How Different Teaching Modes affect Different Student Demographics across a University – A Case Study

Abstract

The concept of hybrid mode education is spreading. Little research compares hybrid teaching modes to online and face-to-face (F2F) teaching modes rather than compares online teaching to F2F teaching. Nearly all this research assumes that there is no difference in the students' demographics entering F2F, hybrid, or online sections of a course. This study used all the data from five years of all the undergraduate courses at Kennesaw State University. The data set, which includes individual student and course section outcomes, included full student demographics and the student's university GPA at the start of the course. The results showed that for all demographics, students in hybrid course sections earned higher final course grades than those in online or F2F sections. The study also showed that differences in demographics affects how advantageous hybrid mode is over the online and F2F.

Hybrid, Online, Teaching modes.

Introduction

Many studies [from Stern (2004) to Amparo et al (2018)] looked at of the outcomes of pure online teaching compared to face-to-face (F2F) teaching (often called face-to-face in research). This study found far less research that compared hybrid teaching to online and F2F teaching [from Valdares, and Slavkin (2005) to Lovern (2010)]. Hybrid in this paper is the traditional hybrid or flipped class where some of the class is in person and the rest online asynchronously. For example, a three-credit course meets for 1 ½ hour a week for discussions and covers everything else online, including lectures and assignments. One can view the concept of hybrid education as a compromise between F2F and online teaching or alternately as taking the best parts of both. Another problem is a lot of previous research, such as McFarlin (2008), has considered only a single course or instructor. Some research, such as Blau and Drennan (2017) has considered student satisfaction with different modes, as well as the academic outcomes

A possible gap in the research is that nearly all this research assumes that there is no difference in the characteristics or demographics of the students entering F2F, hybrid, or online sections of a course. The research gap identified is that there may be a difference in demographics between students who opt for one mode over the others, and that certain student demographic groups may do better proportionally in certain teaching formats. This research uses the entering characteristics of students, a large sample of many instructors, and the final mean course grade achieved to see if the benefits (including negative benefits) of hybrid and online over F2F modes depends on the characteristics of the entering student. Xu and Jaggers (2013) and Cavenaugh and Jacuemin (2013) hinted that student demographics can be different for the different modes.

This research uses data across a whole university to investigate demographic effect on student outcomes. This research uses no data after 2019 to avoid any tainting due to the effects of Covid. This study is not an analysis of an experiment but an analysis of an existing data set, which existed before the study began.

Research Questions

Thus, the research questions that the research examines are:

1) Are there any differences (both with demographics and with previous academic achievement) in the students using the different teaching modes?
2) Do students from different demographics and in different parts of the university have different student final grade outcomes in different modes?

Literature Review

Little previous research examined the differences in the type of students taking different modes. The research assumed that students taking different were the same on average. We first report the conclusions of the larger research output that does not include hybrid courses, then the

smaller research that includes hybrid courses, such as Rivera (2016), who pointed out for science courses, hybrid allows the hands on lab experience that online cannot give.

Online to F2F Comparisons

Many studies, with sample sizes ranging from very small to very large, have compared the outcomes of online versus F2F courses. The following is a selection of some of the latest studies.

No Examination of Student Demographics

Stern (2004) examined online and F2F instruction for one course and concluded that online mode works as well as F2F if online instructors have enough time to do a thorough job. Sapp and Simon (2005) compared grades for online and F2F writing courses. They showed that more students thrived (defined as A or A-) in F2F courses than online courses (32% to 52%). Summers et al. (2005) examined grades for online versus F2F for a statistics course. They found no significant difference between modes of teaching. Kelly (2009) reported that she could find no significant difference between student grades for online and F2F modes. She did not control for entering GPA. Dell et al. (2010) found no differences between online and F2F sections of a graduate human development and an undergraduate psychology course. Ni (2013) found that there were no significant differences in outcome between online and F2F classes. Amparo et al. (2018) used a very large sample (96,000 students) across two institutions to compare online and F2F results. They found that F2F students outperformed online students in course final GPA. Blau and Drennan (2017) used student's perceptions to compare different teaching formats and suggested that universities find ways to increase perceived favorability of online and hybrid courses for those that prefer F2F.

None of these studies examined whether the more previously more successful students prefer a particular teaching mode. In conclusion, most previous research, which compared online and F2F sections of courses, did not examine differences in pre-course GPAs or any demographics of students. They nearly all found no significant difference in final course grades between modes or that online courses achieved worse final course grades than F2F ones.

Examination Included Student Demographics

Cavanaugh and Jacuemin (2013) used a large sample size (5,000 courses) in one institution. They found no significant differences overall between online and F2F classes. They did find that students with good pre-course GPA did better those who did not. Online courses increased the effect of higher pre-course GPA. They also found that better students tended to do online courses, as the mean pre-course GPA was 3.41 for online students, while only 3.02 for F2F students.

Xu and Jaggers (2014) researched a very large data set of online and F2F courses (500,000 student-course sets). They did allow for differences in pre-course GPAs. They found that males, younger students, black students, and those with lower pre-course GPAs did worse in online courses, while females and Asians had no significant differences. Older students did better in online courses. They also looked at subject matter and reported that computer science, communication, and health had no significant differences. All others had F2F giving better results than online courses. The social sciences, business, law, and nursing showed the biggest

differences. Teaching mode affected starting students more adversely than continuing students were.

Nguyen (2015) summarizes research comparing F2F and online teaching modes. He found that generally research considers online learning is better but that there were problems with much of this research due to selection bias and a lack of rigorous methodology. Amro et al. (2015) showed that for their algebra courses, F2F students got higher grades than students studying online did. Although they looked at age and gender factors, they did not look at pre-course GPAs to see if the students were similar in academic ability.

Bief and Brams (2016) compared student performance in online and F2F courses. They encountered mixed results; some studies showed the F2F course were better and some the online courses. Sun and Chen (2016) did a review of 47 papers comparing online and F2F teaching modes. They concluded that online teaching works as well as or better than F2F if done properly. That is a course has well-designed content, motivated interaction, and well prepared and supported instructors.

Most studies did not look at the effect of demographic factors. However, Cavanaugh and Jacuemin (2013) found that students, who had been more successful previously, tended to choose online courses. Xu and Jaggers (2014) reported the outcome differences between online and F2F depends on race, gender, previous GPA, and age. They showed that older students did slightly better in online courses. These two studies hinted that demographics and pre-course GPA might affect course outcomes. Blau et al. (2019) used the students' intent to transfer as an output measure.

Hybrid Comparisons

Studies that did not Examine Student Demographics

Several studies looked at comparing hybrid to either or both of F2F and online modes. Reasons, Valdares, and Slavkin (2005) examined the three teaching formats and concluded that online was better in achieving a higher mean final course grade than hybrid or F2F. McFarlin (2008) examined grade results for hybrid and online sections. He found that student learning, as represented by grades, increased in hybrid and online sections compared to F2F sections. Lovern (2010) found no significant difference in outcomes between online, hybrid, and F2F sections of the same course. They did not examine pre-course GPA self-selection. Son et al. (2016) looked at a lab class that they offered in the three formats. They concluded that grades were highest in a hybrid mode, and lowest in a pure online format.

Studies that Looked at Student Experience

Mansour and Mupinda (2007) looked at students' experiences rather than outcomes in online and hybrid classes. They found that students preferred hybrid classes, but some students preferred online courses. This maybe reflected the students' learning style. Senn (2008) reported on student perceptions in the three modes for one course. He concluded that students felt that hybrid sections were more difficult for his technology heavy course.

Larson and Sung (2009) looked at hybrid sections, as well as online and F2F. Unfortunately, they used student perceptions of learning effectiveness not actual learning achieved as a variable. They did not look at whether student self-select types of course by their

pre-course GPA. They showed that students preferred hybrid to online and online to F2F. Sackett (2009) compared the three modes' outcomes based on the training that the instructors had had. He found that online learners were older and had better computer competency.

Yuen (2011) concluded that teachers and students liked blending learning in terms of easier communication between parties, and constant availability of resources and that technology assisted self-learning time, namely when students could not contact a teacher.

Kemp and Grieve (2014) looked at student preferences and outcomes between F2F and online activities. They found no difference in learning outcomes but found students preferred online for written assignments and F2F for discussions. Goerke (2018) examined the three modes of training for one Air Force course. She found no difference of customer satisfaction between the three modes. Cathorall et al. (2018) assessed student performance in hybrid and online classes. They found no difference in student grades, but higher student evaluations in online courses.

Studies that Examined Student Demographics

Brau et al (2010) reported on completion and success results in a course transitioning from F2F to hybrid and online modes. They found that completion rates increased significantly as did success rates. They did not think this was due to better students entering online and hybrid sections. Hybrid sections had higher completion rates than online sections.

Price et al (2016) looked at the effect of different factors on student performance and satisfaction across modes. They looked at age, sex, interaction, clarity, control and motivation. They found little correlation between age or sex and student outcomes. They found that course design (participant interaction, learner control, and course clarity) did affect student outcomes. Mode had no significant effect. Kim and Keuegar (2017) compared hybrid and F2F courses. They concluded that using two formats, F2F and online, in the same course can be challenging to instructors. Baum and McPherson (2019) examined learning in online and hybrid sections, taking account of the academic weakness of entering students. They suggested that students with weak academic backgrounds and other risk factors, including socioeconomic status, struggle in online classes. Hybrid classes do not exhibit these problems.

The research that include student differences showed it sometimes affected student outcomes. In addition, they found that hybrid sections often achieved better outcomes to either online or F2F sections.

Analysis

The Data Set

Kennesaw State University (KSU) provided every student-course record in KSU's Banner system from 2015 to 2019 for all KSU undergraduate courses. The study did not use later data available because of the effects of Covid-19. KSU has offered during Covid synchronous online, plus rotating hybrids, as well as standard hybrid, full F2F, and asynchronous online sections. KSU has also told faculty to give students the benefit of the doubt when grading, and many pure F2F

faculty had to teach online for the first time with little or no training. Thus, the study considers any data after 2019 as tainted.

The researcher removed from the data set all student-record data that had no grade awarded, or had a grade of I (incomplete), S (satisfactory), or U (unsatisfactory), as these grades did not give a full indication of student learning.

Each student-course record set originally consisted of the following:

1) An arbitrary random number instead of student name. The researcher deleted this column from the working database as not useful.

2) Final course grade in letters. This was converted to numbers; A = 4, B = 3, C = 2, D = 1, F = 0.

3) Previous overall university GPA of student at the start of course. This was missing for some students who were just entering KSU. Previous GPA varied from zero to four. Starting transfer and freshmen students would have no previous GPA. The analysis only deleted the students with no previous GPA when examining the effect of previous GPA analysis only.

4) Age varied from 14 to 75. The study removed all those under 18, a small number, for IRB reasons.

5) The analysis converted teaching mode [online (OL), hybrid (Hy), or face-to-face (F2F)] to zero-one variables. That is online is [1, 0, 0], hybrid is [0, 1, 0], and F2F is [0, 0, 1] for columns online, hybrid, and F2F.

6) Term – Fall, Spring, or Summer. Some analysis used one for summer and zero for Fall or Spring. This is because the summer term is a different length (2, 4, 6, or 8 weeks, rather than 15 weeks).

7) Calendar year.

8) Course Name - consisting of discipline and number.

9) College

10) Academic department home of the course. I deleted extraneous courses offered through non-KSU only entities.

11) Course Number. The first digit of course number gave the course level (1 = freshman, 2 = sophomore, 3 = junior, or 4 = senior)

12) Sex of student. This research converted this to male = 1, and female = 0.

13) Reported Ethnicity. This converted an ethnicity of Alien, Asian, Black, Hispanic, Multiethnic, and White to zero or one variables. For example, Alien was [1, 0, 0, 0, 0, 0] for columns Alien, Asian, Black, Hispanic, Multiethnic, and White. Other ethnicities, such as American Indian, Hawaiian, Pacific Islander were grouped under the term Pacific, and would be [0, 0, 0, 0, 0] for Alien, Asian, Black, Hispanic, Multiethnic, and White columns.

14) This analysis did not use Instructor ID, which was an assigned random number.

15) Previous number of F2F courses taken.

16) Previous number of hybrid courses taken.

17) Previous number of online courses taken.

This gave 939,917 student-course data records for the analysis. However, there was missing data under some demographics or circumstances, such as the course being the first that the student did at KSU. As a result, for some analysis the number of records was smaller.

Basic Characteristics of the Dataset.

Table 1 shows the basic properties of each variable in the data set.

Table 1

Properties of All Variables with Mean and Standard Deviation or Percentage of Total Dataset.

