

Teaching Online in 2020: Experiments, Empathy, Discovery

Maxwell Bigman
Graduate School of Education
Stanford University
mbigman@stanford.edu

John C. Mitchell
Department of Computer Science
Stanford University
jcm@stanford.edu

Abstract—The rapid shift to fully online university courses in response to the global pandemic led to widespread instructor-based experimentation on an unprecedented scale. We summarize the experience of a full term of instruction in Spring 2020 in a Computer Science department serving close to 2000 declared undergraduate majors and graduate students. Three themes emerge: (1) there is extensive experimentation; (2) tracking the progress and well-being of students takes center stage; and (3) many instructors draw heavily on the toolbox assembled over the last decade of progress in online learning. We summarize recommendations for university instructors and course designers based on our findings, as well as for others interested in how to best serve learners in the emergent era of online learning.

I. INTRODUCTION

The mandatory rapid shift to fully online courses in Spring 2020 has opened a new era in online learning. Grassroots experimentation is underway worldwide, drawing on insights from online learning efforts of previous decades, the MOOC movement, and new collaborative learning tools. The result is a panoply of effective composite approaches and a deeper appreciation of the pervasive shortcomings of the online personal learning experience. New insights from this period will undoubtedly affect future programs at both traditional and non-traditional institutions, profoundly reshaping in-person, online and blended learning environments — and changing higher education forever.

Looking back and simplifying slightly, each of the past three decades ushered in a new era of online instruction. The 1990s saw the rise and subsequent fall of *Fathom* and *AllLearn* [1], testing the water for alumni continuing education. The early 2000s brought expanded accredited online instruction to community colleges and others, largely using traditional classroom pedagogy without tapping into the broader affordances of modern digital technology. The subsequent MOOC decade began with innovators such as *Khan Academy* and evolved through platforms such as *Coursera* and *edX* into broader university participation in open education, informal learning, online professional education, and online degrees.

At the dawn of a new decade in 2020, the pandemic has created a new era: one that is informed by platforms, pedagogy and tools tested in previous years, yet driven in the US by widespread independent experimentation at 90% of colleges and universities [2]. While students are challenged by disparate conditions in widely varying home environments, colleges

have drawn on their local teaching and learning centers [2] to support instructor innovation fueled by dramatic necessity.

In this paper, we present a case study of how the Computer Science (CS) department at one university made the transition from in-person to fully online instruction. Because the quarter-based academic calendar aligned with the onset of the COVID crisis, we were able to collect data from a complete, online ten-week term. With the unique opportunity to observe a one-time combination of challenges and opportunities, we aim primarily to document the attitudes of instructors, the range of experiments they created, the subjectively appraised progress of their efforts, and possible consequences for the future.

Our data come primarily from two CS department faculty meetings convened to share approaches and experiences with online teaching, twelve interviews with instructors and course staff over the duration of the term, and a few confirmations from a university-wide survey. Three themes emerged from our research:

- 1) New circumstances led to experimentation and key insights for online instructional practices;
- 2) Widespread disruption forced instructors to adapt to the uprooted student experience, including expanding their conception of their own role;
- 3) Certain experiments appear informative and predictive of future options and challenges.

Each of the three sections below elaborates on one of these three themes. We then summarize implications for online instructional design and broader implications for education at scale in a discussion section, suggesting future research directions in the conclusion.

II. INSTITUTIONAL CONTEXT

This case study is based on a highly selective US research university that operates on-campus instruction and has a history of online programs, the latter historically aimed at continuing and professional learners. Our study focuses on Computer Science courses; this department teaches approximately 20 percent of total university course units and has approximately 20 percent of the total university undergraduate majors, as well as a large course-based Master's of Science program. Courses represented in our interviews generally ranged in enrollment from around 100 to over 500 students.

The unplanned transition to online teaching of all courses began abruptly just before the last week of Winter term. This gave students and instructors a first one-week exposure to online operation. After a two-week break, the Spring term opened entirely online. Ten days prior to the launch of the Spring term, the university changed the grading policy to make every class Pass/Fail. A substantial portion of student course selection occurred before this policy change; additional increases in student enrollment also occurred thereafter. While university-wide teaching support teams recommended using *Canvas* and *Zoom* among other tools, instructors had very broad leeway in designing and delivering their courses. In particular, CS instructors felt sufficient familiarity with a range of technological tools to devise many of their own recording, broadcasting, and interactive environments.

III. THEME 1: EXPERIMENTS IN INSTRUCTION

The movement to a fully remote quarter on short notice with mandatory Pass/Fail grading led instructors to be much more willing to experiment with their course structure than in typical terms. One instructor expressed that the crisis conditions put instructors in a “position to respectfully experiment in how we teach classes.” Four trends stood out from the many instructional approaches employed this quarter: (1) the use of pre-recorded lectures to create a “flipped classroom” course structure; (2) the challenge of creating virtual office hours; (3) the mixed reactions of students to ‘breakout rooms,’ and; (4) a shift in attitudes about the purpose of grades and exams.

