

COVID-19 STATISTICS: PANDEMIC RESPONSE AND STUDENT SUCCESS IN THE UNIVERSITY STATISTICS CLASSROOM

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ABSTRACT

The nation's universities have traveled an uncertain path since March of 2020. The Covid-19 pandemic created new challenges across the academic landscape and each institution was required to pivot, and then reinvent the way they educated students. The authors of this paper attempt to create a narrative that follows one such mid-sized southern university as they react to the pandemic in the spring of 2020, and then prepare and attempt to maintain a high level of rigor and engagement in its midst. Specifically, this study tells the story of 600-700 statistics students enrolled each semester from fall 2019 to spring 2021. The student success data and the policies enacted by the university combine to give insight into what happened, what worked, and what else could be done.

Keywords: Teaching innovation; Digital learning strategies; Pandemic response; Covid-19

INTRODUCTION

Collegiate teaching has been undeniably impacted by COVID-19 in terms of the traditional foci of pedagogy such as relationship building and contextualization of course content to the student's lived experiences. The ability of an instructor to leverage traditional tools to accomplish these goals has been dramatically altered, perhaps irrevocably. The question remains, however, to what extent are these changes in pedagogical practices driven by the COVID-19 pandemic impacting the equitability of learning within the classroom? A cautious and protective posture by administrators and educators at all levels has led to guidance and policies such as requiring flexible attendance policies or even the outright removal of attendance requirements and other top-down directed changes in content delivery methodologies. However, are the various changes in classroom policies having a negative, and possibly disparate, impact upon learners?

The five major approaches to pedagogy: constructivist, collaborative, integrative, reflective, and inquiry-based learning all require significant yet varying degrees of interaction between the learner and the instructor. It is these very interactions that have been most impacted by responses to the current pandemic. Research on inclusive pedagogy has shown some learners respond differently to various approaches and that due care must be exercised to ensure equitable learning opportunities are available for everyone (Florian, 2015; Florian & Black-Hawkins, 2011). In an era of forced, by policy or simply circumstance, changes to pedagogical approaches in every

classroom, what are the outcomes of these changes, and are there techniques that result in improved outcomes?

Emergent research indicates stress disorders are appearing in students due to many direct and indirect effects of COVID-19 (Ye, Yang, Zeng, Wang, Shen, Li, & Lin, 2020). These anxiety-related traumas induced by the pandemic and the multitude of instructional and procedural responses by instructors, institutions, and civil authorities are negatively impacting our students. Recognizing these impacts and identifying appropriate pedagogical responses such as adopting a flux pedagogy (Ravitch, 2019) based approach and exercising radical empathy (Koss-Chioino, 2006) have become among the highest priorities for many instructors. Individual instructor, departmental, and institutional responses to these challenges are defining current students' programmatic learning outcome success levels. Beyond the direct effects upon student learning, our responses today will impact how these soon-to-be alumni and society as a whole assess the value of higher education both now and in the future.

In this case study, we describe our institutional setting, student profile, and the pedagogical approaches that we employed while teaching our courses during this era of COVID19. Then we will present a statistical analysis of the outcomes of the introductory statistics courses taught across six departments on our campus. We use this course intentionally because although it is taught differently across campus, the University of Central Arkansas (UCA) has designated all six of the introductory statistics courses as equivalent. A substantial and conscious effort was made by UCA's campus community during the 2018 academic year to standardize the introductory statistics course topics across the various offerings and instructional modalities (e.g. traditional face-to-face or online asynchronous) to implement these equivalencies. This provides us with an opportunity to assess pandemic-related effects across a very large student segment that includes many different instructors, instructional methods, and departmental subject foci while controlling for consistent topical coverage.

Our analysis finds significant results between all semesters relating to student outcome measures using the pre-pandemic fall 2019 semester as a baseline. The statistically significant results include a grade spike during the initial pandemic semester of the spring of 2020. These differences coincide with what one may anticipate given the circumstances of forced changes relating to the modes of content delivery. To a large extent, the focus of course instructors was on modality changes and creating materials for the last portion of the semester that resulted in an arguably overly permissive response to student difficulties and understanding of their situations. This created a sense of survival frequently characterized by a triage approach to navigating the effects of this punctuated equilibrium that was forcing rapid changes upon everyone, staff, students, and teachers alike. The results were higher grades and fewer students dropping the course.

This initial pandemic semester's results were followed in the fall 2020 semester by a drop in outcome measures, well below the baseline semester. This occurs during what we refer to as the *radical empathy phase*. This phase was intended to provide support for learners and meet them where they needed to be met to foster a compassionate learning environment given the difficult times. Unfortunately, as it relates to student outcomes, the results were significantly negative, falling below the fall 2019 baseline as the various administrative policies and rules surrounding radical empathy were in full effect.

However, we as educators and administrators learned a great deal during those semesters regarding what worked and what did not as it relates to supporting our students in their learning experiences. The following spring 2020 semester showed a significant increase and a return to the baseline of student outcome measures. This change, we believe is due to changes in policies, procedures, teaching methods, and modalities, some subtle, and some more glaring, that were made between the fall 2020 and spring 2021 semesters. These changes were a result of the conscious shift in focus away from the radical empathy phase that frequently resulted in compassion fatigue or exhaustion. Although we didn't have a theme for this semester while it was ongoing, we later identified an appropriate phrase that we will use to describe the spring 2021 and following semesters. This phrase was articulated by our Provost during the fall 2021 faculty convocation as "*caring, not caving.*"

The realities of the pandemic are that it has real impacts upon our students, our campus, and our teaching. These effects remain to this day, and likely will linger on for several more semesters at a minimum. Although the challenges have been many, we all have had the benefit of experiencing first-hand a tremendous natural experiment relating to traditional, online, and mixed-mode teaching. A thorough investigation will help us to explore and understand our responses so that we can recognize, embrace, and extend what worked, and eschew what did not. The resultant discussion will help us to improve in our primary role as educators and ultimately help our students learn and achieve success in their educational goals.

