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Track: The Post-Covid Classroom: Innovations to Keep

Panel: Institutional Changes due to COVID

Disentangling Pandemic and Teaching Strategy Effects:
Flipping Research Methods in Treacherous Times

Evidence that the COVID-19 pandemic has negatively affected students' learning outcomes at all levels is overwhelming. It remains unclear, however, the extent to which such negative effects are due to socio-psychological factors -isolation, hopelessness, depression, etc.- which continue to linger after the general 2020 shut-down or to the sudden transition from in-class, in-person courses to remote learning. While these two factors are not mutually exclusive, they are often conflated in the public discourse, and their relative impact is still to be explored. This paper attempts to assess their relative effects by taking advantage of a natural experiment of sort that took place in the author's research methods course between spring 2018, when the course began being taught in hybrid format, and spring 2022. Neither the course content nor its delivery format changed during this time period, and students continued to be exposed to both remote and in-person learning activities. Any observable average treatment effects emerging at the end of the current spring semester provide the opportunity to isolate the negative socio-psychological impact of the pandemic from classroom-related changes in pedagogy.

From sourdough bread baking to conspiracy theories about microchips-laden vaccines, the COVID pandemic has not left any aspect of our lives untouched. It is hard to think, however, of anything that was affected more thoroughly and profoundly than education. It is difficult to take stock of the many ways in which society felt the blow the pandemic delivered against education. Students have had to adjust to a "new" learning environment in which computer screens, digital rooms, kitchen tables or living room couches replaced instructors, classrooms, desks and chairs. Educators found themselves scrambling to learn or outright invent new methods and technologies to deliver their content, interact with their audiences, and carry out assessment.   Families had to readjust work-life routines and reassess social and economic priorities. More than two years after the onset of COVID, no day seems to go by that we do not discover yet another ramification of the toll the pandemic has taken and is taking on education.

Without neglecting or minimizing students' and families' experiences, the pandemic created crises and challenges for educators but also forced them to reassess their entire craft, their pedagogical objectives, their strategies. and their outcomes (Durnford et al. 2021). On a surface level, one gets the impression that the public discourse about the effects of COVID on teaching has largely focused on and emphasized the negative effects of the pandemic. It is arguably too soon to tell, but it is also possible that all the trouble-shooting, invention, re-invention, and self-reflection engendered by the pandemic may ultimately lead to innovation and some positive new practices at all educational levels (quote from Italica).

One such innovation concerns, of course, the adoption of remote, asynchronous content-delivery strategies. Originally forced to adopt remote content delivery strategies and technologies, many educators have chosen to retain such approaches as they began to

slowly return to campuses and school buildings in the fall of 2021. Since the start of the pandemic "rollback", there seems to have been a proliferation of hybrid courses in which either the class laternates remote meetings with in-person meetings or some pedagogical activities take place asynchronously while others occur synchronously -an approach better described as flipped classroom. A cursory survey of the education literature suggests that some of the educators who first and most enthusiastically embraced this approach were teachers in subjects with a considerable "hands-on" component. Teachers in scientific and professional-training disciplines involving extensive lab time and in-person practicums appear to have extensively adopted some form of hybrid teaching approach as: (1) it creates more time and opportunities for in-person practice of the remotely-delivered content; and (2) it seems to have positive effects on the various phobias and anxiety that students harbor towards these subjects. In the social sciences, including Political Science, research methods courses have been prime candidates for this innovation, as they tend to include more hands-on activities and lab practices.

There is some emerging evidence that the extensive adoption of some form of hybrid approach may lead to positive educational outcomes (cite Journal of Technology ed.), but this evidence remains weak and controversial. For social and political scientists teaching research methods, as well as for hard science educators, it is challenging to assess whether the post-pandemic adoption of hybrid approaches has beneficial effects on students' performance because many students approach math, statistics, data analysis, and research methods with some of form of what has been generally labeled math anxiety (cite). The negative impact of math anxiety on students' performance is well documented. During the pandemic this negative impact has been compounded by the "COVID anxiety" students experienced as a result of isolation, alienation, displacement, uncertainty about the future and, often, depression they were forced to experience. It remains unclear, then,

whether the beneficial effects of hybrid teaching approaches registered in social science research methods courses in these early post-pandemic phases is due to the actual positive aspects of these strategies or to the slow decline of COVID anxiety and return to some sort of normalcy.