A. Pre-Recorded Lectures

A number of instructors use pre-recorded videos to present material, often combining them with interactive sessions. These asynchronous course elements help students who are unable to watch live lectures due to time zone or Internet limitations; they also reduce “Zoom fatigue.” Using pre-recorded video, many instructors ‘flip’ their model of instruction, using shortened synchronous class time to engage with students, work on practice problems, clarify concepts and answer questions. In some cases, instructors remove all synchronous aspects of the course, and instead make themselves highly available on class discussion forums (i.e. Piazza and Slack), as well as offer more office hours to meet with students one-on-one and in smaller groups. Some instructors realize the benefit of students arriving to class with understanding of the material rather than learning about the material for the first time in lecture. Others find that students may fall behind in such a format because missed videos accumulate and create a barrier to catching up.

B. Virtual Office Hours

Office hours are a critical component of the CS learning experience at this institution, with plenty of support offered for students across the introductory and upper-level courses. Instructors and TAs alike are concerned about the challenges associated with virtual office hours both from a logistical standpoint and from the need to offer students the ability to

learn with and from one another. Logistically, course TAs are overloaded with office hour queues that need to close after a few minutes because they have filled up with over one hundred students. There are two parts to this problem: more students are signing up for office hours because they (1) have essentially no barrier to entry, and (2) have few other alternatives to turn towards for help. There are additional logistical challenges for TAs of piecing together different tech tools without consistent or clear protocols from instructors. From a student perspective, there is a clear gap in the learning experience when students are unable to take advantage of the informal instruction that happens when people are co-located in a physical space waiting for and/or receiving help from a TA. Typically, instructors rely on TAs fielding common questions, while students rely on finding classmates with similar challenges to problem solve collaboratively – a key descriptive norm in the CS department.

C. Student Interaction

Pedagogical practices such as peer instruction [3], [4] have become accepted in this department. However, instructors struggle to create opportunities for meaningful student-to-student interaction during online class meetings. In particular, *Zoom* ‘breakout rooms’ are a polarizing pedagogical tool, with widely varying instructor and student opinions. On one end of the spectrum, some instructors hear from their students that entering into breakout rooms with strangers does not afford psychological safety because there is no trust, familiarity or social capital. As a result students find these virtual spaces stressful and emotionally taxing. On the other end of the spectrum, other instructors are finding that breakout rooms create space for students to engage more naturally and intimately with one another, helping them to build class community and stay actively engaged with the material. We have not yet determined what factors might lead to successful use of breakout rooms in some cases and unsuccessful use in others.

D. Grades and Exams

Although the mandatory Pass/Fail course policy was meant to simplify the learning experience for students and instructors alike, it created new problems that reflect a variety of attitudes about the purpose of grades. Some instructors interpret the policy to mean that any student that earns a C- or better deserves a passing grade (i.e. a typical Pass/Fail format), while other instructors worry about “cheapening the educational experience” and adjust course policies to make a passing grade analogous to earning a B or higher to prove mastery of the material. As a concession to the new grading structure, many instructors are adopting resubmission policies for homework assignments (and in some cases, exams) so that students can continue to improve their grades as they gain further mastery of the material. Additionally, instructors are using exams in a variety of ways, with some eliminating them entirely (citing concerns about fairness), and others allowing for 24-48 hour take-home exam windows. The expectation gap between instructors and students led to a number of complications

and added student stress. For example longer exam windows caused many students to spend significantly more time than they would have in traditional timed exams. Going forward, a number of instructors are considering designing courses without exams until every student can be physically present in a classroom again, aiming to use other mechanisms to check students' conceptual understanding of the course material.

IV. THEME 2: DEALING WITH DISRUPTION

With students sent home on short notice, there are new demands on instructors to respond to variations in student study environments, lack of traditional on-campus resources and variations in Internet connectivity and bandwidth. Notably, multiple instructors shared anecdotes about example high achieving students they know from previous terms who have struggled academically during the virtual quarter. This suggests that the challenges of learning at a distance (during a pandemic) affect even the most prepared and capable students.

A. *Disrupted Students: Virtual Learners*

Students are experiencing a wide variety of disruptions, as they are scattered around the globe, living in environments that are not necessarily stable nor conducive to learning, and lacking the resources that they traditionally rely on during their residential on-campus experience. Some of the most common disruptions that students report to their instructors include limited internet capacity, attending class from shared workspaces, a lack of proper technology, and the need to worry about essential needs, such as food. Meanwhile, many students have responsibilities beyond attending class, such as taking care of family members, earning income, and being responsible for household meals. Instructors also note that in a given class, at least twenty percent of students will be in time zones completely different from the US, and therefore mostly unable to access any of the content in a synchronous way – or otherwise will choose to adjust their sleep schedules to match the school time zone. Overall, instructors report that inequities in the student body are much more salient in a virtual classroom, and are thinking about how to create a course structure that is fair and can cater to the extremely heterogeneous student experience.