The University of Central Arkansas

The University of Central Arkansas is a regional university serving central Arkansas and surrounding areas. The institution was founded as the Arkansas State Normal School in 1907 with a statewide mandate to train teachers. The name was formally changed to UCA in 1975 and simultaneously granted university status. UCA has a current enrollment of more than 10,000 students enrolled in over 80 undergraduate degree programs and 15 graduate degrees and certificates including several doctoral programs offered by 5 colleges housed within the university campus. UCA is accredited by the Higher Learning Commission (HLC) and over 65 program-specific accrediting bodies such as the Association to Advance Collegiate Schools of Business (AACSB) and the Council for the Accreditation of Educator Preparation (CAEP).

THEORETICAL FRAMEWORK

Challenges of Online Teaching and Learning

Kebritchi et al. (2017) conducted a meta-analysis using Cooper's framework from 1990 to 2015 to identify challenges in online education and identified several issues in delivering an online course. For the students, the issues centered on their expectations of online courses, their identity in an online environment, and their readiness to participate in this new format. Online pedagogy has improved but has not eliminated the trepidation for students. For instructors Kebrichi et al. (2017) identified concerns with the changing roles in traditional classrooms vs online, the modification to teaching style required in the new format, time management, and transitioning from face-to-face with higher kinesthetic (i.e. physically moving around the classroom) to primarily a seated position for online courses (Clemons, 2004). The Kebrichi et al. (2017)

literature review also found challenges for course developers including, for example, multimedia integration, the role of instructors in new online course development, and the need for professional development and technical training for instructors. These challenges required time and significant recurring efforts to address. In short, even before the COVID disruption to higher education, there were many challenges to delivering online education for students, instructors, and course developers.

Another factor impacted by the increase in online courses is student engagement. The relationship between taking online courses and student engagement has shown that those who take more online courses are less likely to engage in collaborative learning, discussions, and student-faculty interactions (Dumford & Miller, 2018; Ding et al., 2017). This concern can be addressed during course development but that takes time and careful planning (Dixson, 2015).

Several studies have compared the performance of students in traditional courses to the performance in online courses. Ury, 2005 found both methods to be effective but mean grades for online courses to be significantly lower. In contrast, Summers et al., 2005 found course grades between traditional and online courses to be similar but students in online courses were significantly less satisfied. Pedagogical concepts like active learning, student engagement, and experiential learning can be easily applied in a traditional or flipped course while in a fully online course extra care and effort must be applied to reach similar outcomes (Khan et al., 2017; Fadol et al, 2018; Budhai, 2021).

Case Study

In response to a meta-analysis sponsored by the US Department of Education which suggested that student learning outcomes were superior in online courses, Jaggars and Baily, (2010) reported these findings did not hold for fully online semester-long college courses. They suggest a lack of generalization to traditionally underserved populations and suggest online courses may hinder low-income and academically underprepared students. Online education has been studied for decades with the consensus being that well-designed courses take careful design and planning (Hodges et al., 2020).

When online courses are compulsory they cannot produce the desired results due in part to response time, technical issues, and the lack of socialization students of traditional courses require (Adnan & Anwar, 2020). Hodges et al., suggest a new terminology called "emergency remote teaching" to describe the academic communities' response to COVID-19. In contrast, a typical online course development takes six to nine months (Hodges et al., 2020).

In conclusion, our examination of traditional vs online courses made several observations:

- Effective course development in any format takes time and effort.
- Converting a course from traditional to online is complicated.
- Teachers and students face new challenges when forced to rapidly convert to online.

The current research takes the form of a case study. Yin (2018) suggests five situations that by themselves warrant a single-case design which is, having a *critical, unusual, common, revelatory,*

or *longitudinal* case. A *critical* case satisfies several key circumstances for testing a theory. An *unusual* or *extreme* case deviates from the norm and is not a typical occurrence.

The third rationale for a single case study is what he refers to as the *common* case. This is a case in which the focus of the study is to observe the circumstances or conditions in a typical situation, typically where the unit of analysis is a subunit within the case. The fourth rationale is the *revelatory* case, one where few scientists have the rare opportunity to study a phenomenon previously inaccessible to others. The last rationale Yin gives for performing a single case study is the *longitudinal* case. A longitudinal case would be one where the same single case is studied at multiple points in time.

The current study meets three of the five conditions that Yin suggests, namely *unusual*, *common*, and *revelatory*. COVID-19 caused a major disruption to education at all levels. In this study, we examine the *unusual* impact of COVID-19 on traditional courses forced to transform to online in a relatively short time. This rapid conversion is a very unusual situation that warrants deeper understanding. The current study also meets the *common* rationale for a single case because it observes pedagogy in traditional vs online courses but where the influence of COVID-19 is the subunit under analysis. Finally, this study meets Yin's *revelatory* rationale for a single case design because of the opportunity to study a single course, taught by multiple colleges within a single university.