Variable Name	***Mean or %***	***Standard Deviation***
Course Grade	***2.980***	1.174
Previous GPA	3.113	.600
Age	22.1	5.432
Course Level	2.11	1.08
Previous # F2F courses	17.26	13.02
Previous # Online courses	2.09	3.23
Previous # Hybrid courses	.925	1.36
All in Person Mode	76.67%	
Hybrid Mode	5.29%	
Online Mode	15.86%	
Summer Term	9.74%	
Sex – % Male	52.4%	
Alien Ethnicity	1.99%	
Asian Ethnicity	5.26%	
Black Ethnicity	20.54%	
Hispanic Ethnicity	9.9%	
Multiethnic Ethnicity	4.52%	
White Ethnicity	55.83%	
Other ethnicities (incl. Pacific)	0.11%	

N = 939,917

ANOVA				
Source of Variation	***SS***	***df***	***MS***	***F***
Between Groups	6E+08	18	33295961	3463181
Within Groups	1.7E+08	17609256	9.614	
Total	7.7E+08	17609274		

Note that hybrid student-section records are a small (5.29%) part of the overall data set. In addition, ethnicities do not add up to 1, as some students did not choose an ethnicity (1.96%).

Statistical Analysis

The statistical analysis used the final grade awarded for the course as the predicted variable and all the other variables as predictor variables. The research reports the most significant results from the many correlations in Table 2 and the most interesting results from many regression analyses of the main data set in Tables 3 and 4.

Table 2

Partial Correlation Results of All Variables with Course Final Grade

Note that bold numbers are the correlations above 0.1. The paper deleted columns with no correlations above 0.1.

Variable	*Course Grade*	*Sex Male*	*Summer Term*	*Age*	*Prev. # F2F*	*Prev. # Online*	*Prev. # Hybrid*
F2F	-0.025						
Hybrid	0.038						
Online	0.004						
Sex Male	-0.078						
White	0.096	0.035					
Black	**-0.119**	-0.056					
Hispanic	0.016	0.028					
Asian	-0.017	0.000					
Multiethnic	0.024	0.011					
Alien	-0.013	-0.013					
Summer	0.037	-0.006					
Age	0.003	0.041	**0.105**				
Prev. GPA	**0.436**	**-0.117**	-0.002	-0.043			
Prev. # F2F	0.033	0.063	0.063	**0.137**			
Prev. # Online	0.012	-0.096	0.081	**0.270**	0.104		
Prev. #Hybrid	0.021	-0.088	0.046	0.032	**0.208**	**0.161**	
Level	**0.117**	0.002	0.075	**0.269**	**0.428**	**0.278**	**0.215**
Year #	0.021	0.005	0.017	-0.037	-0.010	**0.137**	**0.106**

As expected, the highest correlation is between course grade awarded to student in the course and the student's previous GPA. One would expect student with high previous university GPA to get a high grade on a course. There is a correlation between course level and age. There is a low correlation between course level and final grade. There is also a negative correlation between course grades with black ethnicity. Next, the study reports some of the regression analyses.

Table 3

Regression on Course Grade using all Predictors without Previous GPA.

Note bold figures are regression coefficients above 0.1.

Regression Statistics				
Multiple R	0.933			
Adjusted R Squared	0.871			
Standard Error	1.149			
Observations	939911			
ANOVA	***df***	***SS***	***MS***	***F***
Regression	16	8370061	523128	396008
Residual	939895	1241605	1.3210	
Total	939911	9611666		
Variable	***Coefficients***	***Standard Error***	***t Stat***	***P-value***
F2F Mode	**2.902**	0.010	295.59	0
Hybrid Mode	**3.066**	0.011	276.62	0
Online Mode	**2.918**	0.010	280.02	0
Sex - Male	**-0.199**	0.002	-82.62	0
White	0.032	0.008	3.92	8.69E-05
Black	**-0.345**	0.009	-40.59	0
Hispanic	0.015	0.010	1.51	0.129811
Asian	**-0.122**	0.009	-13.57	6.4E-42
Multiethnic	**0.113**	0.012	9.55	1.29E-21
Alien	**-0.135**	0.010	-13.70	9.63E-43
Summer Term	**0.133**	0.004	32.56	1.8E-232
Age	-0.002	0.000	-8.02	1.1E-15
Previous # F2F	-0.002	0.000	-21.26	3E-100
Previous # Online	-0.012	0.000	-29.00	6.9E-185
Previous # Hybrid	-0.008	0.001	-8.51	1.73E-17
Level	**0.154**	0.001	115.84	0

This regression backed up the correlation analysis. Male is a negative predictor. Black ethnicity is the highest negative predictor followed by Alien and Asian ethnicities. Course level was also a positive predictor.

As the biggest correlation with course grade was previous university GPA, the analysis ran a regression with only previous GPA with the results reported in Table 4. The results included those records with zero previous GPA, which were for those student courses where the students had failed all courses taken before. The exercise was without the records with blank previous GPA, which were for those students that had not done any previous courses at KSU.

Table 4

Results of Regression of Course Grade with only Previous GPA including Zero Previous GPA.

Regression Statistics				
Multiple R	0.944			
Adjusted R Squared	**0.892**			
Standard Error	1.053			
Observations	798860			
ANOVA	***df***	***SS***	***MS***	***F***
Regression	1	7308591	7308591	6596406
Residual	798859	885108.3	1.108	
Total	798860	8193699		
	Coefficients	***Standard Error***	***t Stat***	***P-value***
Previous GPA	**0.9548**	0.00037	2568.3	0

Analysis of Mode Effect

The initial analysis suggested that the teaching mode relates to the final course grade, so the study did more analysis, giving the results in Table 5.

Table 5

Mean Data for All Students by Mode

Variable	***F2F***	***Hybrid***	***Online***	***All***
Course Grade	2.959	3.163	2.988	2.975
%	78.86%	5.29%	15.85%	
N	741246	49709	148962	939917
Sex Male	54.56%	44.43%	45.55%	52.60%
White	55.67%	54.22%	57.14%	55.83%
Black	20.54%	23.24%	22.08%	20.93%
Asian	5.26%	4.60%	4.06%	5.03%
Hispanic	9.90%	9.23%	8.18%	9.59%
Alien	1.99%	1.74%	1.39%	1.88%
Multiethnic	4.52%	4.93%	4.83%	4.59%
Summer	7.15%	9.57%	22.67%	9.74%
Age	21.78	22.11	24.34	22.20
Previous # F2F	14.79	14.67	14.56	14.74
Previous # Online	1.27	1.75	4.42	1.79
Previous # Hybrid	0.70	1.43	1.01	0.79
Level	2.073	2.325	2.229	2.111
Previous GPA	3.123	3.088	3.061	3.111

Separating results by teaching mode, shows that the hybrid mode leads to higher course grades over online mode (5.85 %), and online over F2F (0.98%). Note that previous GPA for hybrid is lower than online (0.88%), which is lower than that for F2F (2.02%), but it appears that the hybrid

mode leads to higher course grades for lower previous GPA. However, these results are for all students. Online students had done the most online courses previously, whilst hybrid students had previously done the most hybrid courses.

Table 6
t-test for All Students by Mode Comparisons

Differences & t-test	***F2F-Hybrid***	***F2F-Online***	***Online-Hybrid***
Mean	-0.044	-0.029	-0.015
Variance	0.100	-0.137	0.237
Observations	699536	592283	107253
Degrees of freedom	46919	206958	71836
t Stat	-7.680	-8.341	-2.321
P(T<=t) one-tail	8.1E-15	3.69E-17	0.0102
P(T<=t) two-tail	1.62E-14	7.39E-17	0.0203
Modes	***F2F***	***Hybrid***	***Online***
Mean	2.959	3.003	2.988
Variance	1.363	1.263	1.500
Observations	741245	41709	148962

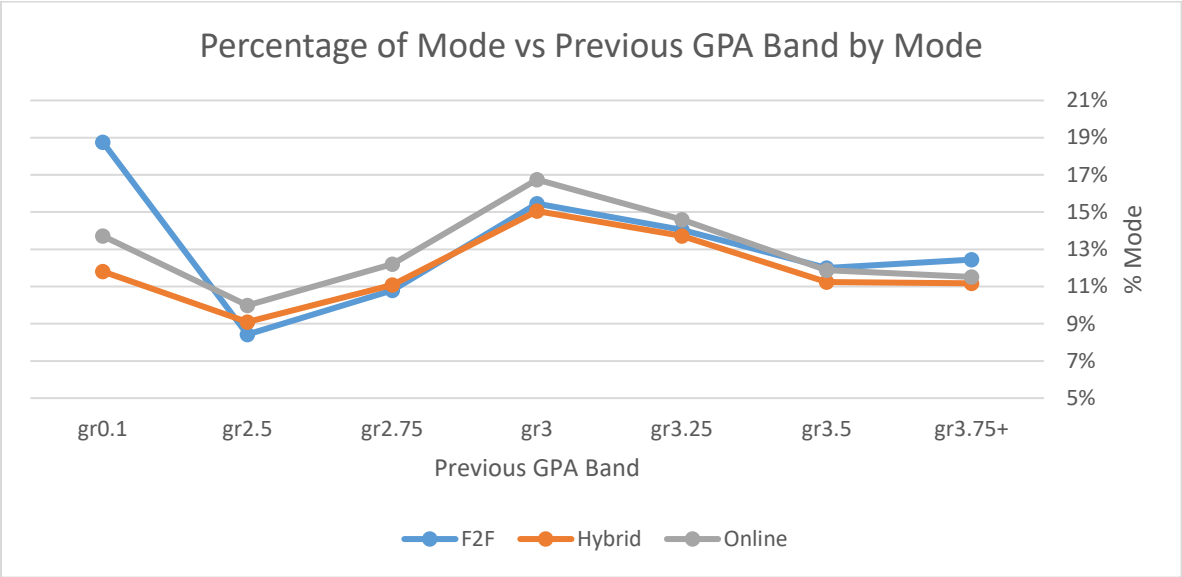
The t-test results shown above show that all the differences in mode course grade means, although small, are significant. The t-test between F2F and hybrid was 7.68, between F2F and online was 8.34, and between hybrid and online was 2.32. Therefore, the differences in final grades between F2F and the other modes was highly significant, while that between online and hybrid was significant.

Analysis Using Previous GPA

Previous university grade point average (GPA) before the start of the course is a strong indicator of academic ability. So, one would expect students with high previous university GPA to get better final course grades. The analysis split previous GPA into eight bands, where number is lowest GPA of band and band includes up to next GPA listed above. Note that the previous GPA "0" row are those students who had only filed a course before at KSU. Figures 1 and 2 shows the effect of previous GPA.

Figure 1

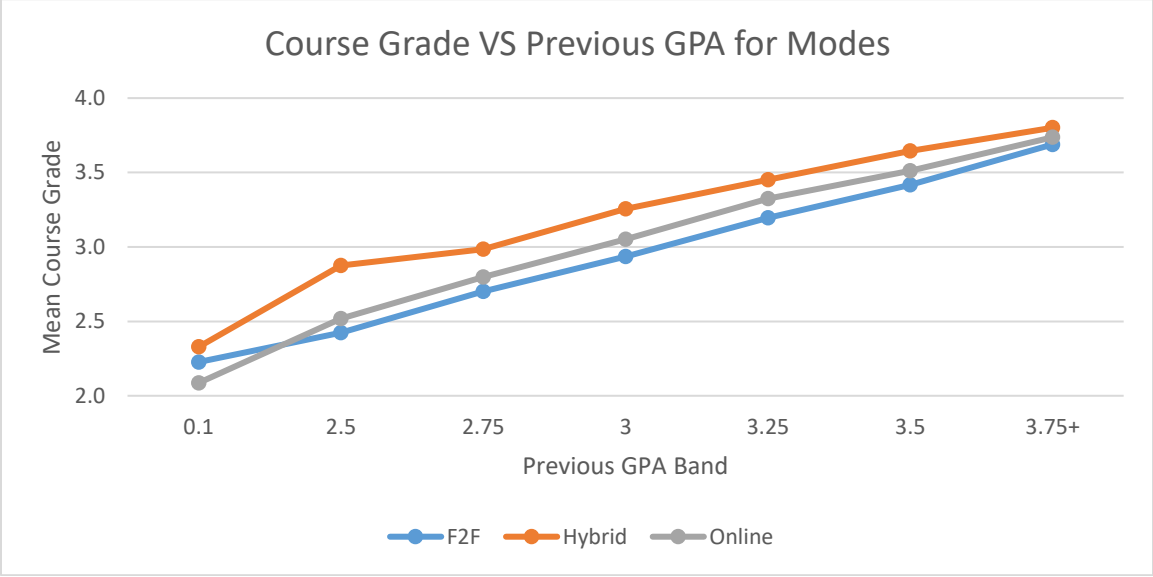
Percentage Data for all Students by Previous GPA Band and Mode



Note that the previous GPA band distribution was nearly the same for all modes except that F2F had far more from the previous GPA band of below 2.5. F2F has marginally more from higher previous GPA bands and online more from middle previous GPA bands.

