asynchronously was a barrier to my learning in this class
Q6c	I chose not to work in groups asynchronously

Table 2. Survey Questions Given to Either Face-to-Face, Synchronous Online, or Asynchronous Online Students

Results

Nineteen students between the two sections responded to the voluntary survey. The majority of them were synchronous online students. Table 3 shows the number of respondents that participated in each HyFlex modality. Additionally, one participant responded to a request for a follow-up interview. This student attended the class synchronously online, and their responses are for context of the survey results.

Answer	Count
In Person	4
Online Synchronous	10
Online Asynchronous	5
Total	19

Table 3. Responses to Q1: “What modality of CruFlex did you most often use in Statics?”

The second question of the survey addressed overall satisfaction with the flipped course when compared to the traditional delivery model. Student responses could range from preferring the class before the switch to preferring the class after the switch, with five different strengths of preference. As seen in Figure 1, eleven of the students either slightly preferred or preferred the lecture-based portion of the class, and seven preferred the flipped classroom. Two students had no preference.

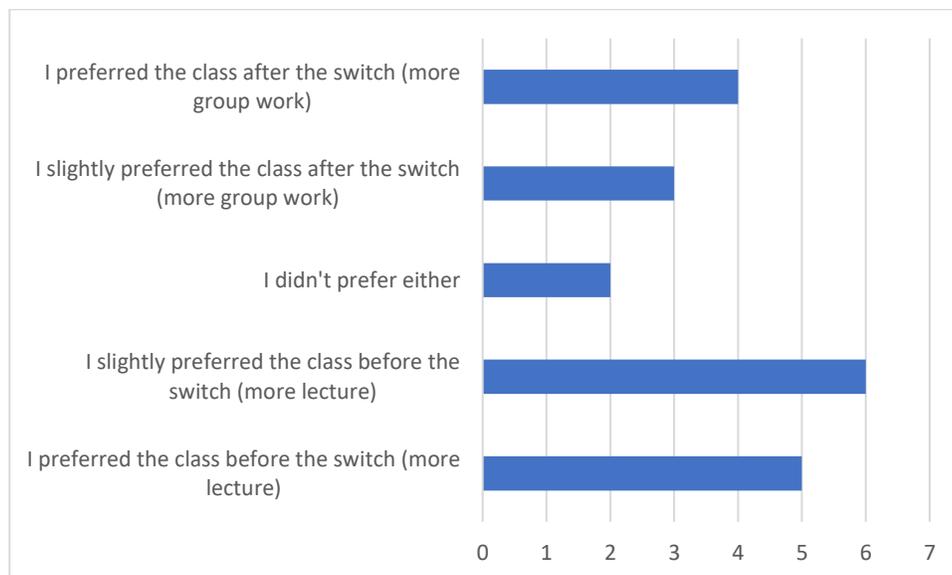


Figure 1. Responses to Q2: “Overall, did you prefer the class before or after the switch to in-class group work?”

This result deviates from the evidence stated above that students are generally more receptive to flipped classrooms. Further insight into this result is revealed in the subsequent questions.

Question 3 provided more detail on students' preferences. Each statement was given a score on a five-point Likert scale, with a score of 1 being the strongest agreement, and a score of 5 being the strongest disagreement. Figure 2 shows the mean agreement score for each statement. Interestingly, although most students reported to prefer the traditional lecture model, they also reported to improve their grades, increase engagement with the class, attend synchronously more often, and understand the course material better, on average. This result agrees with the evidence stated above that student outcomes improve in a flipped classroom.

In the follow-up interview conducted with a single online synchronous student, they indicated that the switch to a flipped classroom had no impact on their grades, and even though they preferred traditional class, their engagement with the class increased with the flipped classroom. They elaborated on this disconnect by stating, "I wanted the opportunity to do something more kinetic, even though [the group work] wasn't ideal."