Course Delivery Expectations

Within the context of this case study, a few course delivery methods are discussed. The first of which is the traditional face-to-face method of course delivery, which is denoted TRAD for course registration purposes. Students enrolling in a course labeled TRAD know to expect to meet face-to-face for lectures 2 or 3 days a week depending on the course schedule. Students should not expect lectures delivered online, although many instructors choose to assign and collect course assessments using the online learning management system, Blackboard.

The next course delivery method is fully online, asynchronous, which is denoted DEAS in the course registration management system. Students enrolling in a course designated DEAS know to expect that there will be no face-to-face or synchronous lecture requirement. All course activities, assignments, and assessments are delivered fully online through the Blackboard, LMS.

The final course designation that was traditionally used by the university is called the hybrid delivery method or HYBR. The hybrid delivery method is used to define a course that has at least one traditional lecture replaced by online activity. However, typically courses designated HYBR will have roughly half of the face-to-face lectures replaced by some online or distance component. Of the three, HYBR is the least used designation.

PANDEMIC RESPONSE

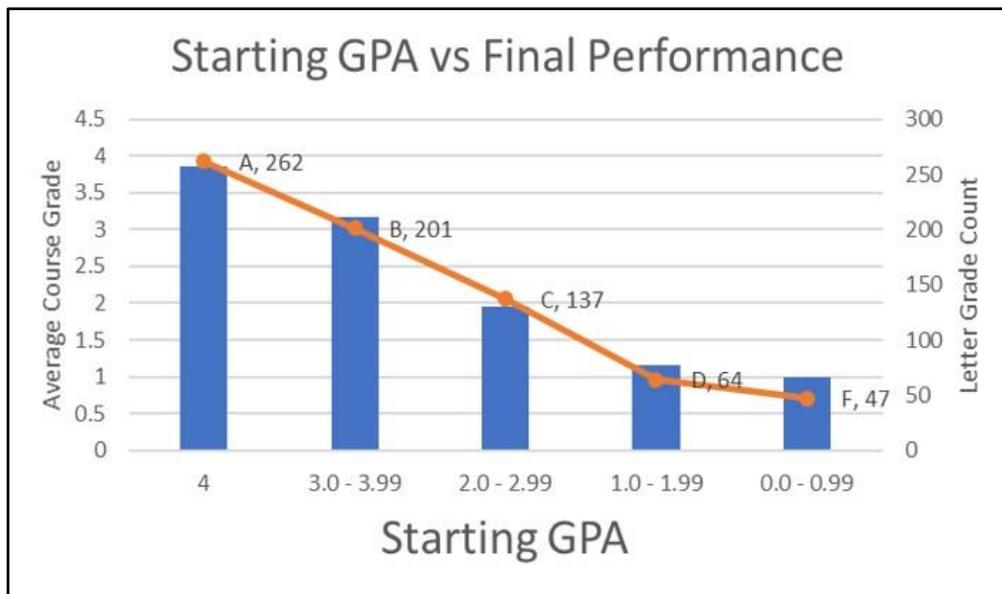
Baseline (Fall 2019)

The fall of 2019 started and ended like all semesters since 2018 when introductory statistics courses were standardized across campus. Therefore, it is reasonable to assume that the student

experiences and outcomes in 2019 would be similar to the previous semesters, and as such, relevant to the study for establishing a baseline. In all introductory statistics courses taught across campus, there were 711 students enrolled. There were 249 male students and 462 female students. Of the 711 students, 87 were enrolled in an asynchronous online section, and 624 were enrolled in a traditional face-to-face offering.

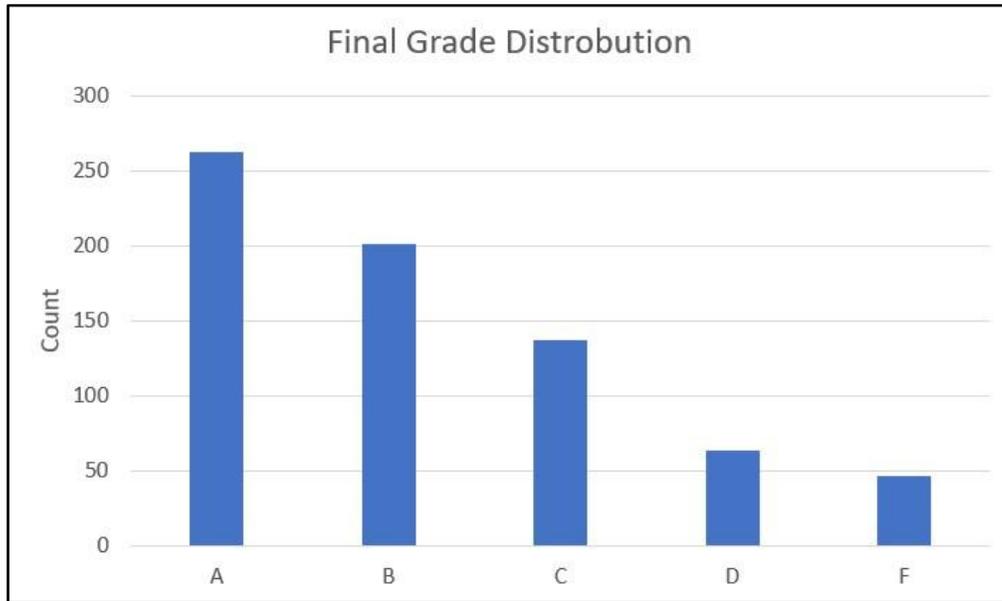
The average institutional grade point average (GPA) of entering fall 2019 semester students was 3.19. Students that started the semester with a perfect 4.0 GPA averaged a final grade of 3.86 on a 4-point grading scale. Students that started with a GPA between 3.00 and 3.99 finished with an average grade of 3.17. Students beginning in the 2.00 to 2.99 GPA range earned an average grade of 1.95, while students carrying a GPA between 1.00 and 1.99 averaged a final grade of 1.15. Finally, students bringing less than a 1.00 GPA into the semester finished with an average grade of 1.00 on the same 4.0 scale.