Figure 2

Course Final Grade for all Students by Instructor Mode and Previous GPA Band



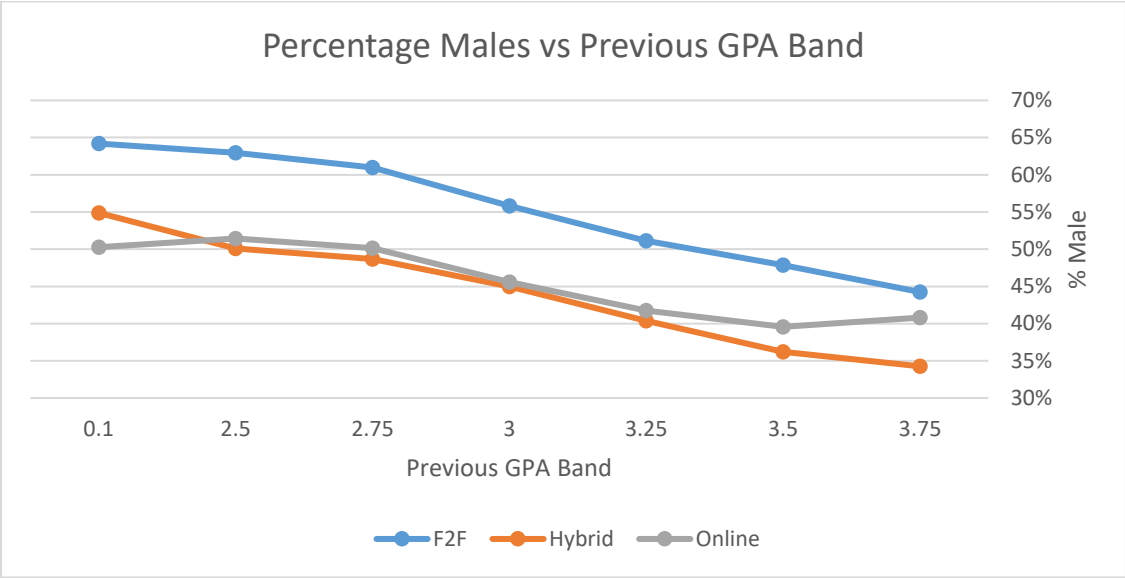
This shows that whatever the previous GPA band, the mean final grade is better for hybrid, which is better than online (except for the lowest two bands), which is better than F2F. Again, for all modes, the average grade for students who had not done courses at KSU before, is slightly less than that for all students.

Analysis Using Previous GPA and Sex

Figures 3 and 4 shows the effect of previous GPA, when split by sexes.

Figure 3

Percentage Data for all Students by Previous GPA Band and Mode



Note that the percentage of males increases with lower previous GPA for all modes. The percentage of males is about the same for those doing first courses at KSU as the percentage for all.

Analysis Using Previous GPA and Ethnicity

Figures 4, 5, and 6 shows the effect of previous GPA, when split by ethnicity by mode.

Figure 4

Percentages with F2F Mode for Ethnicity and Previous GPA Band for F2F Mode

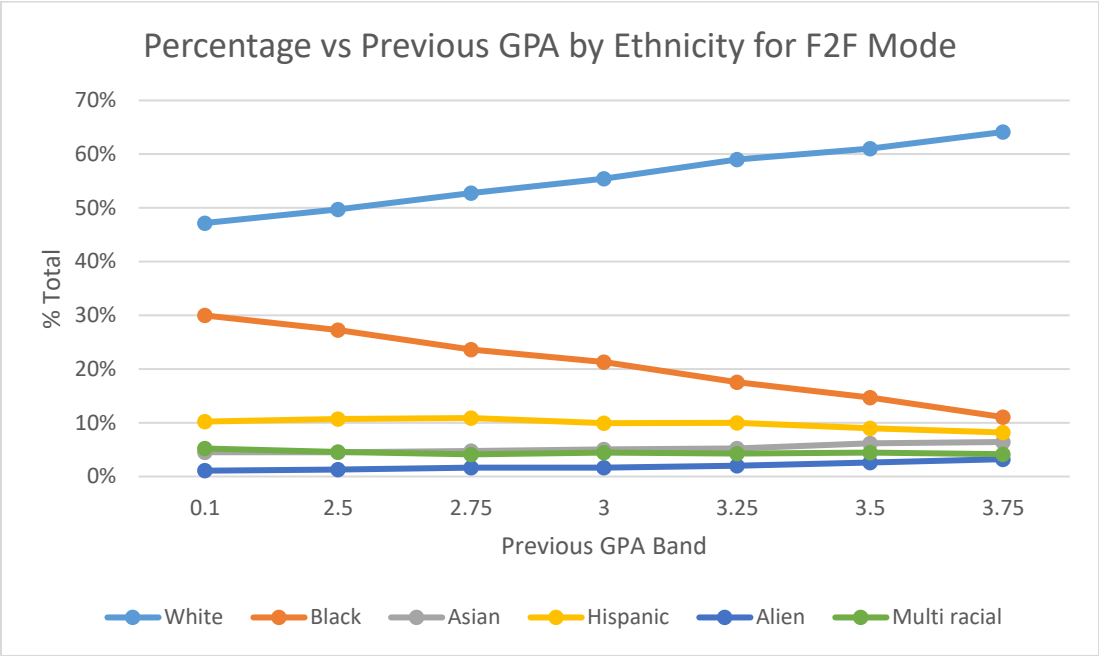


Figure 5

Percentages with Hybrid Mode for Ethnicity and Previous GPA Band for Hybrid Mode

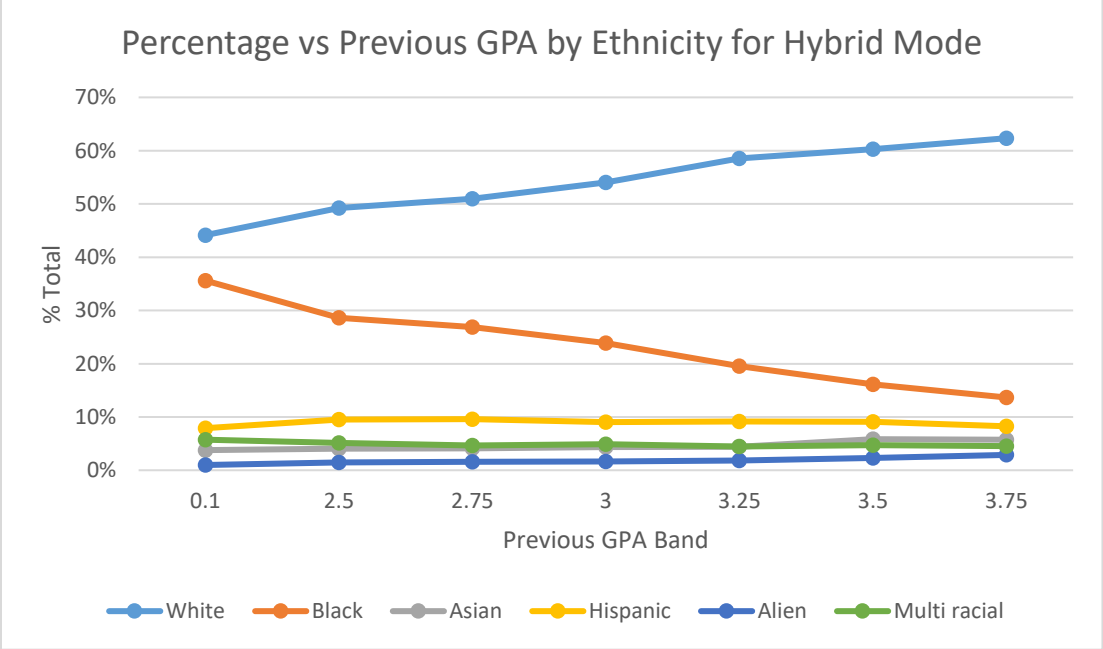
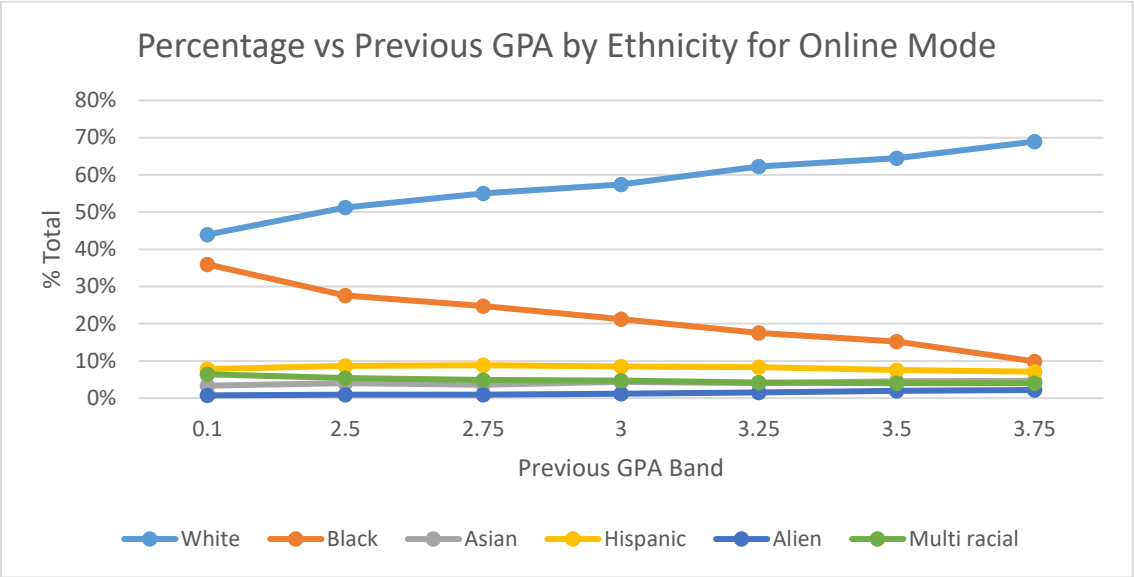


Figure 6

Percentages with Online Mode for Ethnicity and Previous GPA Band for Online Mode



The percentage of the black ethnicity increases with lower previous GPA for all modes. Note also that the figures for students on first courses at KSU are very similar to those for all.

Analysis for Sex

To examine the effect of sex, the analysis examined the results by various student characteristics, against the sex of the student and the mode. Figures 7 and 8 summarize for percentages and mean course grades by mode

Figure 7

Percentage Data for Sex by Sex and Mode

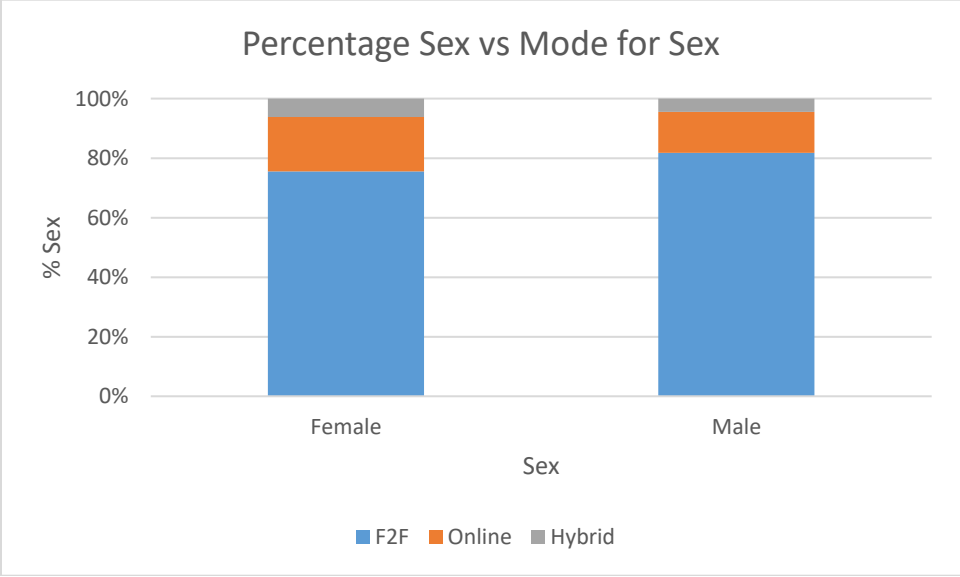


Figure 7 show that the overall sex balance is 52.6% male to 47.4% female. Despite this, females do more online and hybrid courses proportionally than male students. 18.2% of female student-courses are online versus 13.7% for male. Proportionally, more female students (6.2%) do hybrid than male (4.5%) students.