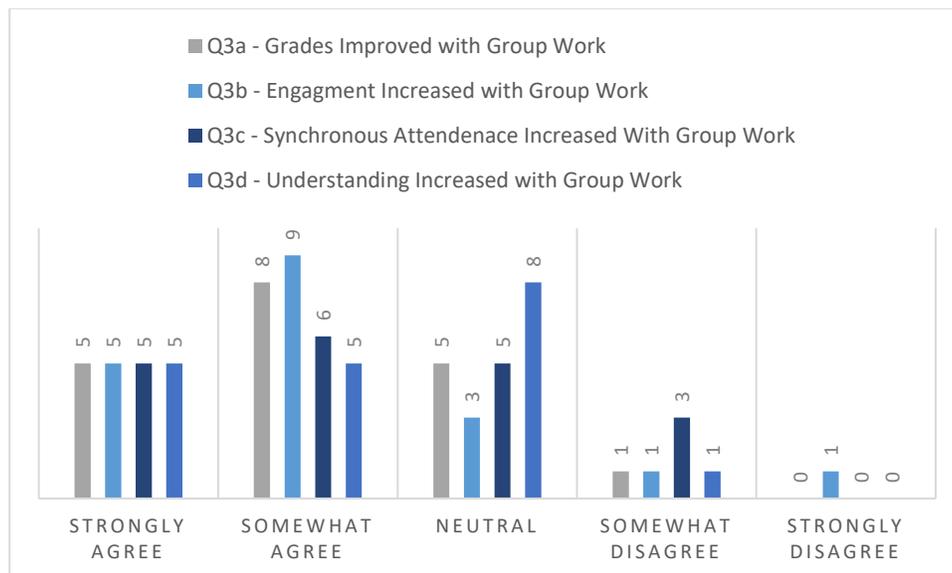


Figure 2. Agreement with Statements of Q3

Each student was given one more set of questions based on their previous response indicating their most often chosen HyFlex modality. Figure 3 shows the agreement of students who reported attending face-to-face courses most often. In a small sample ($n = 4$), these students showed a strong preference for in-person group work as opposed to the other synchronous group work option of Zoom breakout rooms. These students also agreed with the statement that social distancing hampered their group experience, though the agreement was not as strong as the preference for in-class group work.

As shown by Figure 4, synchronous online students ($n = 10$) also preferred their chosen HyFlex modality, but the preference was not as strong as reported by the face-to-face students. These

students also agreed that the group work in Zoom breakout rooms was successful. Because of the structuring of the question, this result can not be directly compared to the experience of the face-to-face students.

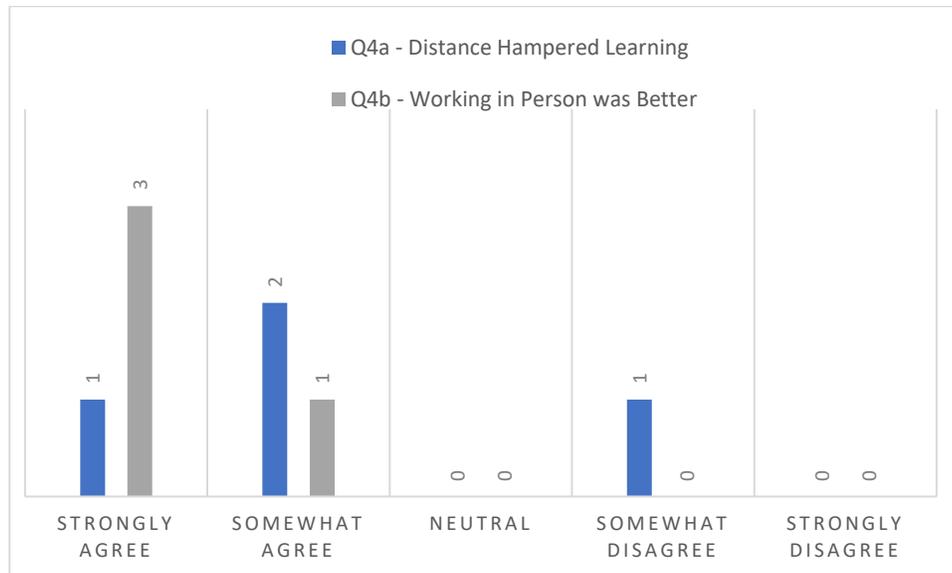


Figure 3. Agreement with Statements of Q4 (Face-to-Face Students)

The student that agreed to be interviewed for this study comes from this sample group, and their responses inform the interpretation of students reporting dissatisfaction with the HyFlex flipped classroom. When asked to expound on the statements in question 5, the student stated that group work “was only helpful insofar as I did the work myself.” There was frustration that the obstacles to group work in the Zoom breakout rooms were difficult to overcome. For example, this student stated, “people rarely turned on their cams” even though the instructor explicitly set rules from them to do so and periodically monitored the status of their webcams. Other obstacles that the student identified were that “exiting a [breakout] room and getting help was an inconvenience,” and that other students’ work was “difficult to see because of video resolution.” The student summarized that “In short, teamwork as a whole was very difficult except verbally.” Although this student didn’t think that the flipped classroom hurt their grade, they responded to question 2 with a preference for the traditional classroom.