Figure 1 Fall 2019 GPA entering the semester v. final performance in statistics 4.0=A; 3.0-3.99=B; 2.0 – 2.99=C; 1.0-1.99=D; 0.0-0.99=F



Overall, the 711 students enrolled in introductory statistics courses in the fall of 2019 earned an average final grade of 2.78 on a 4.00 grading scale. With 37% earning an A (4.00), 28% B (3.00), 19% C (2.00), 9% D (1.00), and 7% F (0.00). 16% of students earned either a D or an F, which are final letter grades that typically result in retakes for grade forgiveness in Bachelor of Science programs.

Figure 2 *Fall 2019 Grade Final Grade Distribution*



Disrupted Equilibrium (Spring 2020)

Students enrolling in courses for the spring semester of 2020 mainly did so in the mid to late fall of 2019. There was no indication during this time that there would be any deviation from the norm, so students enrolled in online and face-to-face courses at a similar rate to those in the fall. Overall 641 students enrolled in an introductory statistics course, 73 of whom selected an online asynchronous section, while the other 568 chose a traditional classroom setting. There were 268 male students and 373 female students.

The 641 students who enrolled in the introductory statistics courses carried an average overall institutional GPA of 3.06 into the semester. The semester progressed as was customary until the first weeks of March. At that time the news of local cases of Covid-19 began to spread across the United States, and by March 12 the university president sent the following message to faculty, staff and students.

“Dear Students, Faculty, and Staff:

I am reaching out today with another very important update regarding the University of Central Arkansas and COVID-19.

The University of Central Arkansas has decided to cancel all classes from Friday, March 13 through Monday, March 16. Class cancellation will allow us to set "social distancing" in motion and will give faculty some time to transition their classes online. The amended instructional schedule is as follows:

- *Friday, March 13 - Monday, March 16: All classes canceled*
- *Tuesday, March 17 - Friday, March 20: All classes held online*
- *Saturday, March 21 - Sunday, March 29: Spring Break*
- *Monday, March 30 - End of spring 2020 semester: All classes held online*

During this time, the university will remain open, university housing and food service will continue to serve students, and day-to-day business operations will proceed as normal. University employees are expected to report to work unless they are sick or exhibiting flu-like symptoms. Telecommuting opportunities may be approved on a case-by-case basis at the discretion of the division supervisor.

Much thoughtful consideration and preparation have gone into the decision to shift our inperson classes fully online. We acknowledge that this can be a big adjustment for many instructors and students. The UCA Center for Teaching Excellence has worked diligently to develop training and resources to help faculty move in-person classes fully online. We appreciate their excellent work on this initiative.

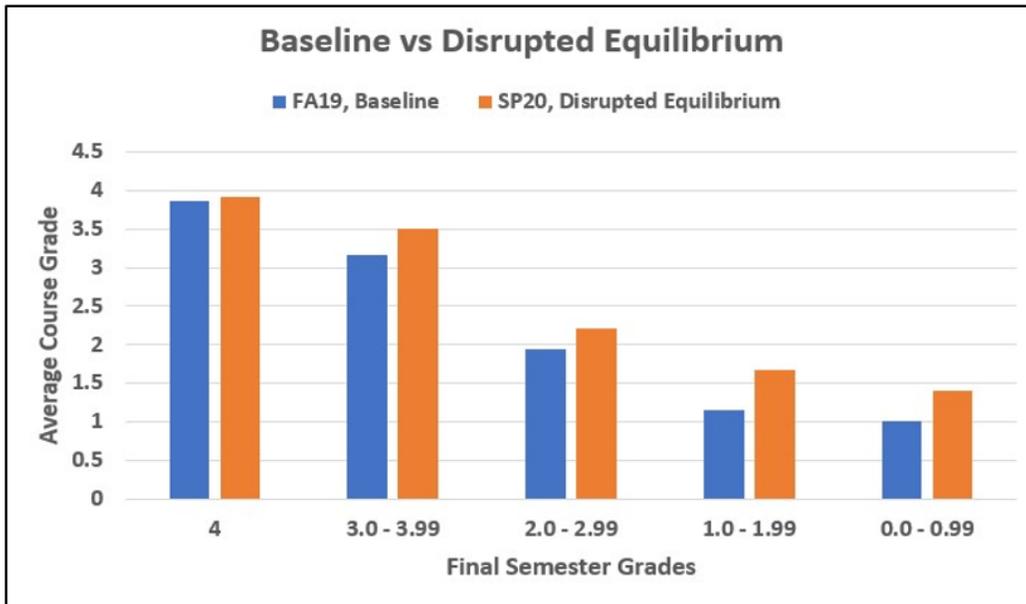
... ”

Although this news was anticipated by faculty the sudden termination of all face-to-face classes still seemed abrupt. The university’s timeline allowed the faculty five days to make the sudden pivot, and in doing so also recommended that they show sweeping compassion when deciding how to proceed with course requirements, grading, and reporting of final grades. This message may have created a scenario, wherein students that had been struggling academically were given opportunities they would not have normally received.