This paper intends to offer some exploration in this issue as a result of some sort of natural experiment that occurred in the author's data analytics course between 2018 and 2022. This "data analysis for political scientists course" made its transition to a hybrid, flipped classroom format in 2018. Starting in 2018, the course content began being delivered through videos and other technologies asynchronously. The class would meet in person, in a computer lab during regularly scheduled class time to practice the material delivered remotely. The onset of the pandemic in 2020 removed the option of conducting synchronous lab activities but, otherwise, it imposed limited changes in the way in which the course main content was being delivered. The course returned to its original format in 2021. As a result, any observable average treatment effects emerging at the end of the current spring semester provide the opportunity to isolate the negative socio-psychological impact of the pandemic from classroom-related changes in pedagogy. Evidence from the author's data analytics course for the 2018-2022 period is provided in following sections of the paper, after a brief review of the literature and theories concerning the flipped classroom format, COVID adjustments and COVID induced anxiety, as well as math anxiety in research methods courses.

The Pandemic, Hybrid Teaching, and Methods Anxiety

A considerable amount of research work on education and teaching following the pandemic has begun to emerge between the summer of 2020 and 2022. The consensus in all disciplines is that, of course, the COVID shutdown has caused unprecedented challenges

and dislocation at all educational levels for both teachers and students (Bartalesi-Graf and Zamboni 2020; Pittinsky 2020; Durnford et al. 2021; Loepp 2021; Ray 2021). The transition to full online teaching has been traumatic for all involved, generating new -and now documented- levels of anxiety, stress, sense of isolation, alienation, and depression. For educators, the challenge was amplified by the fact that the transition to online instruction was not part of planned practice but resulted from an emergency. Rather than standard online education, what teachers and students experienced was a sudden transition to "emergency remote teaching" (ERT) or "emergency e-learning" (Marshall, Shannon and Love 2021; Loepp 2021). Most educators reported not having taught online before and struggled with adjusting to it due to the increased workload the transition imposed, lack of institutional support -especially on the technological aspect of the transition- and work-life balance dynamics (Marshall, Shannon and Love 2021, 47-48; Bartalesi-Graf and Zamboni 2020). The transition to full online teaching took a toll on students as well "for reasons that had nothing to do with the online medium per se" (Marshall, Shannon and Love 2021, 47).

However, the seismic changes in education caused by COVID may have not been entirely negative. From some educators' perspective, the transition to remote teaching invited deep reflection about both the deeper meanings of their craft and the strategies through which they strive to achieve such goals (Dunford et al. 2020). Already in the latter part of 2020 some educators were reporting that, following the tough adjustments of the first few months, they had begun to find some positives in the COVID-imposed pedagogical approaches and were planning to retain some of the changes they had been forced to implement in earlier stages of the pandemic. In particular, some resistance to online education strategies and tools began to weaken. While early on most teachers saw online learning as inferior to face to face learning (Marshall, Shannon and Love 2021), several months into the pandemic they began to consider retaining some aspects of remote

teaching as they were slowly returning to campuses and school buildings (Bartalesi-Graf and Zamboni 2020, Ray 2021).

This attitude has led to growth among the ranks of proponents of hybrid learning. No specific boundaries exist among educators about the meaning of hybrid learning. In the literature the term is used interchangeably with "blended learning", "reversed instruction", "mixed modality course design", "just-in-time teaching", "inverted classroom" and, most often, "flipped classroom" (Auster 2016; Galindo-Dominguez 2021; Zheng et al. 2020). At the most general level, hybrid learning has been and is interpreted as involving asynchronous (remote) delivery of a course content -mostly through pre-recorded videos- and synchronous (face-to-face) practice of the content to which students are exposed online. Synchronous practice may involve simple in-class discussion, lab activities, games, teamwork in various forms, and problem-based learning. Overall, the flipped classroom approach is seen as a way to pursue the broader nation of active learning, which has been widely documented as leading to positive pedagogical outcomes (Campisi and Finn 2011).