Figure 8

Grade Data for all Students by Sex and Mode

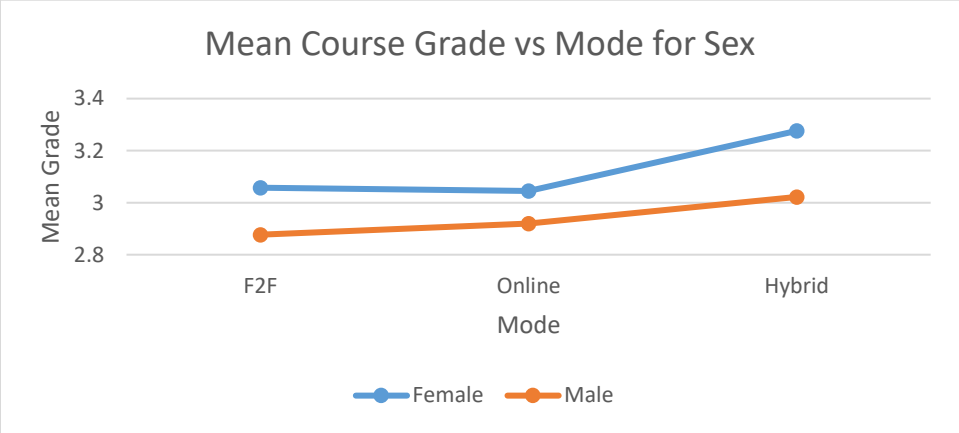


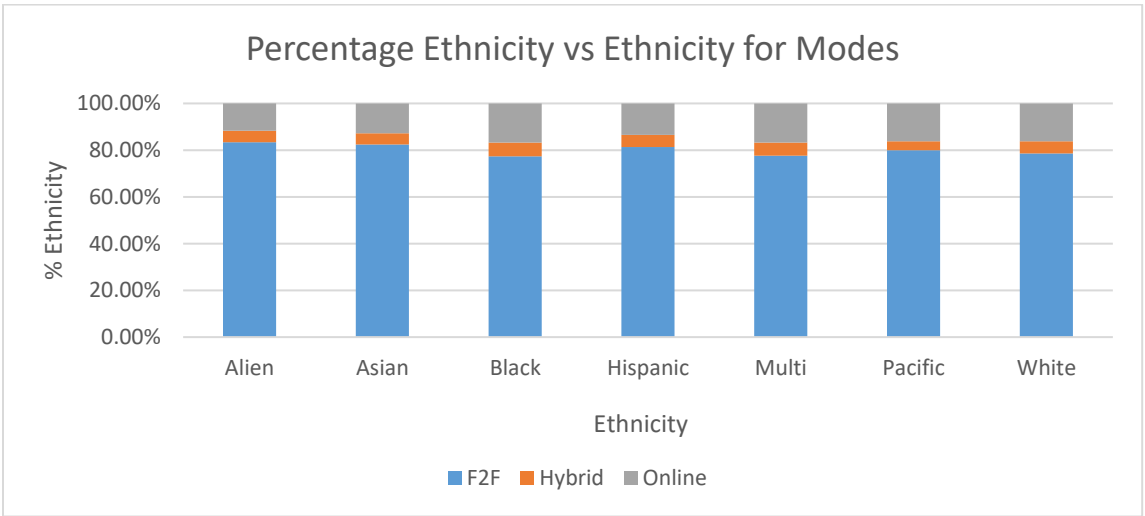
Figure 8 shows that for final course grade, hybrid is best for both sexes, but for females F2F is better than online, whilst for males it is the opposite. Females get appreciately higher grades than males in all the modes, with the biggest differential in hybrid.

Analysis by Ethnicity

The study considered whether different ethnicities were better doing certain modes for their courses. Some students reported N/A or unknown for ethnicity and thus this analysis did not use those. Note that the Pacific ethnicity is a combination of Hawaiian, Pacific Islander, and Indigenous American ethnicities, which are a tiny proportion of the whole student body. Figures 9, 10, and 11 summarizes the data.

Figure 9

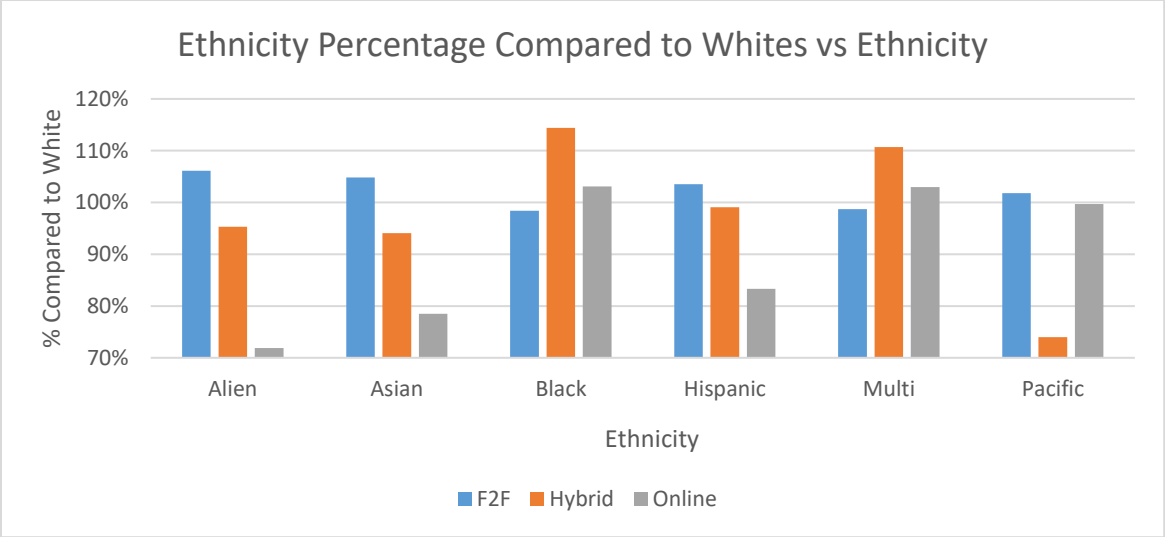
Percentage Data for all Students by Ethnicity, and Mode



Notice that the black ethnicity attends the most hybrid sections proportionally, and the Pacific ethnicity the least. The black ethnicity attends the most online and the alien ethnicity the least. ICE regulations limit alien students in the proportion of courses that they can take online.

Figure 10

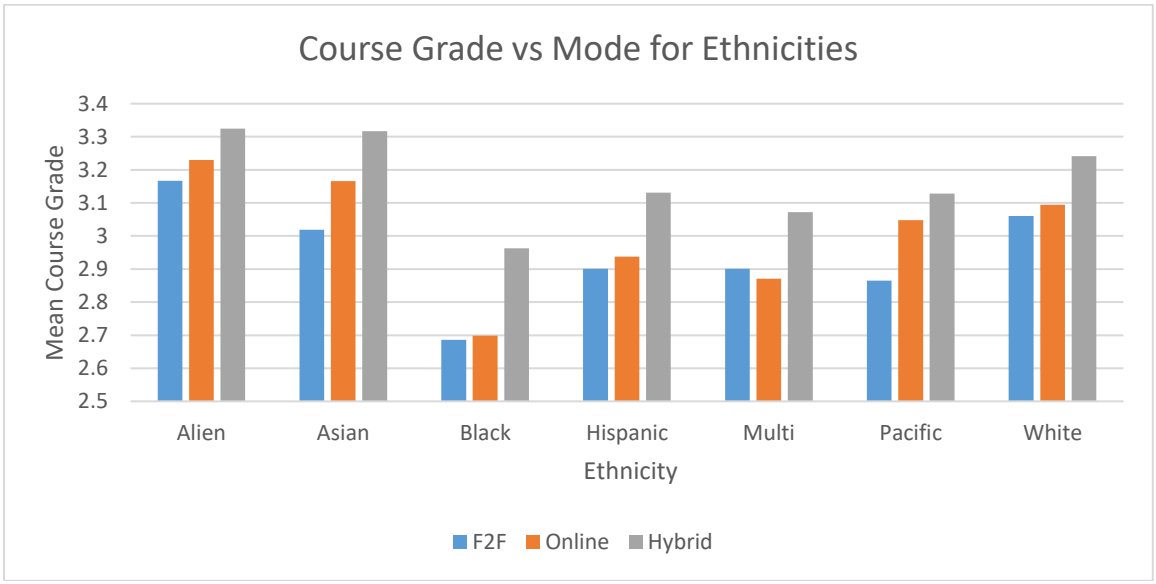
Percentage Data Compared to White, for all Students by Ethnicity and Mode



Here, the alien, Asian, Hispanic, and Pacific ethnicities do more F2F sections proportionally. While the black and multiethnic ethnicities do more hybrid and online sections proportionally. The alien, Asian, and Hispanic ethnicities do far less online sections, and the Pacific ethnicity does less hybrid sections proportionally.

Figure 11

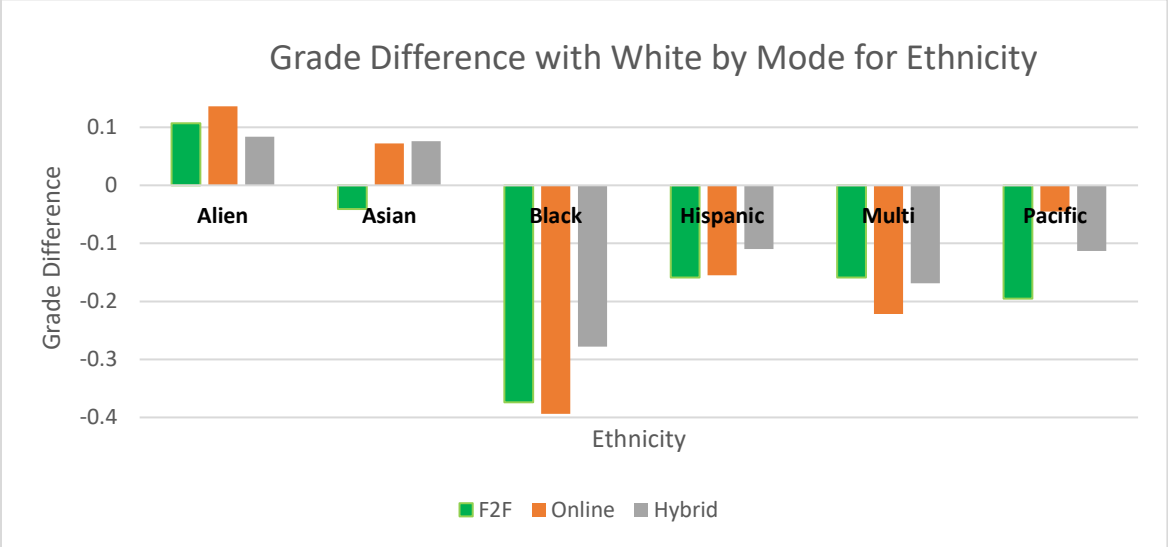
Grade Data for all Students by Ethnicity and Mode



Note that for all ethnicities in Figure 11, the hybrid mode produces the highest grade, and for all except the Hispanics ethnicity, online is better than F2F. The study now uses the white ethnicity mean as the base case in the Figure 12, as it is the largest ethnicity. So, the analysis compared the other ethnicities with the White ethnicity for mean course grade.

Figure 12

Final Grade Data Compared to White, for all Students by Ethnicity and Mode



Note that the alien ethnicity does better than the white ethnicity in all modes. The Asian ethnicity has better grades than the white ethnicity in hybrid and online sections. However, the black ethnicity reduces their deficit to the white ethnicity in hybrid sections, compared to F2F and online sections.

Analysis by Ethnicity and Sex

The analysis then looked at separating ethnicities by sex in Figure 13 and 14.