As the spring semester ended, statistics instructors reported grades that reflected an overall average final grade of 2.98 on a 4-point grading scale. This was a statistically significant increase over the previous semester.

Not surprisingly, students that started the semester with a perfect institutional GPA of 4.00 had a final average grade of 3.92, and students that started with an institutional GPA from 3.00 to 3.99 finished with an average final grade of 3.5. Students beginning the semester with an institutional GPA of 2.00 to 2.99 earned an average final grade of 2.22, while students carrying a 1.00 to 1.99 institutional GPA averaged a final grade of 1.68.

Figure 3 *Baseline Semester v. Disrupted Equilibrium Final Grades*



Students that began the semester with an institutional GPA of less than 1.00 finished the semester with a final grade average of 1.40. Overall, of the 641 students enrolled in introductory statistics courses in the spring of 2020, 45% earned a letter grade of A, 27% earned a letter grade of B, 15% C, 7% D, and 6% F. Letter grades results of D and F had a combined percentage of 13%, which was the lowest of any semester studied.

Radical Empathy (Fall 2020)

Leading into the fall semester of 2020, the university developed policy and guidelines for faculty to follow when preparing the courses that they would be teaching. The policies, discussed in detail in the background section of this paper, held one central theme, radical empathy. Specifically, all coursework and activities needed to be delivered in such a way that did not require a student's physical presence in the classroom. Although the intent was to ensure that no student felt obligated to come to class while experiencing covid-like symptoms, statistically it resulted in a significant drop in student achievement in the statistics courses being studied.

In the Fall of 2020, there were 629 students enrolled in introductory statistics courses. The overall average institutional GPA of those students was 3.18, which was higher than the spring of 2020 starting GPA (3.06) by twelve one-hundredths of a point. There were 236 male students and 393 female students enrolled in these introductory statistics courses.

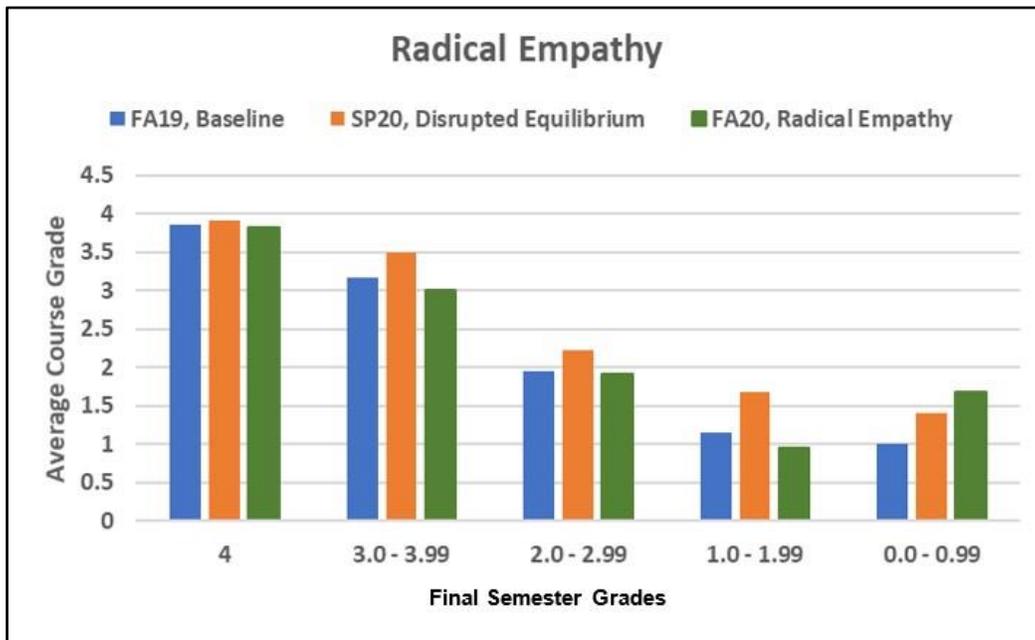
One hundred and thirty-three of the students were enrolled in online asynchronous course sections, while 435 enrolled in traditional face-to-face sections. The remaining 61 students enrolled in traditional face-to-face lecture courses but were switched into online sections because the instructor did not feel safe returning to a face-to-face setting. These students offer a valuable insight into how students that self-select into traditional courses fare in the online setting. Overall

online enrollment nearly doubled from Spring 2020 to Fall 2020 while the overall enrollment fell. This jump is due in large part to the creation of more online sections as a pandemic response.

Although students were afforded great flexibility with how, when, and if they attended lectures, once final grades were reported, the overall average score of introductory statistics students for the fall semester of 2020 was 2.72 on a 4-point grading scale. This is a significantly lower mean grade score than both our baseline semester (2.78) and the disrupted semester (2.98).

Students that began the semester with a perfect 4.0 GPA ended the semester with an overall average score of 3.80, the lowest in the study for that group. Students starting the semester with an institutional GPA of 3.00 – 3.99 earned an average final score of 3.01. Students beginning in the 2.00 to 2.99 GPA range earned an average grade of 1.91, while students carrying a GPA between 1.00 and 1.99 averaged a final grade of 0.94.

Figure 4 *Fall 2019, Spring 2020, Fall 2020 Final Semester Grades*



Finally, students carrying less than a 1.00 GPA into the semester finished with an average grade of 1.67 on the same 4.0 scale. All GPA strata, other than those with an institutional GPA of less than 1.00, achieved the lowest average score of all semesters studied. Overall, 36% of students finished with a letter grade of A, 28% earned a B, 17% received a C, 9% achieved a grade of D, and 10% earned F's. The percentage of D and F grades is also the highest of any semester studied.