Evidence in support of the flipped classroom approach is mounting, but its effectiveness has not been fully established. A few meta-analyses across a variety of disciplines report overall positive evidence about the effectiveness of the hybrid method, but neither these studies nor the studies they themselves analyze are without limitations (Zheng et al. 2020; Galindo-Dominguez 2021). The existing meta-analyses cover a fairly limited number of studies and lament the absence of control groups, small sample sizes, limited moderator variables, and publication biases as flaws in existing pedagogical research. All in all, flipping the classroom seems to produce substantively and statistically significant learning improvement at the high-school level and in higher education but not in primary education. A few studies exist that, instead, report no difference between the flipped classroom and the traditional classroom (Sparks 2013; Strayer 2012). Additionally,

some studies remain skeptical about the hybrid model of learning because, while promoting higher student performance, it also generates higher rates of student dissatisfaction and does not modify study habits (Boeve et al. 2017).

It seems that many cautiously curious, and sometimes outright enthusiastic, adopters of the flipped classroom approach have been research methods and statistics teachers in a number of disciplines, including the social sciences.[1] There is evidence that full online courses in statistics and research methods are less effective than traditional, face-to-face synchronous learning (Ni 2013). Hybrid approaches, on the other hand, hold considerably more promise. In the first place, the flipped classroom method has been successfully implemented in a variety of introductory social science courses (Craig and Hale 2008; Jenkins 2015; missing one?). In addition, hybrid techniques seem to have a good track record in methods and statistics courses in professional disciplines (Craig and Hale 2008; Campisi and Finn 2011; Gopaian, Butts-Wilmsmeyer, and Moran 2021) and in social sciences other than political science (Strangfeld 2013). In general terms, one of the main potentials of the flipped classroom approach in teaching quantitative political analysis courses lies in its intrinsic potential to reach a variety of learning styles (Gershkoff 2005). Preliminary evidence suggests that it may reduce the well-documented anxieties and phobias (Bos and Schneider 2009; Wisecup 2017) that student feel toward this kind of courses in general, and improve self-confidence and more positive attitudes (Gershkoff 2005; Campisi and Finn 2011).

During and after the COVID pandemic, an additional advantage of flipping the classroom lied in the fact that it eased both the transition to online, remote teaching and the subsequent return full or partial synchronous learning (Gopaian et al. 2021). Instructors

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[1] In their meta-analysis, Zheng et al. (2020) report the highest number of studies in their sample as belonging to the social sciences.

using the flipped classroom approach adapted faster and more easily to emergency e-learning and reverted to more traditional learning strategies more smoothly after the pandemic peaks. Some educators who had a positive experience with remote strategies during the pandemic chose to retain some of the approaches in the fall of 2020 and spring of 2021 and transitioned to more blended forms of teaching. This seems to have been the case in particular with research methods and statistics courses which, notoriously, are more hands-on and require direct practice, problem-driven application, and lab time (Gopaian et al 2021; Gopaian, Butts-Wilmsmeyer, and Moran 2021).

The effectiveness of the post-pandemic transition to the inverted classroom approach some educators pursued in their methods and statistics course is yet to be assessed. On the one hand, we are only a few semesters removed from our return to some level of normalcy on campuses and schools. More longitudinal evidence needs to accumulate. On the other hand, when it comes to methods, statistics, data analysis, etc., it is difficult to disassociate the effects, positive or otherwise, of the transition to flipped classroom methods from the compounded effects of COVID-anxiety and math-anxiety. The potential benefits of flipping the classroom in data-driven courses after the pandemic could be due to a progressive easing of the personal and social challenges students experienced during the pandemic. If flipping the classroom turned out to be ineffective after the pandemic, that outcome may be due to a persistence of math-anxiety and negative attitudes compounded with the anxiety associated with the return to campuses that many students experienced.

Covid and Methods Courses: Lemonade out of Lemons?