Figure 13

Percentage of Ethnicity and Sex for all Students by Ethnicity, Sex, and Mode

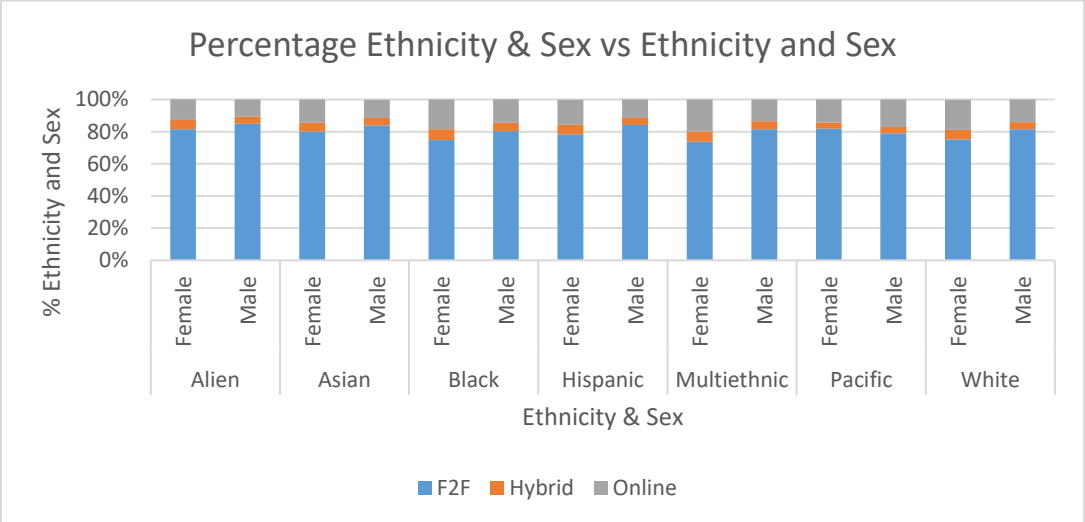
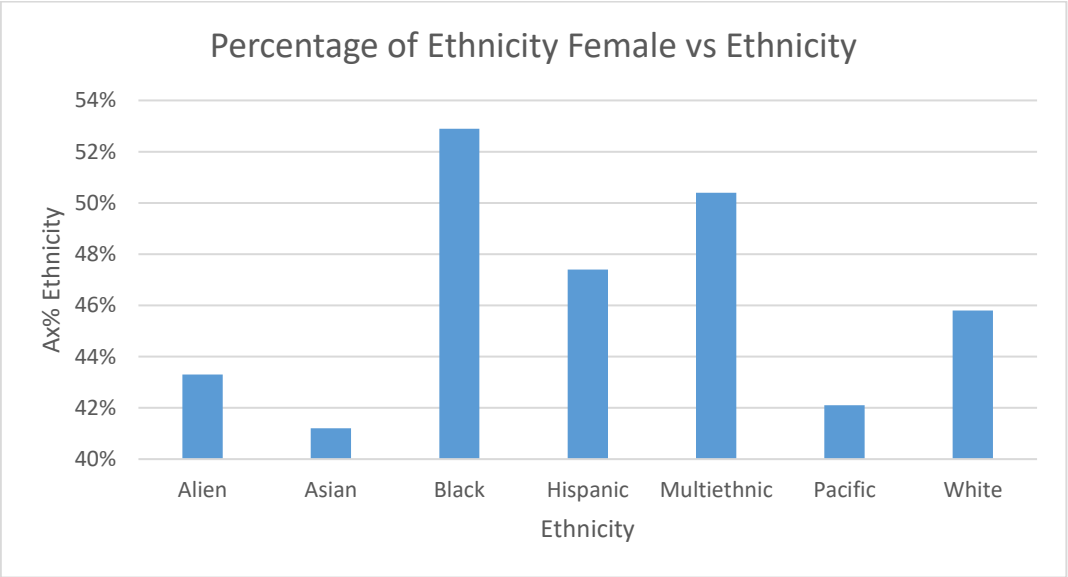


Figure 14

Percentage of Ethnicity Female by Ethnicity

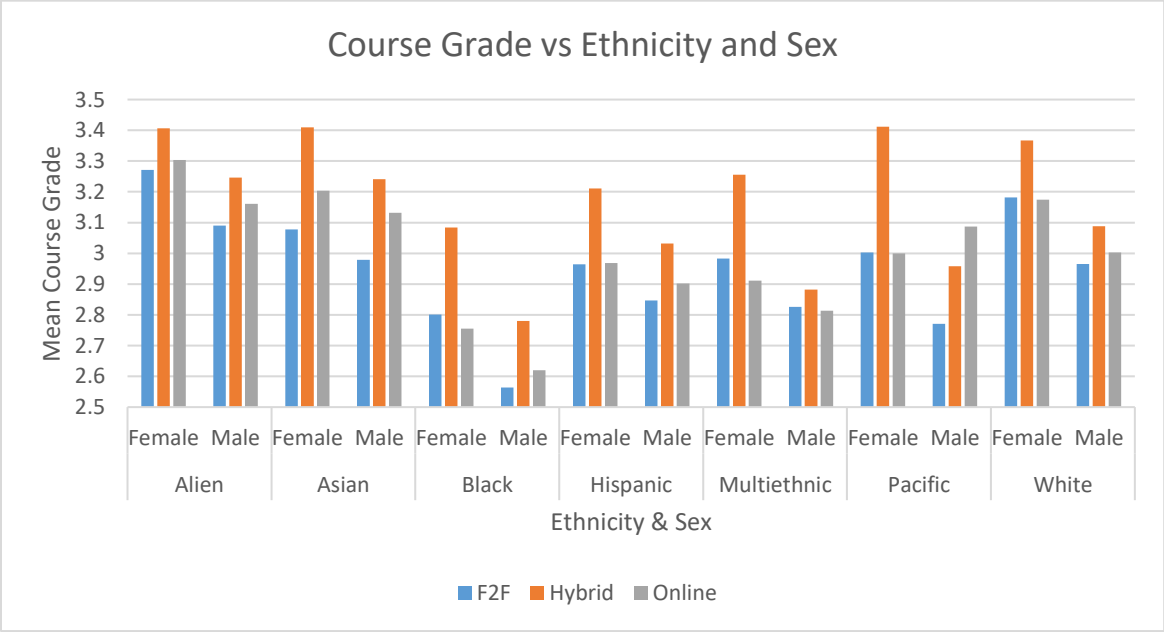


Note that the black and multiethnic ethnicities are the only ethnicities where there are more females than males.

The analysis then looked at the combination of ethnicity, sex, and mode for course grade in Figure 15.

Figure 15

Mean Course Grade Data by Ethnicity and Sex for Mode



Note that for all ethnicities and for all modes, except the Pacific ethnicity in online sections, females have higher mean grades than males. The online proportion of the Pacific

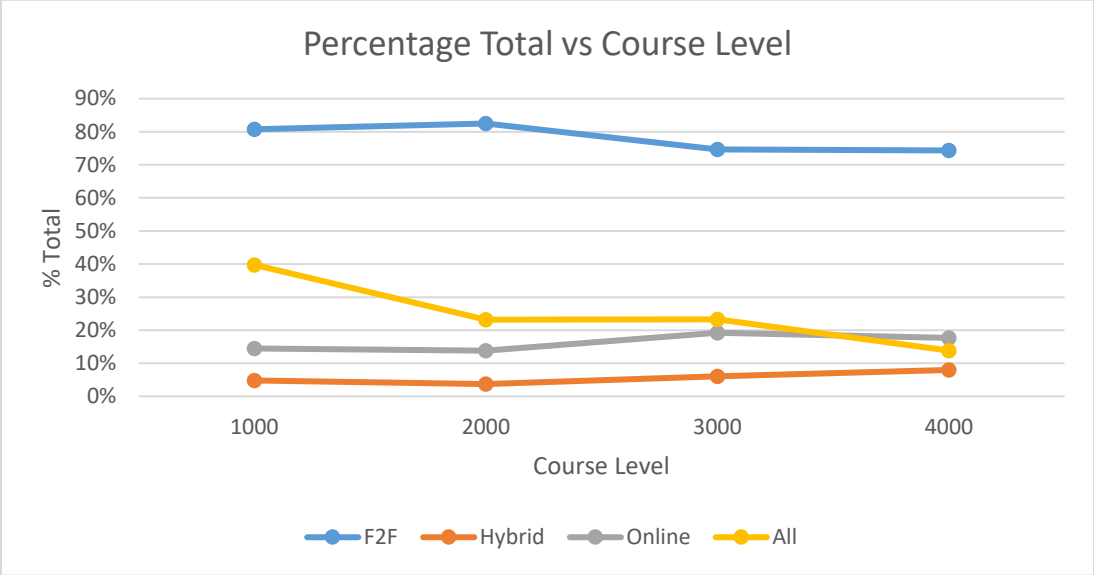
ethnicity is only 0.01% of the total student-courses. The hybrid sections give the highest mean grade for all sex and ethnicity combinations.

Analysis by Course Level

The study then investigated in if the results varied by course level. Figure 16 shows some of the results.

Figure 16

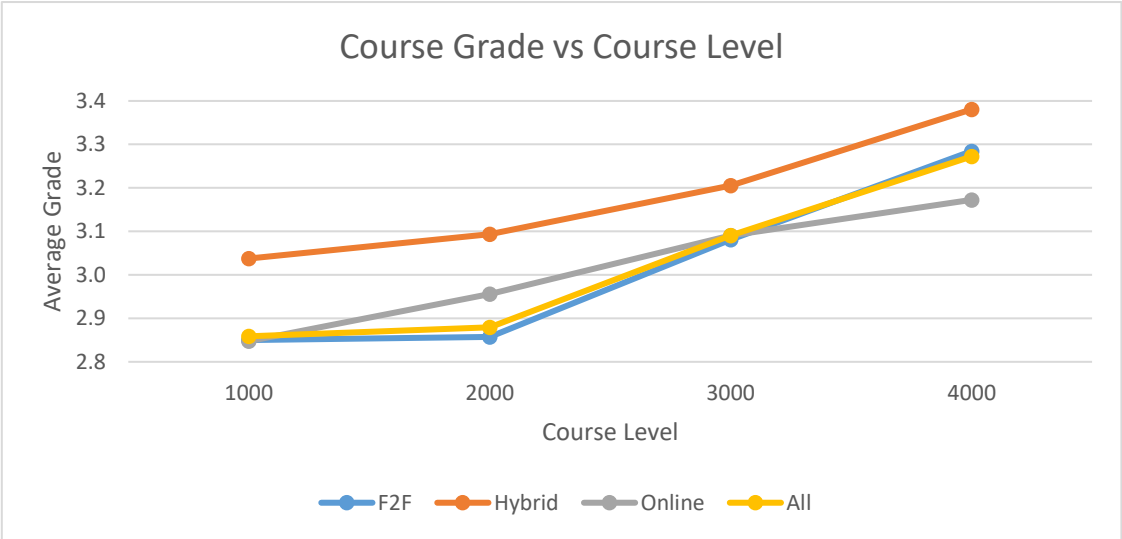
Percentage of Student-courses for All Students by Course Level and Mode



Note that overall there is a drop off in total student-courses from the freshmen to sophomore years and from the junior to senior years. The percentage of hybrid and online student-courses increase in the upper division. It is interesting that the overall mean final grade for all student-courses is almost exactly a B (3.975).

Figure 17

Mean Course Grade for all Students by Course Level and Mode



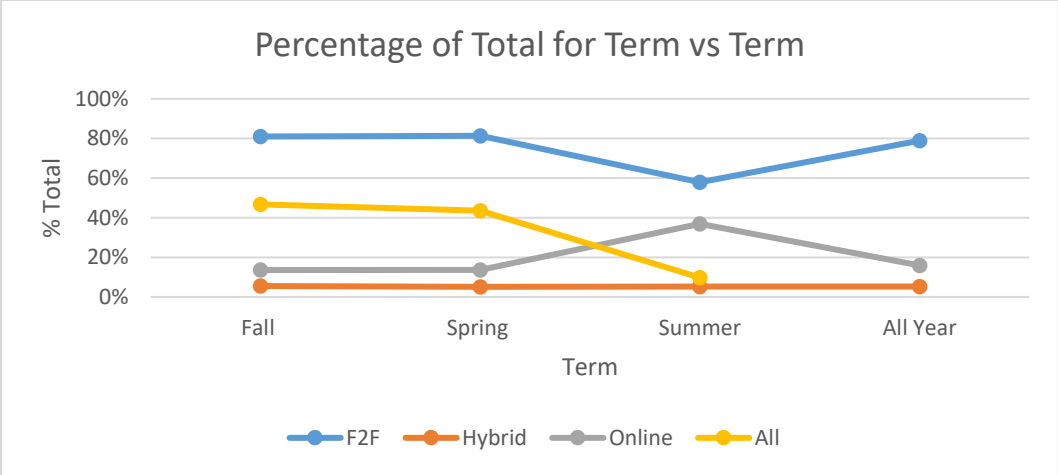
In all levels, hybrid has higher final grades than online and F2F. Online is almost the same as in all levels as F2F (marginally higher in sophomore and junior levels, and lower in freshmen level). Grades go slightly up with level for all modes. In the senior level, the mean F2F section grades are higher than online sections.