Caring not Caving (Spring 2021)

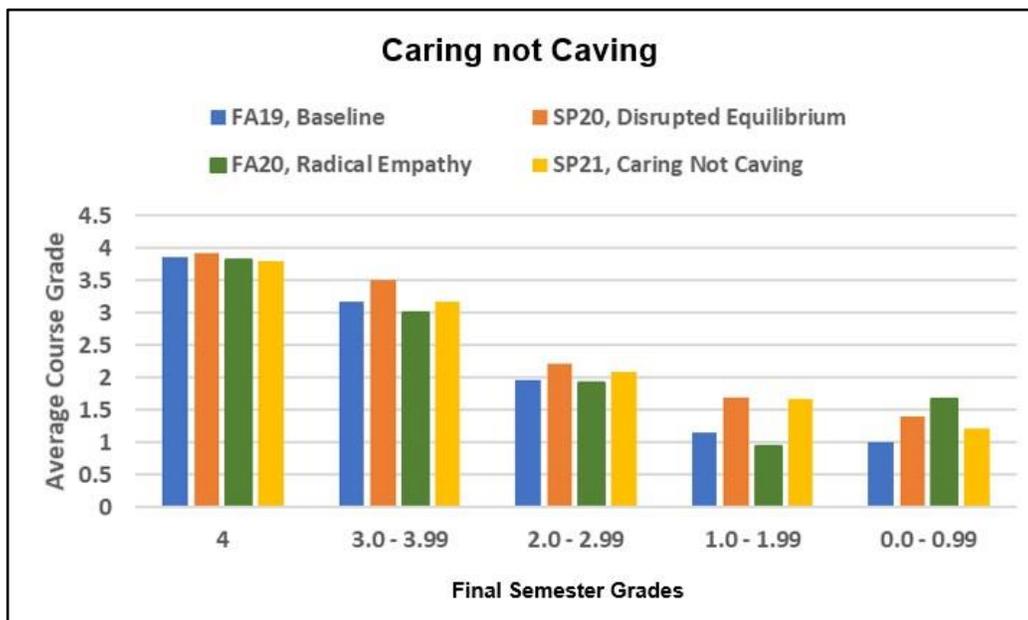
As the fall of 2020 turned into the spring of 2021, the pandemic ebbed for a time, vaccines became a certainty, and students and faculty began to prepare for the new semester. As intimated by the section title, faculty gained a new understanding of empathy. Rather than allowing students the choice to consume the course content however they chose at any given time, options were limited

and reserved for special circumstances. Students also seemed to respond with a renewed self-awareness.

In the spring of 2021, there were 598 students enrolled in introductory statistics courses. The enrollment was split between 198 students enrolled in online sections, and 400 were enrolled in courses designated as hybrid or traditional face-to-face offerings. The courses designated as hybrid offered students the same experience they had in the fall of 2020, while the students enrolled in courses designated as traditional face-to-face could expect an experience more similar to those of pre-pandemic semesters. Creating this new distinction, allows the traditional face-to-face faculty more flexibility to enforce attendance policies, due dates, and typical class norms.

The overall average final grade of students enrolled in introductory statistics courses in the spring of 2021 was 2.82 on a 4-point scale. This is significantly higher than that of the previous semester. Students carrying a 4.0 institutional GPA into the semester had an average final score of 3.80. Those entering the semester with an institutional GPA from 3.00 to 3.99 earned an average final score of 3.17, and students starting with a 2.00 to 2.99 institutional GPA finished with an average final score of 2.09 on a 4- point scale.

Figure 5 *Fall 2019, Spring 2020, Fall 2020, Spring 2021 Final Semester Grades*

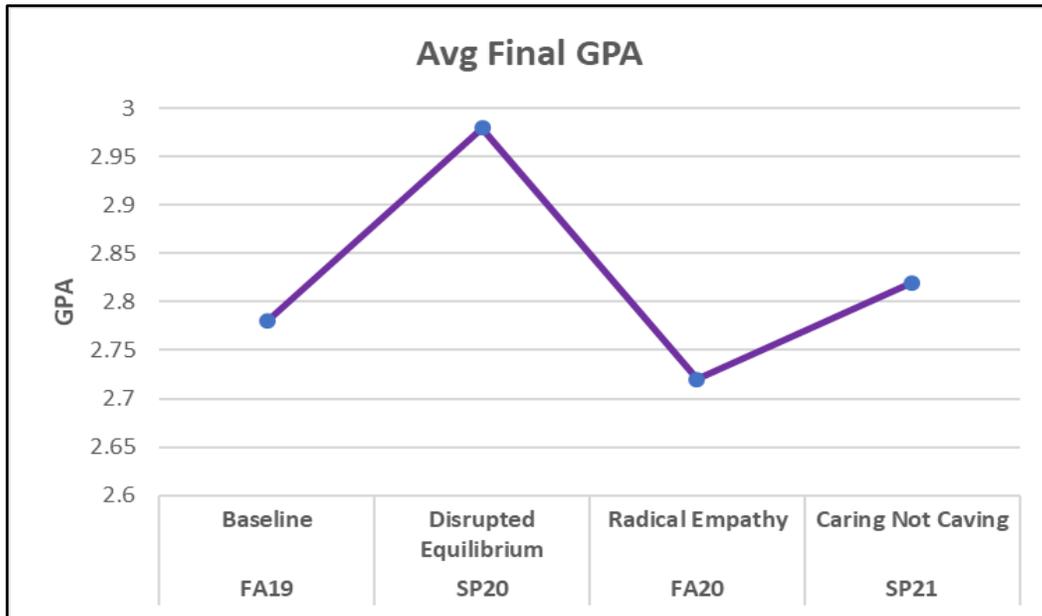


Finally, students enrolling with an institutional GPA of 1.00 to 1.99 had an average final score of 1.67, while students with an institutional GPA of 0.00 to 0.99 earned an average final grade of 1.20 on the same 4-point scale. These final scores contained letter grades of 37% A, 30% B, 17% C, 8% D, and 7% F. The percentage of D and F grades fell to 15% from 19% in the previous semester.