Arguably, a possible silver-lining in the pandemic-induced transition to emergency e-learning is that it allowed -or forced- teachers to experiment with new teaching

strategies, including the flipped classroom approach. Flipping the classroom may have been particularly appealing to teachers of methods/statistics/data analysis courses for several pedagogical reasons in addition to the practical aspects highlighted above. In general, in most disciplines methods courses tend to follow the traditional "synchronous lecture/asynchronous practice format." In the social sciences in particular, such courses tend to be lecture-heavy. Teachers feel the need to spend a lot of time elucidating challenging content to students who may be less prepared for and have more negative attitudes toward quantitative principles than students in STEM disciplines. Students are often left to their own devices trying to make the connection between quantitative methods and their chosen field or professional ambitions. Many Political Science methods teachers may have heard the question "I am going to law school; why do I need to study statistics?" The end result of the synchronous lecture-heavy approach is that it reinforces negative attitudes towards quantitative methods, produces alienation in the classroom, reduces performance, and leads to higher drop-out rates.

Concerning methods teaching, the flipped classroom approach has the potential to promote learning and engagement by touching different types of learners, as defined according to the Myers-Briggs Personality Type Indicator (MBTI) and Gardner's theory of Multiple Intelligences (see Gershkoff 2005).   This can be the case particularly if the asynchronous content is delivered in a variety of ways in addition to pre-taped lectures. The asynchronous delivery of content frees up class-room time to engage in a number of applied, active learning activities in addition to traditional computer applications. Small-group work, discussions, problems-solving, just-in-time surveys, and even games can be employed during time that would be otherwise devoted to lecturing. These activities can not only reinforce the type of learning that takes place at lower levels of Bloom's taxonomy, but it also promotes higher-level learning -including evaluation and creativity

(Armstrong 2010). Synchronous active-learning activities can help students see tangibly and directly the connection between quantitative methods and their social science discipline as a whole. They can also reduce methods- and performance-anxiety by allowing students to practice in advance what they will encounter in exams and to seek guidance and help in-person from the instructor.

Evaluating whether these objectives are achieved in reality in methods course presents its own set of challenges, as indicated earlier. The COVID pandemic may have promoted the adoption of hybrid methods in quantitative methods courses, but it may have complicated the evaluation of their effectiveness. The following investigation of this puzzle takes advantage of the course design changes enacted in this instructor's data analytics course a couple of years before the onset of the pandemic. A junior/senior level course in quantitative political data analysis is required of all Political Science majors at UAB. This course covers a mix of research methods principles (about 20 percent of the content), statistics (about 40 percent) and data analysis (40 percent). In order to promote retention and graduation rates, in 2017 the decision was made to retool this class by experimenting with the flipped classroom approach. This instructor spent a good portion of the 2017-2018 academic year planning, scripting and eventually taping lecture videos with the help of UAB's eLearning division. Lectures were "chunked" into relatively short, self-contained segments of 5 to 10 minutes each and then grouped into more comprehensive, coherent modules. Content is also delivered in other formats, including radio podcasts, social media videos, publicly available blog posts, links to online discussion fora, etc. In addition, this instructor began developing an ever-growing collection of in-class activities for synchronous practice. Most of these activities consist of practices with the R software, but small-team problem solving, group discussions, on-the-fly data gathering activities, just-in-time surveys and a couple of quick simulations are included.   During synchronous lab activities I (the

instructor) pace the floor among students, troubleshoot either computational or conceptual problems, re-explain research design data analytical principles, if asked, and provide feedback on their lab practice progress -or lack thereof. The in-person lab activities are designed to reflect[2] the questions and problems they will encounter during their take home graded assignments and exams.

Student evaluation is based on three take-home lab assignments and two take-home exams. The three lab assignments revolve around the research design aspect of data analysis, data description and exploration, and inferential analysis respectively. Students have 5-7 days to complete take-home assignments and exams. The difference between assignments and exams is minimal. Exams are slightly longer and more comprehensive than lab assignments, and they weigh a little more toward their final grade than assignments. The redundancy among lab practices, take-home assignments, and exams is purposely designed so as to produce progressively greater familiarity with the subject matter and to minimize performance anxiety on graded exams.