Analysis for Academic Term

The analysis looks at whether courses in summer have different student demographics and outcomes from the rest of the year. The summer term courses are 2, 4, or 8 weeks long, as opposed to 15 weeks for the other terms. KSU also emphasizes online teaching for the summer term. Figures 18 and 19 summarize the data for percentage and grade.

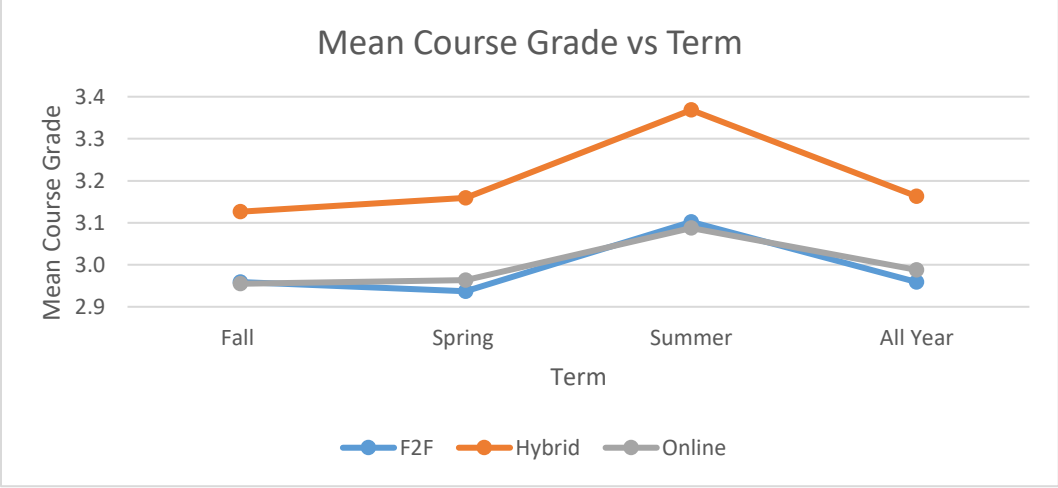
Figure 18

Percentage for all Students by Term and Mode



This shows Fall and Spring are similar in mode distribution, but Summer has a far higher percentage of online sections. Hybrid percentage does not vary appreciately with the term.

Figure 19 – *Mean Course Grade for all Students by Term for Mode*



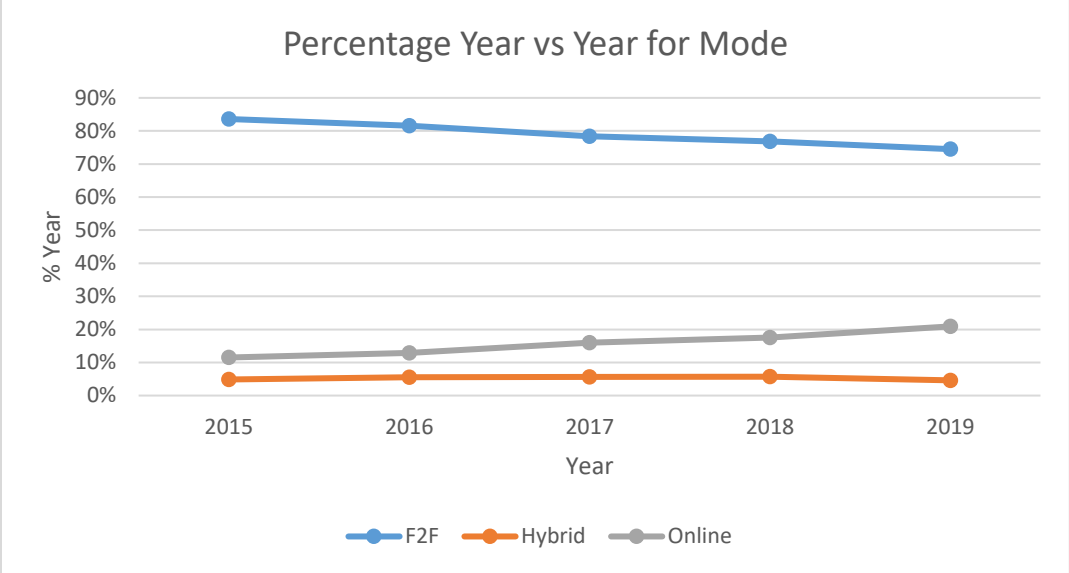
There does not appear to be much differences in F2F and online mode course final grades for all terms However, the summer term has higher mean grades for all modes. Hybrid is the best for all terms. There is little difference between fall and spring in mean grades.

Analysis by Year

The analysis next looked at whether these percentage results had varied with the calendar year and reported some results in figures 20 and 21.

Figure 20

Percentage of Year by Calendar Year for Teaching Mode



The percentage of online sections has been rising steadily whilst that of F2F decreased. Hybrid percentage remained flat. The analysis next looked Figure 21 at whether the course grade results had varied with calendar year.

Figure 21

Course Grade Data for Calendar Year and Teaching Mode

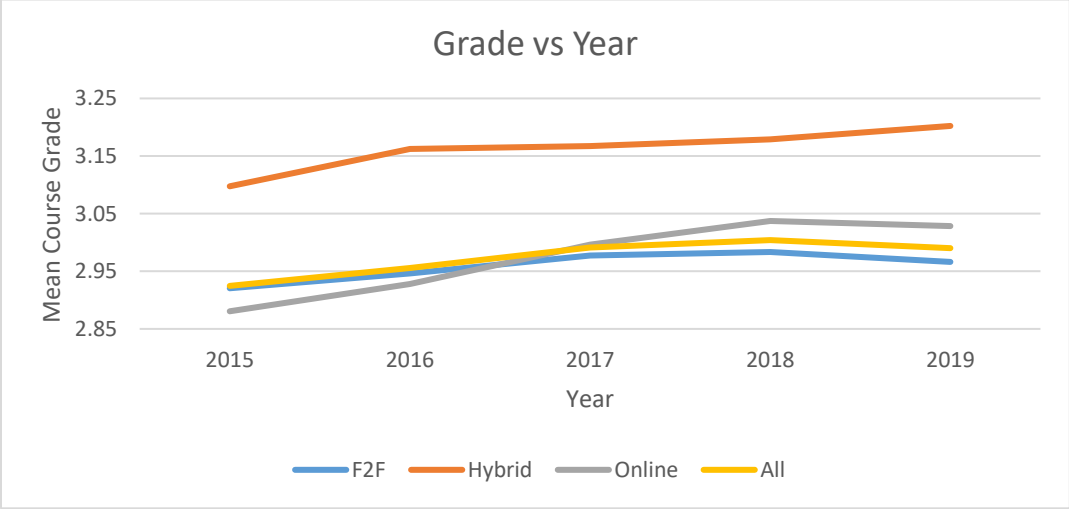


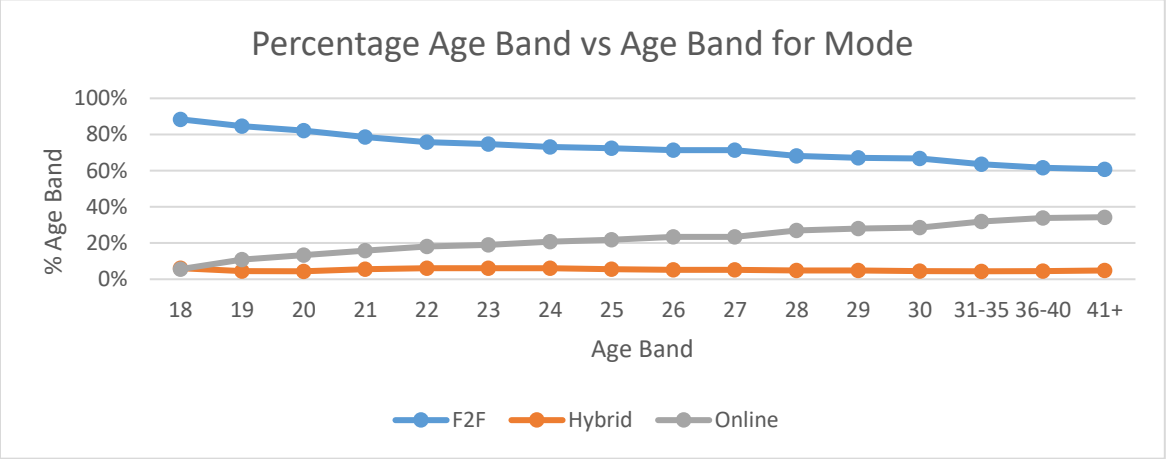
Figure 21 shows that the hybrid mode has produced superior grades for all the five years. Online which was below F2F is now just above F2F. There has been a general increase in all average grades year to year.

Analysis by Age

The analysis by student age, using sixteen age bands, shows the percentage results in Figure 13. Each number for a band shows the lowest age in the band, with the band covering up to just below the next age band below.

Figure 22

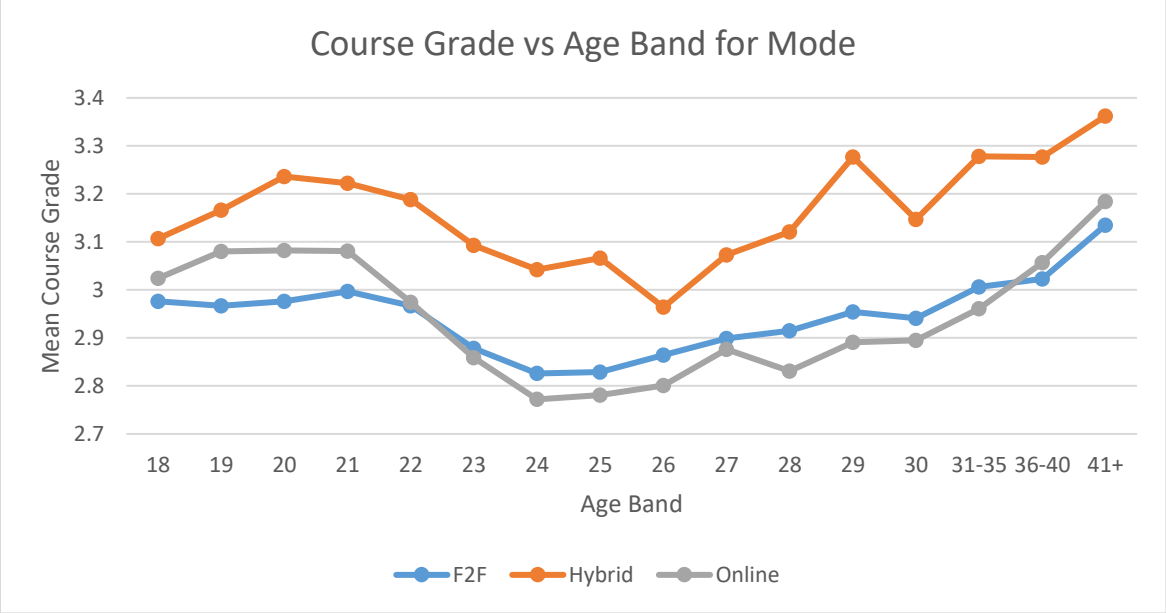
Percentage Data for Student Age Band and Teaching Mode



There is a decline in use of F2F and hybrid modes with student age band. The analysis by student age shows the mean course grades in Figure 23.

Figure 23

Course Grade Data by Student Age Band for Teaching Mode



The above shows that hybrid is best for all ages of students. Interestingly the course grade dips in the mid-twenties for all modes. The best average grades occur with the over 40s.

Analysis by College

The study reports in Figure 24 the relative size of the college and in Figure 25 whether the college that offers a course affected the percentage of student demand with different modes.