DISCUSSION

The most notable observation from the semesters studied is the unexpected jump in average final grades in the spring semester of 2020, and then the precipitous drop in the fall semester of the same year.

Figure 6 *Fall 2019, Spring 2020, Fall 2020, Spring 2021 Final Grades*



Disrupted Equilibrium

An initial impression might lead one to believe that the abrupt disruption in the status quo would affect student achievement adversely. However, the Spring 2020 data does not reflect this to be the case. The reason for this can be better understood by looking at the breakdown between online courses in the Spring 2020 semester, and the traditional delivery courses.

While the online course average final grade saw a bump from 2.83 in Fall 2019 to 2.90 in Spring 2020, the TRAD courses' average final grades went from 2.79 to 2.99 in the respective semesters. This data suggests that the face-to-face courses were the ones that sustained the biggest disruption from the pandemic. It stands to reason as those were the courses that stopped and then continued using a different modality.

Taking a closer look at the traditional delivery courses during the spring of 2020 reveals that those courses lost a full week of instruction during the initial move from online to face-to-face. Combining that finding with the knowledge that, traditionally, most introductory statistics courses were offered face-to-face, 88% in Fall 2019, it stands to reason that most introductory statistics instructors were left with the daunting task of creating fully online content for the final 5 weeks of the spring semester, all while dealing with the realities of the pandemic themselves. It is also reasonable to concede that course rigor fell with the sudden switch to online, under the

mentioned circumstances. The decrease in rigor was also likely a result of the grace and understanding offered to students by instructors throughout the remainder of the semester. The combination of a less rigorous final 5 weeks, which generally covers the most difficult content, and the sympathetic approach taken during that time could explain the unexpected jump in final average grades for the spring semester of 2020.

Radical Empathy

Over the summer leading into the Fall 2020 semester, the university developed multiple course delivery method options for instructors accommodating student attendance, social distancing in classrooms, and potential isolation for Covid-19 positive cases and close contacts.

The table below was disseminated for planning purposes.

	Model	Description	Considerations	Possible Scenario
More Face-to-Face	Essential/Traditional Face-to-Face	<ul style="list-style-type: none"> Courses whose enrollment do not exceed maximum occupancy limits Courses deemed most critical to meet learning objectives and to best provide students with a necessary college experience Courses that have clinical, practicum, or other situations and need F2F to meet accreditation, certification, or licensure requirements Lab and studio classes that cannot be effectively delivered online 	<ul style="list-style-type: none"> Space must accommodate 100% attendance. Priority to classroom space may be given to these classes. Classes might meet in non-traditional settings such as the Student Center. A process needs to be established to use non-traditional spaces to offer priority to those courses with the greatest F2F need (e.g., a clearinghouse). Online delivery must still be available for students who physically cannot attend class. 	<ul style="list-style-type: none"> A first-year course that is deemed essential to form a strong foundation and to set expectations for future courses meets F2F in a space that can accommodate 100% attendance. A course with eight students in a classroom that can accommodate them all meets in-person at its assigned time while adhering to social distancing protocols does not need to alter its delivery method.
	Split Sections	<ul style="list-style-type: none"> A single F2F section of a course is split into multiple F2F sections so that each section does not exceed maximum classroom occupancy limits. Section sizes determined by occupancy limitations, available spaces, and times that do not conflict with other regularly scheduled classes. 	<ul style="list-style-type: none"> All students get the benefit of 100% F2F delivery. Students who share resources (such as transportation or childcare) will need to be in the same section. The new section(s) cannot conflict with existing class schedules. Online delivery must still be available for students who physically cannot attend class. 	A faculty member prefers to repeat the instruction one or more times so that all students get F2F delivery rather than utilizing the technology to provide real-time or recorded instruction.
Less Face-to-Face	Hybrid Delivery: Modular Approach	<ul style="list-style-type: none"> Instruction requires planning in a series of modules. Some modules are F2F and others are completed online. Modules are repeated for groups of students until all students have completed the same instruction. 	<ul style="list-style-type: none"> Every student gets equal in-class and online experience. Students who share resources (such as transportation or childcare) will need to be in the same group. Works best when content does not have to be delivered sequentially (i.e., students can complete the online module without having had the F2F interaction). 	Faculty plans a module that can be done online while teaching another module F2F. On the next class day, the groups switch and get the module not presented to them on the previous day.
	Hybrid Delivery: In-Class/Online Groups (Synchronous)	<ul style="list-style-type: none"> Students are assigned to either the in-class or the online group. How to divide up students can be determined by faculty or other factors. Class is live-streamed for those who "attend" online. 	<ul style="list-style-type: none"> Allows for interaction with those viewing online. In-class attendance must not exceed maximum occupancy limit. In-class/online groups can alternate delivery method so that both groups receive some in-class instruction (e.g. the two groups switch at some interval and those in-class become the online students and vice versa) 	Faculty delivers the content for an in-class group while the remaining students view the content real-time but online.
	Hybrid Delivery: In-Class/Online Groups (Asynchronous)	<ul style="list-style-type: none"> Students are assigned to either the in-class or the online group. How to divide up students can be determined by faculty or other factors. Class is recorded so that those in the online group can view when convenient. 	<ul style="list-style-type: none"> Online attendance gets no real-time interaction. In-class attendance must not exceed maximum occupancy limit. In-class/online groups can alternate delivery method so that both groups receive some in-class instruction (e.g. the two groups switch at some interval and those in-class become the online students and vice versa) 	Faculty delivers the content for an in-class group and then provides a recording of the content for the online group to view.
	Hybrid Delivery: Consultation Model	<ul style="list-style-type: none"> All content delivered online. Faculty meet F2F with small groups on a regular basis. 	<ul style="list-style-type: none"> Small groups must be organized and scheduled. Small group meetings must follow safety guidelines. 	A faculty member delivers all content online and then schedules regular consultations with small groups of students for F2F interaction.