Results from a Forced Natural Experiment

The "new and improved" hybrid version of the course went live in 2018. The first two years of data, comparing 2018 and 2019 to prior years when the course was a traditional in-person, lecture based class, show some degree of progress in terms of student performance, retention rate, and overall satisfaction with the course.[3] The COVID pandemic imposed a clean break in terms of course content delivery. As our campus shut down in

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[2] Interestingly, the largest share of issues I have to address during in-class activities are computer problems related to Windows and Mac OS rather than data analytical concepts or R issues. This has led me to suspect that a good deal of the much feared steep learning curve of R has to do with students' weak basic computing skills rather than with the R software itself.

[3] During the first two years of the flipped classroom approach students remained ambivalent about the u subject matter. In their course evaluations they tended to recognize the importance of the content but struggled to "embrace it", voicing unhappiness with the amount of effort it takes to master it compared to other Political Science courses.

mid-March 2020, the "Data, Politics, and Policy" course went fully online and remained so until the end of the semester. During this time I continued to assign remotely the same lab activities we would have done in-person under normal circumstances and made myself available for consulting via Zoom. Needless to say, the experience was nowhere comparable to pre-pandemic practices, both in terms of student attendance, their ability to participate when present via Zoom, and my ability to address their concerns. Our university's decision to allow students to opt for a Pass/Fail grade option further reduced motivation to engage with material and to attend synchronous activities. Due to the strenuous circumstances, any evidence about student learning, performance, attitude toward the course etc., was not comparable to prior years.

However, the resumption of activities on campus in 2020-2021 meant that the COVID break provided the opportunity to carry out an unusual natural experiment. In the 2021 spring semester, the data analysis course returned to its original flipped classroom course as we were allowed to resume in-person practices in the department computer lab. The content and format of the course remained unchanged. The circumstances surrounding the course, however, had changed as students resumed courses carrying the scars of the pandemic experience, which compounded with their anxiety and phobias about taking what they continued to refer to as the "stats requirement." In some respects, this constituted a "reversed natural experiment" about the effectiveness of the flipped classroom approach for teaching methods and data analysis. What would have otherwise been the treatment -implementation of the hybrid approach- remained unchanged,whereas possible confounders may have changed naturally as a result of the COVID break. If the flipped classroom approach is equally effective, or even superior, to traditional asynchronous approaches, and if its hybrid format facilitated the return to pre-pandemic learning, we

should observe non-significant or even positive changes between the pre and post pandemic phases.

After the 2022 spring semester two years of post-COVID data had accumulated, making a comparison to the pre-pandemic experience reasonable. As mentioned above, the course had changed minimally during this period. I slightly modified some content -such as data examples, news sources about data, etc.- to make it more relevant and consonant with political development. I also changed some of the data sets used in lab practices and exams, but format and pedagogical objectives of these activities remained the same. Similarly, the groups of students who took the course before and the after the pandemic are comparable. 55 students took the course in 2018 and 2019 versus 59 in 2021 and 2022 for a total of 114. All students, except two, were juniors or seniors in 2018-2019. Again, in 2021 and 2022 only two students were not of junior or senior rank. A similar comparison can be made about majors, as almost all students in the pre and post-COVID group are Political Science majors. Fifteen students who are not listed as Political Science majors are usually double-majors who have listed another discipline before Political Science when they declared. The pre- and post-pandemic groups are also comparable with regard to gender composition and prior experience with my courses.

To be fair, the analysis of these preliminary data is not favorable to the flipped classroom approach. The mean score for the pre-covid group is 81.56. The post-covid mean is 74.12. The means rise to 85.57 and 78.35, respectively, after dropping four extreme cases of students who stopped attending early in the semester but never formally dropped the class. The variances for the two groups are also considerably different, at 85.94 for the pre-covid group and 249.22 for the post-covid group. A t test for difference in means reveals that the difference is statistically significant at $p < .006$. On a slightly more optimistic note, regression analysis indicates that the effect of having taken the course

after the pandemic is not significant, although still negative. The "COVID treatment" does not achieve significance even after controlling for confounders such as gender, having taken classes from this instructor in the past, rank, and major, the effect of taking the class after the pandemic is not statistically different from zero –i.e, having taken the course in pre-pandemic times. This suggests that, after all, flipping the class in research methods/data/statistics courses has retained some effectiveness after the pandemic.