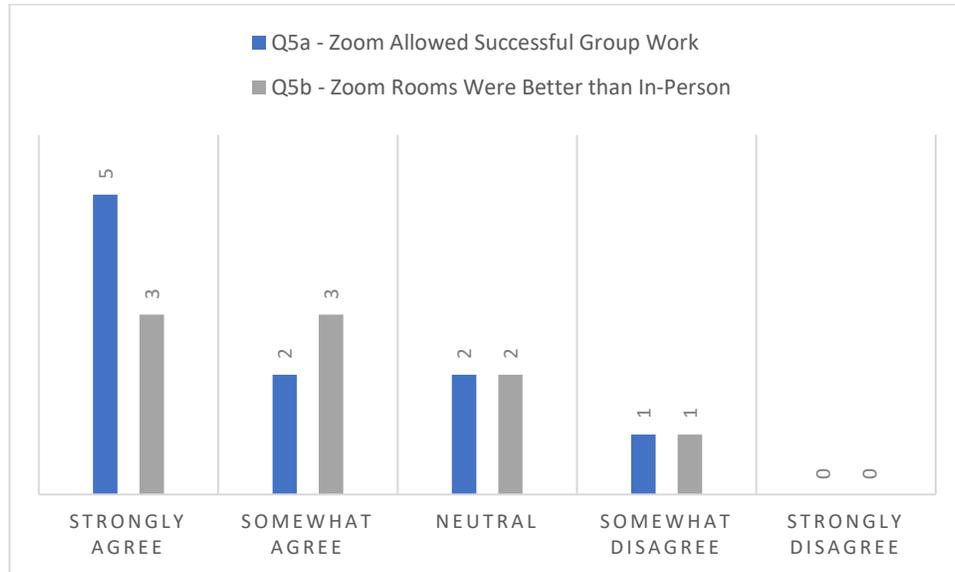


Figure 4. Agreement with Statements of Q5 (Online Synchronous Students)

Finally, Figure 5 shows the agreement of the asynchronous online students to the statements about group work. These questions were necessarily different than those posed to the students preferring the other two HyFlex modalities. Many asynchronous students simply chose to not participate in any form of group work and receive the corresponding grade of zero for each assignment. These students did not strongly agree or disagree with the statement that working asynchronously was a barrier to their learning. However, the lack of participation in the discussion boards set up for asynchronous group work shows that this barrier was difficult to overcome.

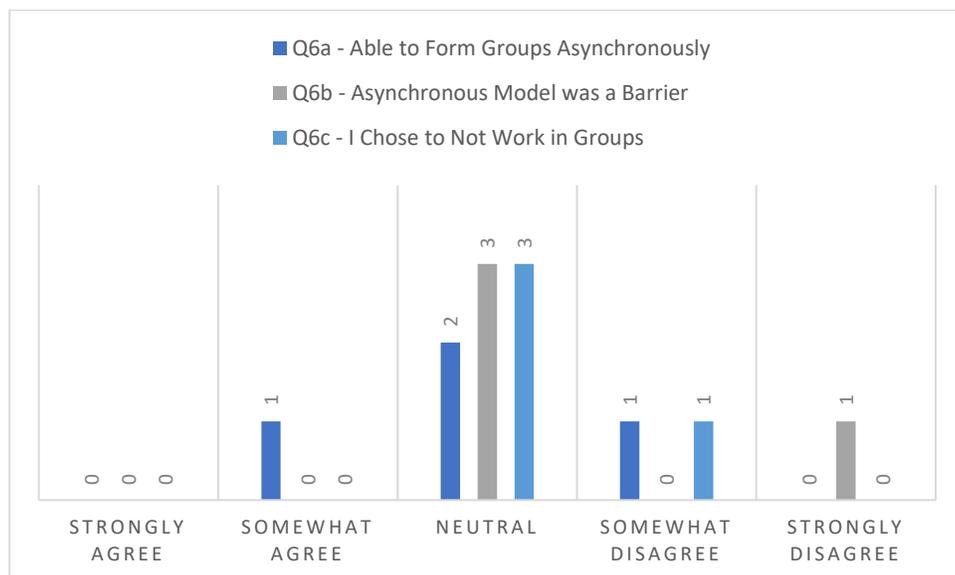


Figure 5. Agreement with Statements of Q6 (Online Asynchronous Students)

Summary and Conclusions

This study offers a glimpse into the difficulties of offering a flipped class within a socially distanced HyFlex model. Taken as a case study, student perception to the flipped classroom was not as positive as previous studies would lead one to expect. Frustration with group work was identified within all three modalities of the HyFlex model. However, reported student achievement and engagement both increased with respect to the period of the course that was offered in the traditional lecture-based model. If the HyFlex model is to remain an option post-pandemic, these results suggest that more rigorous research should be done on how to engage students with active learning strategies within the HyFlex classes. Flipped classrooms maintain some advantages over traditional lecture-based classes but could be improved by overcoming the barriers to group work.

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