Figure 24

Percent of All Student-courses by College

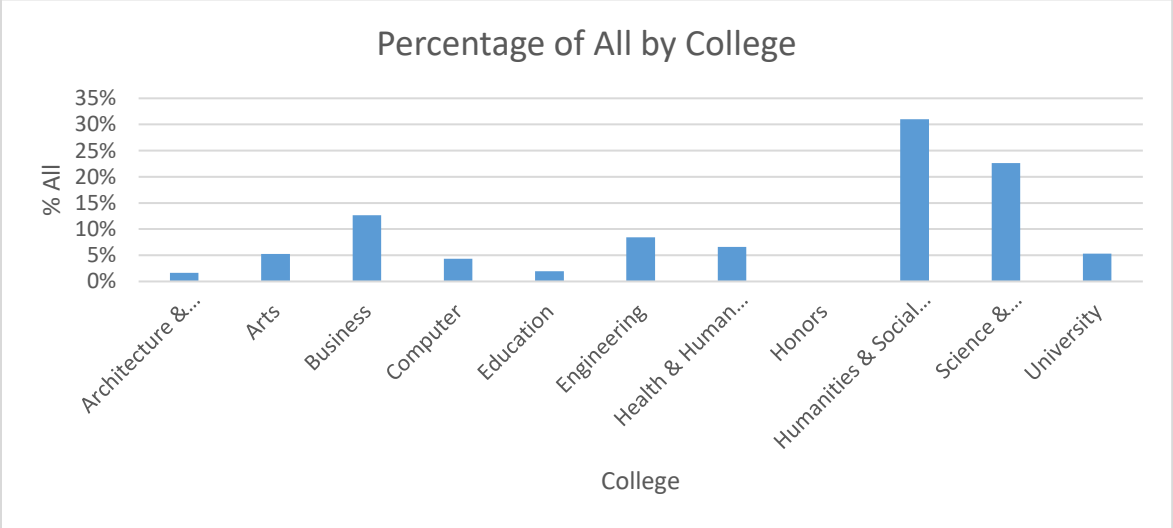
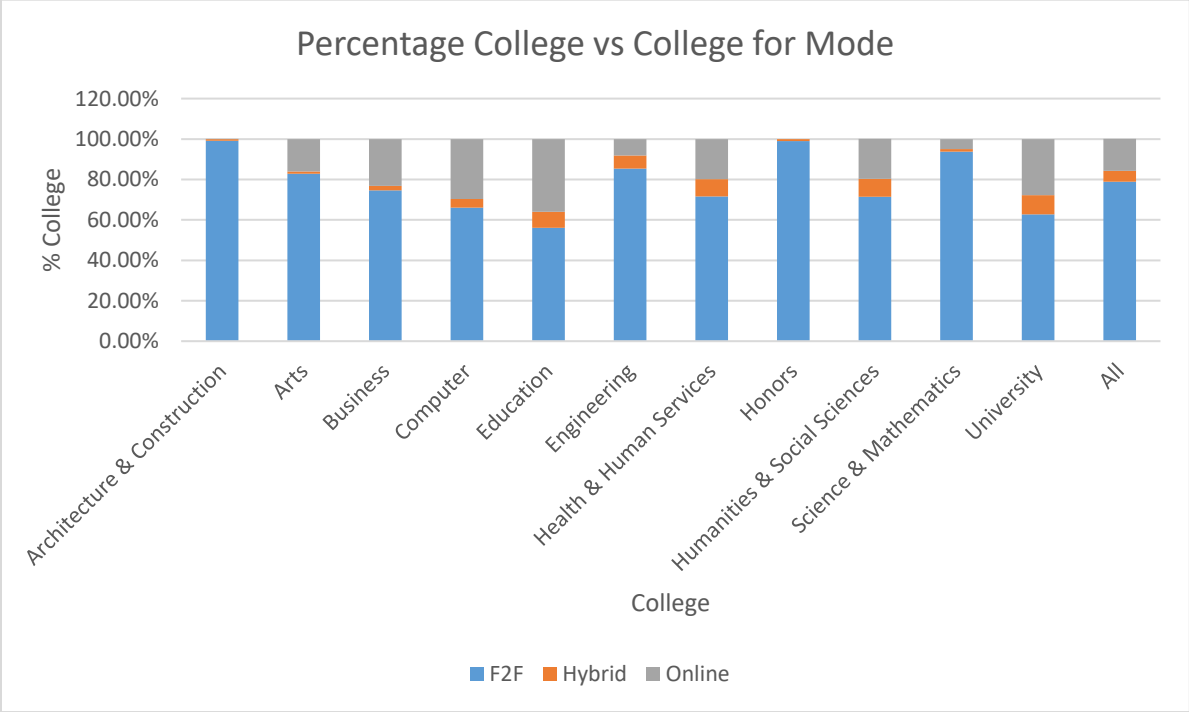


Figure 25

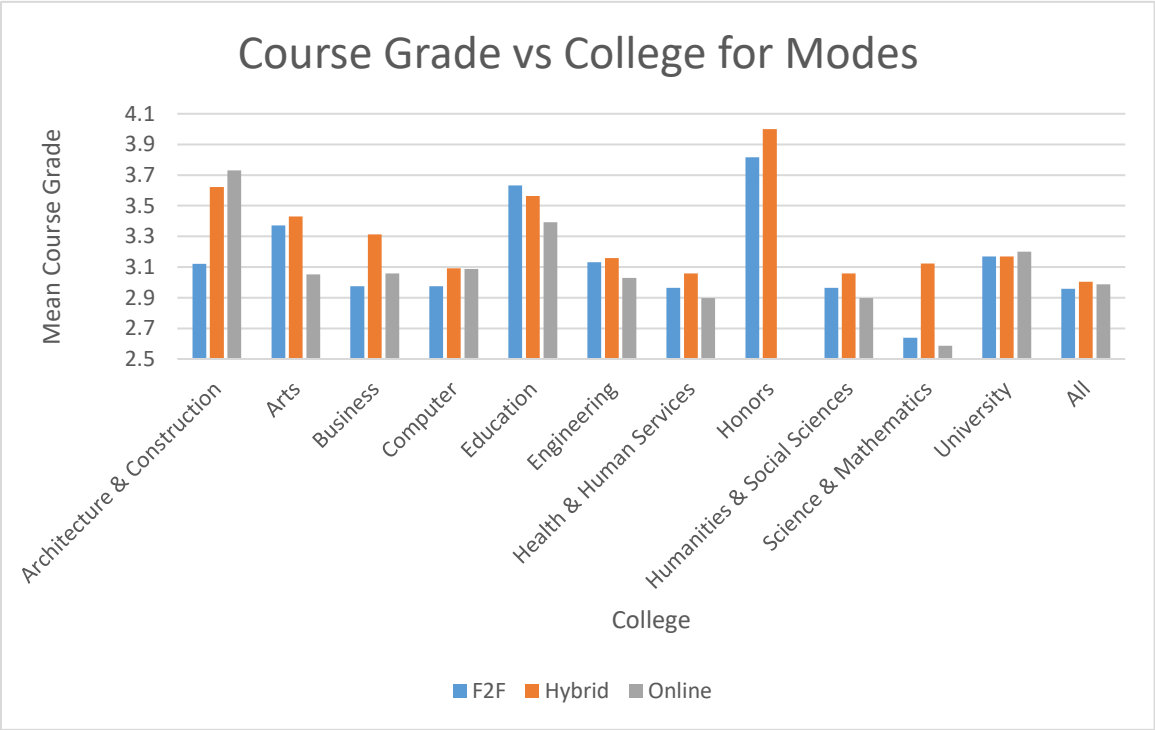
Percent of Student-courses in each College by Mode



Note that all colleges, except Honors, offer both online and hybrid sections. Otherwise, the percentages vary a lot. Hybrid varies from 9.4% to 0.7%; online from 36% to zero. The study investigated whether the college that offers a course affected the average course grade with different modes and reported results in Figure 26.

Figure 26

Mean Final Grade Awarded in each College by Mode



Note that in all colleges except three (in bold italics), hybrid sections have the highest mean grade. University, and Architecture and Construction, which are very small colleges, have their online section having the highest grades; whilst Education, which is a large college, had F2F as the best.

Analysis by Department

The investigation then reported the percentage mode data for each department in table 6.

Table 6

Percentage Data for all Students by Department and Mode

Department	***F2F % Dept.***	***Hybrid % Dept***	***Online % Dept***	***Dept % All***
Accountancy	91.34%	0.19%	8.47%	2.676%
Architecture	100.00%	0.00%	0.00%	0.801%
Art & Design	84.17%	2.78%	13.05%	1.836%
Biology	91.51%	0.18%	8.31%	6.638%
Business College courses	91.16%	0.27%	8.57%	0.059%

Chemistry	94.76%	5.20%	0.04%	4.704%
Civil & Environmental Eng.	91.27%	3.52%	5.21%	2.424%
Comm. & Media	67.67%	15.85%	16.47%	3.643%
Computer Engineering	99.97%	0.02%	0.00%	0.517%
Computer Science	85.18%	4.73%	10.09%	1.599%
Construction Management	98.40%	1.29%	0.32%	0.876%
Culinary & Hospitality	88.48%	1.46%	10.06%	0.986%
Cybersecurity	0.00%	0.00%	100.00%	0.079%
Dance	87.25%	0.00%	12.75%	0.473%
Early Childhood Education	88.03%	5.31%	6.66%	1.134%
Economics, Finance, & QA	88.18%	2.91%	8.91%	4.647%
Electrical & Computer Eng.	96.59%	0.00%	3.41%	1.449%
Engineering Technology	81.85%	8.15%	10.00%	0.980%
English	69.61%	13.91%	16.48%	6.791%
Exercise Science & Sport	82.87%	6.42%	10.71%	1.670%
First Year, Trans Studies	86.54%	8.00%	5.45%	1.336%
Foreign Languages	80.91%	4.07%	15.02%	1.788%
Geography & Anthropology	54.55%	6.41%	39.04%	3.135%
Georgia Film Academy, USG	100.00%	0.00%	0.00%	0.024%
Government & International	73.83%	2.64%	23.52%	3.234%
Health & Physical Education	65.68%	8.23%	26.09%	3.307%
History / Philosophy	86.19%	0.16%	13.65%	5.158%
Honor's Department	98.98%	1.02%	0.00%	0.073%
Inclusive Education	50.52%	6.10%	43.38%	0.421%
Industrial & System Eng.	33.02%	34.32%	32.66%	1.016%
Information Systems	47.18%	1.51%	51.32%	1.433%
Information Technology	26.08%	10.42%	63.50%	1.015%
Instructional Technology	100.00%	0.00%	0.00%	0.128%
Interdisciplinary Studies	38.02%	13.78%	48.20%	2.629%
Management, Entr., & Hosp.	59.48%	5.08%	35.44%	2.631%
Marketing & Sales	55.88%	0.52%	43.60%	1.520%
Mathematics	94.45%	0.28%	5.27%	7.915%
Mechanical Engineering	97.56%	1.56%	0.88%	1.778%
Music	83.29%	0.22%	16.49%	2.083%
Nursing	84.83%	11.48%	3.68%	0.948%
Physics	98.16%	0.00%	1.84%	2.636%
Psychology	60.86%	24.53%	14.61%	3.497%
Robotics & Mechatronic Eng.	99.98%	0.01%	0.01%	0.251%
Secondary & Middle Grades	71.16%	20.80%	8.04%	0.296%
Social Work & HS	75.99%	11.97%	12.04%	0.818%
Sociology & Criminal Justice.	68.15%	0.41%	31.43%	3.275%
Software & Game	71.70%	1.40%	26.90%	1.904%

Statistics & Analytical Sc.	87.76%	1.59%	10.65%	1.055%
Tech Comm. & Inter. Design	56.95%	18.95%	24.10%	0.725%
Theatre & P.S.	76.65%	0.98%	22.37%	0.960%
All	78.85%	5.29%	15.86%	
Mean	77.3%	5.4%	17.4%	2.0%

Departments had large variations in how they used teaching modes. Online use varied from 100% (Cybersecurity) to 0% (IT). Hybrid use varied from 34.3% (Industrial and Systems Engineering) to 0% (ten departments).

The investigation then looked at the mean course grade data for each department in Tables 7 and 8.