However, results of this preliminary exploration are sobering to say the least. One cannot put an overly optimistic spin on the statistical, rather than substantive, significance of a coefficient that points in the opposite expected direction. Most concerning is the rather sharp post-COVID drop in average student performance and the greater variance in student final scores. As hypothesized earlier, one would hope for these differences to be small and non-significant regardless of the controls included in the regression model. The main takeaway is that the impact of COVID on students could be larger than we usually estimate. It is also worth noting that some of the junior-rank students who took my data analysis course in 2022 were freshmen or sophomores in 2020. The pandemic may have left in them deeper scars as they seem to have a harder time returning to a more traditional class format, including a hybrid format. The expectation that the flipped classroom format would somewhat ease the return to the traditional classroom by splitting the work between remote delivery and in-person practice does not bear out, contrary to what the emerging literature from other disciplines suggests.

Conclusions

Hybrid learning approaches, and in particular the flipped classroom format, hold considerable promise for teaching courses such as research methods, statistics, and data analysis. These courses usually contain a combination of difficult conceptual foundations

and challenging hands-on applications. This holds particularly true for research methods courses in the social sciences and political science, where students routinely display a variety of anxieties regarding the unusual nature of the content and their ability to perform at satisfactory levels. These anxieties may have been magnified by the onset of the 2020 COVID pandemic, which left students first to struggle with purely remote, mostly asynchronous classes, and then with a difficult progressive return to traditional courses and campus life. Research methods instructors in a variety of disciplines were among the first to experiment with hybrid learning approaches, and they were also among the first in championing them as an effective way to ease students' return to more traditional courses after the pandemic. Evidence emerging from professional disciplines suggests the flipped classroom approach has retained its effectiveness for teaching research methods after the pandemic (Gopalan et al 2021; Gopalan, Butts-Wilmsmeyer and Moran 2021).

The present paper offers some preliminary evidence from an attempt to verify whether the experience from professional disciplines holds true for political science. It takes advantage of the fact that this instructor began to employ the flipped classroom method in their "Data, Politics, and Policy" course in 2018 and resumed this approach in the fall of 2020, after teachers and students returned to campus and physical classrooms. The onset of COVID created a sort of "reversed" natural experiment where the flipped classroom teaching strategy remained unchanged while COVID effects varied. Two years after the peak of the pandemic enough data has accumulated to conduct a comparison of student performance before and after COVID. The hope was that the beneficial effects of flipping the classroom before COVID could be sustained after the pandemic break.

Unfortunately the two years of post-COVID data indicate that this is not the case. Students in my research methods/data analytics course between 2021 and 2022 have not been performing at the same level as students who took the same course in 2018 and 2019.

The drop in student performance from pre- to post-COVID times in score is substantial and statistically significant, although such significance is not robust to estimation technique and statistical model. The results of this analysis hint to the possibility that the challenges and displacement brought about by COVID may have deeper lingering effects than we tend to attribute to it. The benefits of the flipped classroom approach witnessed before the pandemic seem to have vanished after 2020. The advantages of the flipped classroom strategy for teaching research methods -catering to multiple learning styles, reaching higher levels on Bloom's taxonomy, allowing students more time to "ruminate" difficult concepts, as well as giving them more time for hands-on practice- were not sufficient to compensate for the blow COVID delivered on students and teachers alike. Educators were called upon to make extraordinary sacrifices during the height of the pandemic, but the need for additional efforts and vigilance is ongoing two years after. While this exploratory analysis applies to research methods courses exclusively -"anomalous" courses in political science- teachers of more traditional topics may also want to consider whether their pre-COVID teaching approaches remain equally effective after the pandemic.

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To be completed…