The table was meant to guide the delivery of classes designated TRAD in the registration system. Instructors teaching traditional courses were encouraged to use the table to decide how much face-to-face interaction their course required, and how best to facilitate that. Another course designation was also created for instructors that no longer wished to offer face-to-face courses due to personal health reasons. These courses were marked DEEV, which was designated an emergency online delivery. Roughly 10% of introductory statistics students (61 out of 629) enrolled in a TRAD course that was then changed to DEEV a few weeks before the beginning of the fall semester.

In addition to the course delivery suggestions in the above table, one week before the beginning of the Fall 2020 semester the following memo was distributed to university faculty:

“Dear Faculty:

Due to the unique demands of the fall semester, we are asking all faculty to record and make available in Blackboard all of their in-person or online, live-streamed (synchronous) class sessions.

Why Do We Need to Record?

Because of the potential for students to be unavailable at scheduled class sessions due to illness or being isolated or quarantined, faculty should record live class sessions delivered in-person or online via Zoom, Blackboard Collaborate, or Google Meet. Recordings also ensure that students who experience technical issues during the live class session do not miss content or activities.

These recordings will benefit all of our students too because it allows them to review class sessions; research shows that traumatic situations like the one we've been experiencing the past six months negatively affect memory and learning in general. Thus, recordings will assist all students in mastering course content.

...”

Despite the late notice, the concept of live-streaming and recording every class during a pandemic was presented with satisfactory justification by the administration. However, the unintended result of giving students too many options for attending class lectures may have ultimately resulted in the abrupt drop in the average final student grades for Fall 2020.

Introductory statistics courses across the university are coded as sophomore level. By and large, the students enrolling in introductory statistics are young and relatively new to college academics. Allowing those particular students, the choice of attending class face-to-face, via live stream, or watching a recording may have facilitated an overall drop in face-to-face lecture attendance. While students that were not attending face-to-face should have been reviewing the recorded lectures or attending the live stream, it is difficult, or in some cases impossible, to ensure that they were doing so regularly. The data shown in the figure below was compiled by instructors from the same department that teaches Business statistics. It represents face-to-face attendance in their classes during the fall of 2020.

The current study also lends itself to a longitudinal study of these courses. Tracking the subject courses long term as new classroom technology is developed and new pedagogical methods are applied, could provide valuable insight into their benefit or detriment. In the event another pandemic or similar disruption to education occurs, a longitudinal study might provide a unique understanding of pedagogical changes over time.

Another area for future research is the development of a more formal emergency response plan for course delivery. In the event of a future pandemic or similar disruption to course delivery, universities need a robust emergency response plan which meets learning objectives, student engagement, faculty continuity, and university responsibilities. Universities can adapt lessons learned by emergency responders (e.g. medical triage, fire and rescue units, and the military) to pedagogy in new and novel ways.

CONCLUSION

This article intended to provide a narrative record of the effects that the COVID-19 pandemic has had upon both teaching and learning at our institution. In doing so we have documented statistically significant effects on learning outcomes for students in our introductory statistics courses. These impacts could be termed grade inflation as it relates to the fall 2020 semester. However, the inflationary effects appear to be transitory given the return to near baseline results in the following semesters. This would indicate that there may be no long-term effects on higher education. However, the question remains open as to what are the long-term impacts on the individual learners that were directly impacted by these pandemic semesters.

The significant differences in outcomes across semesters highlight the importance of disaster planning and preparation at the institutional level. Grade inflation, albeit transitory, is not an indicator of a successful outcome. Regardless of when this particular pandemic abates, there will be other emergent situations that will arise in the future. Not every emergency is global in scope and it does not need to be for proper planning and foresight to be beneficial. It is incumbent upon all institutions to take an introspective look at their response to COVID-19. This critical assessment should help guide them to identify their successes and shortcomings. Learn from this opportunity and not just relegate the experience to the dustbin of history.

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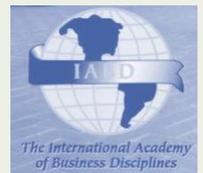
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QUARTERLY REVIEW OF BUSINESS DISCIPLINES

May 2022

Volume 9
Number 1



A JOURNAL OF INTERNATIONAL ACADEMY OF BUSINESS DISCIPLINES
SPONSORED BY UNIVERSITY OF NORTH FLORIDA
ISSN 2334-0169 (print)
ISSN 2329-5163 (online)