Table 7

Grade Data for all Students by Department and Mode

	Mean Course Grade					***Differences***		
Department	***All***	***F2F***	***Hybrid***	***Online***	***Best***	***Hybrid - F2F***	***Hybrid - OL***	***OL - F2F***
Accountancy	2.881	2.873	3.435	2.955	Hybrid	0.562	0.479	0.083
Architecture	2.878	2.878						
Art & Design	3.200	3.185	3.547	3.228	Hybrid	0.362	0.319	0.043
Biology	2.761	2.756	2.723	2.807	F2F	-0.033	-0.083	0.050
Business College	3.057	3.844						
Chemistry	2.594	2.559	3.240	2.368	Hybrid	0.681	0.872	-0.191
Civil & Environ. Eng.	3.046	3.064	2.975	2.777	F2F	-0.089	0.198	-0.287
Comm. & Media	3.022	3.016	3.137	2.956	Hybrid	0.122	0.181	-0.060
Computer Eng.	3.029	3.029						
Computer Science	2.899	2.929	2.438	2.859	F2F	-0.491	-0.421	-0.070
Construction Manag't	3.353	3.348	3.623	3.731	Online	0.275	-0.108	0.383
Culinary & Hospitality	2.985	2.988	3.376	2.897	Hybrid	0.388	0.479	-0.091
Cybersecurity	3.028			3.028				
Dance	3.559	3.609		3.216				-0.394
Early Childhood Educ.	3.581	3.605	3.537	3.299	Online	-0.068	0.238	-0.306
Economics, Fin., & QA	2.882	2.844	3.481	3.161	Hybrid	0.638	0.321	0.317
Elect. & Computer Eng.	3.074	3.076		3.030				-0.045
Engineering Technology	2.902	2.917	2.920	2.762	Hybrid	0.003	0.158	-0.155
English	3.071	3.108	3.011	2.965	F2F	-0.097	0.046	-0.143
Exercise Sc. & Sport	2.969	3.258	3.630	3.473	Hybrid	0.373	0.157	0.215
First Year, Trans Stud.	3.220	3.304	2.759	2.554	F2F	-0.546	0.205	-0.750
Foreign Languages	3.053	3.119	3.401	2.603	Hybrid	0.282	0.798	-0.516
Geography Anthrop'y	2.996	2.944	2.876	3.046	Online	-0.067	-0.170	0.103
Georgia Film., USG	3.367	3.367						
Govern't & Intl. Affairs	2.850	2.800	2.923	2.998	Online	0.123	-0.075	0.198

Health & Phys. Educ.	3.213	3.264	3.305	3.055	Hybrid	0.041	0.250	-0.209
History / Philosophy	2.746	2.770	3.104	2.589	Hybrid	0.334	0.515	-0.180
Honor's Department	3.811	3.809	2.953		F2F	-0.856		
Inclusive Education	3.480	3.529	3.461	3.424	F2F	-0.069	0.036	-0.105
Indus'l. & System Eng.	3.269	3.363	3.265	3.180	Hybrid	-0.098	0.084	-0.183
Information Systems	3.108	3.270	3.039	2.961	F2F	-0.231	0.078	-0.309
Information Technology	3.214	3.077	3.474	3.227	Hybrid	0.397	0.247	0.150
Instructional Technol.	3.668	3.668						
Interdisciplinary Study	3.226	3.233	3.358	3.183	Hybrid	0.125	0.175	-0.050
Man'gt, Entr.. & Hosp.	3.265	3.264	3.587	3.220	Hybrid	0.324	0.367	-0.043
Marketing & Sales	3.032	3.091	3.622	2.950	Hybrid	0.531	0.672	-0.142
Mathematics	2.407	2.413	2.464	2.304	Hybrid	0.051	0.160	-0.108
Mech. Eng.	3.344	3.349	2.985	3.395	Online	-0.364	-0.410	0.046
Music	3.367	3.429	2.782	3.057	F2F	-0.647	-0.274	-0.373
Nursing	3.515	3.443	3.921	3.936	Online	0.479	-0.014	0.493
Physics	3.033	3.040		2.668				-0.372
Psychology	2.904	2.893	2.999	2.791	Hybrid	0.106	0.209	-0.103
Robotics, Mechatronics	3.126	3.126						
Second. & Middle Gr.	3.645	3.674	3.485	3.444	F2F	-0.189	0.042	-0.230
Social Work & HS	3.474	3.551	3.312	3.155	F2F	-0.238	0.158	-0.396
Sociology & C.J.	2.966	2.997	3.071	2.896	Hybrid	0.074	0.175	-0.101
Software & Game	2.984	2.981	3.220	2.982	Hybrid	0.239	0.238	0.002
Statistics, Analytical Sc.	2.881	2.923	2.918	2.523	F2F	-0.006	0.395	-0.401
Tech Com & Inter. Dgn.	3.097	3.152	3.108	2.960	F2F	-0.044	0.147	-0.191
Theatre & P.S.	3.280	3.420	3.125	2.806	F2F	-0.295	0.319	-0.614
All	2.974	2.959	3.163	2.988	Hybrid	0.204	0.175	0.029
Mean	3.126	3.166	3.190	3.010	Hybrid	0.052	0.184	-0.120

Table 8 lists the number of departments for which each mode was the best.

Table 8

Number of Best Mode for Course Grades by Departments

Mode	***# Best in***
F2F	14
Hybrid	20
Online	6
Hybrid not offered	10
All	50

This data shows the large variation in what is the best mode for a department.

Conclusions

The base data set has only 5.29% of all student-course records in hybrid sections. This may mean that the results are heavily biased towards online and F2F modes. However, due to the large number of student-course records, this analysis probably gives out useful information. The analysis also showed there was little difference in type of student who did each mode, except older students tended to do more online courses. The most important predictor of a student's grade was their previous GPA. Followed by ethnicity and sex.

This research replicates most of the previous studies with larger student populations, but with more information of how student types affect the results.

Detailed Results for Course Final Grade

Mode - Overall, average hybrid grades were higher than online and F2F grades. There was a significant difference between the modes for average course grade.

Previous GPA - The biggest predictor of a student's final grade in a course was their previous university GPA at the start of the course. The breakdown of previous GPA bands was very similar across the modes, except the F2F mode had far higher proportion of previous GPAs below 2.5. F2F had marginally more in higher previous GPA bands and online had marginally more in middle previous GPA bands. F2F also had a constant proportion more males for all previous GPA bands.

Hybrid had higher grades for all previous GPA bands than online, which had higher than F2F. Grades for those who had no done KSU courses before, were similar to the average of all bands.

Whilst the percentages of students were nearly the same for all previous GPA bands, this was not true for the black ethnicity. The black ethnicity proportion increased for all modes with lower previous GPA.

Sex - Female students tend to get higher final grades than male students do in all modes. However, hybrid is the best for both sexes. Online is second best for females, whilst F2F is second best for males.

Ethnicity – Proportionally, the black ethnicity has the highest percentages for hybrid and online modes. Aliens have the highest percentage for F2F mode. This probably because ICE regulations limit the use of online sections by aliens.

Aliens tend to get the highest final course grades. Black students tend to get the lowest grades. Hybrid gives the highest final course grades for all ethnicities. However, the hybrid advantage is largest for the black ethnicity and least for the Hispanic one.

Ethnicity and Sex – Proportionally, the blacks and multiethnic ethnicities have a higher proportion of females than males. The other ethnicities have more males proportionally. For hybrid, the largest group proportionally are female blacks. Foe online the largest group proportionally is multiethnic females.

For all ethnicities for all modes, except the Pacific online combination, females achieve higher grades than males of the same ethnicity. Hybrid modes give the highest mean grade for all combinations of sex and ethnicity.

Course Level – The percentage of students using the online and hybrid modes is higher for upper division courses over lower division ones. However, the proportion of the total student courses for all modes drops with higher level. Approximately 40% of all student courses are for freshman classes. The course grade increase for all modes with course level. However, for all course levels, hybrid gives higher grades.

Course Term – There were proportionally far more online courses in summer terms. However, the hybrid proportion remained constant over the three terms. For all modes, summer courses had higher grades than for other terms. For all terms, hybrid had the highest mean grades.

Year – Whilst the proportion of online sections increased over the years, the proportion of hybrid student courses remained much the same. Grading within each mode di not vary much with year. Hybrid had the highest mean course grades for all the years. However, the mean course grade did increase slightly with each year.

Age – Whilst the proportion of online students increased with age, raising to above 34% for the over 40s, that for hybrid was constant. Course grade dipped in the mid-twenties, then rising to be the highest for the over 40s. Hybrid mode was the best for all ages.

College – Whilst all except the honors college offered online and hybrid sections, the proportions varied widely. Hybrid varied from 9.4% to 0 and online from 36% to 0. Hybrid was the best in all colleges except for three. Online was the best in two and F2F the best in one, education.

Department – Online offerings varied from 100% to zero and hybrid from 34.3% to zero. Ten departments did not offer hybrid sections. In twenty colleges, hybrid was best; in fourteen, F2F was best; and in six, online was the best.

Limitations

1. The use of previous GPA to represent the academic ability of an incoming student is a convenient assumption. However, that is how most students rate their learning.
2. The use of course final grade to represent learning from a course is a common approximation of learning.
3. This analysis did not consider other factors like how many online or hybrid courses the student had done before the course, how many online or hybrid courses the student took at the same time, or whether the student was only taking online courses or mixing F2F with online and hybrid courses.
4. In the main study, hybrid sections were only a small proportion of the total data.
5. The study did not examine differences between instructors. However, many instructors grade harder than others do for the same course. Hybrid teaching instructors may grade higher than do those only teaching other modes.
6. The data for this case study comes from one university. Other universities and colleges may show completely different patterns.

Discussion

The results of this analysis supported previous research such as Means et al. (2010), who considered that students in online conditions performed modestly better, on average, than those learning the same material through traditional face-to-face instruction. Instruction combining online and face-to-face elements had a larger advantage relative to purely face-to-face instruction than did purely online instruction.

Answers to Research Questions

1. ***Are there differences (both with demographics and with previous academic achievement) in the students using the different teaching modes?***

There are variations between the demographics of students doing the different modes. For example, more females and blacks tend to do hybrids. However, the differences are not major.

3) Do students from different demographics and in different parts of the university have different student final grade outcomes in different modes?

There are clear differences between outcomes for different teaching modes, and different demographics affect these outcomes. For example, blacks benefit the most from taking hybrid courses. There are clear differences on how different departments use different teaching formats.

Further Points

Bernard (2014) conducted a meta-analysis found that technology has an overall positive effect on learning but aims to focus on blended learning and interaction with technology in higher education. They concluded that blended learning and technological interaction enhance student achievement. This analysis supports their findings.

Currie (2016) claimed that there were five reasons hybrid achieved better results.

1. Students manage their time better to meet the course deadlines.
2. Students get professor *and* classmate face time.
3. Everyone is equal in online discussions.
4. The learning does not stop when students leave the classroom.
5. It can provide deeper and more effective learning.

This study supports his assertion that hybrid get better results. Moreover, it would be interesting to test his five reasons with further research.

An additional question arises from these results. Why, if hybrid mode generally results in higher course grades, do instructors teach such a small proportion this way? Financially, hybrid courses save capital and operating costs. If all F2F courses became hybrid, then one would need half the number of classrooms for the same number of student sections.

However, one possibility is the increased workload for instructors. To teach a hybrid section, instructors will have to spend as much time to set up the online portion before class and administer the course as in online sections, and then they have to spend the time to turn up on campus and teach in person in a classroom. So effectively, hybrid instructors are teaching the equivalent of half an F2F section plus a complete online section.

Implications

Based on this data, one may consider counselling black ethnicity students to do hybrid sections of a course. Simpson (2006) considered the ethical implications of telling students their likelihood of success, based on models. Other implications are that administration may want to consider offering more hybrid sections in courses, and less F2F. Alternatively, it may be that the type of instructor who wants to teach in a hybrid mode gives higher mean course grades, and that the results of this study would not apply if instructors who prefer F2F teaching, started to teach hybrids (as has happened during Covid). Another huge implication is that if junior and senior students do better in online and hybrid sections, is that a university need not build new classrooms to handle an increased student load. Alternately, if student numbers are falling or the same then administrators should consider reducing their number of classrooms by selling off or repurposing their surplus real estate. Although KSU is a high admittance rate institution, it is not an open institution. However, the implications of the advantages of hybrid teaching should work for open institutions too, possibly through synchronous online classes.

Future Work

One should repeat the same analysis again using only data from those instructors who teach hybrid as one of their modes and ignore all data from instructors that do not teach in the hybrid mode.

As many courses are now, due to Covid, being taught using the rotating hybrid (such as Hyflex, where one teaches in person and online at the same time) and synchronous online (which is F2F but not in person) modes, then there should be research to examine how these new modes affect results.

While this study showed hybrid mode teaching had better results than F2F, it did not show why. One line of interesting research would be to find out why hybrid does better. One theory could be is that hybrid only does the interesting interactive stuff in person, while the less interesting basic learning is done online. Another theory might be that knowledge acquisition is best done using the preferred learning times and speed of a student, whilst more advanced learning is best done in an interactive in-person manner. There is also the possibility that the instructors who give higher grades tend to be those who teach hybrid courses.

One further line of study would be to look at the rests by type of subject. That is science, social studies, art, etc., to find if the lessons apply across all sorts of subject matter or only with certain types of subject matter.

It would be interesting to do similar studies with other universities and colleges to see if KSU's patterns are similar or different. If done with several other teaching institutions and one found similar results, then one could make generalized conclusions on the effect of teaching mode on course grades.

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