B. *Disrupted Students: Loss of Residential Resources*

Instructors are noticing that in an online environment students lose a number of key academic and non-academic resources that are typically available in the residential experience. Most notably, students lack access to essential services, such as dining halls, their peers, residential advisors, and campus health facilities. They also lack access to the many student services on campus, such as mental health professionals, affinity spaces, study lounges, and libraries. In terms of learning environments, students are finding it hard to connect with classmates without physical spaces to congregate, and are therefore turning to their existing networks of peers and friends as an inferior solution to the peer learning that is common in many CS courses. In light of these lost resources,

a significant number of instructors are thinking about what additional roles they need to play to ensure that students are taken care of outside of the classroom. What used to be outside of the purview of most instructors (such as mental health challenges or sick family members) is now inseparable from the learning experience. As a result, a handful of instructors are adopting new course policies, making themselves more available to students and explicitly centering self-care as part of the course.

C. *Collecting Feedback*

Nearly all of the instructors are collecting feedback about their courses from students in a regular manner, as frequently as multiple times per week. However, some instructors are much more attuned to their students' overall experiences in and out of class, while others admittedly do very little to collect information about their students' holistic well-being. Feedback is typically in the form of short surveys, with a few longer surveys throughout the term. Questions vary immensely: some are focused on understanding of content (e.g. reflection on a concept) and others on well-being, while some are narrowly defined (e.g. number of hours spent on class material that week) and others are completely open ended (e.g. "how are you doing?"). Instructors are using these feedback forms to make midstream adjustments to their course policies (e.g. grading), instructional pace, student expectations and availability as both instructors and caring adults.

D. *Empathy and Authenticity: Secret Ingredients*

Nearly every instructor we spoke to mentioned dealing with special cases of students that needed accommodations for external circumstances, many of them emotionally demanding on the students. While all instructors were prepared to make these accommodations for students on a case-by-case basis, a few of the instructors we spoke with placed a heavy emphasis on student well-being in their courses. One instructor who teaches an introductory course with approximately 500 students enrolled this term, explained that while it was always a goal to show "personal compassion" for students, this term forced the instructor to think much more about what it meant to be a "compassionate educator," and the corresponding intense emotional labor that went into responding to students with serious catastrophes in their lives. In particular, the instructor emphasized that unlike in other terms, it was most important for the teaching staff to help students to pass "no matter what." In practice that included helping a student who had done effectively no work as of the fourth week to pass the class by assigning members of the teaching staff to special coaching. Another instructor (of a 125 student class) decided to make self-care 10 percent of the student grade, as a way to "encourage students to think that at least some of the time they spend on this class should be spent on themselves." These attitudes reflect an expanded notion of the instructor's responsibilities to their students and the role of compassion in education, which might provide clues about how to make learners feel more welcome in other forms of online courses.

Finally, it is worth mentioning that many of the instructors we spoke to noted how much students appreciated small moments of instructor authenticity, such as pets walking on screen, seeing the inside of their instructor’s home, and hearing anecdotes about the instructor’s lives and new hobbies while in quarantine.

V. THEME 3: THE PEDAGOGICAL TOOLBOX

Instructors are using a variety of approaches and resources to iteratively adapt their courses to the online format and the changing realities of the student experience. We highlight the most innovative and prevalent tools and structures that instructors are employing to adapt their course resources for the online learning experience.

A. Flipped Classrooms

As discussed above, pre-recorded asynchronous lecture videos are emerging as a favored practice of online instruction. While a select group of courses in our department have a history of using the flipped format, for nearly all other instructors this is the first term in which they have attempted this new course structure. For instructors in our interview sample who are trying flipped classrooms for the first time, most chose to re-use recordings of lectures from past terms, while at least one instructor chose to record new videos for this term. The instructor who chose to record new videos deliberately decided to make these videos shorter than a typical course lecture, creating 10-15 minute videos that seemed more appropriate for student bandwidth, rather than the traditional 50 minute lectures. To supplement the lecture videos, instructors are creating a number of resources to support students. One instructor distributes lecture notes, while another creates a “daily briefing” that highlights what is most important in the day’s lecture, what material is of lesser priority, and one non-academic anecdote about life under quarantine. Another instructor put the course readings on *Perusall* and took advantage of the social features of the platform in order to give students the opportunities to ask questions about the material prior to the synchronous class time. Meanwhile, one instructor chose to introduce short quizzes (in the form concept checks) to help students get the most out of the live lecture exercises, although this was met with mixed feedback by the students.

Instructors adopting a ‘flipped’ format are using synchronous class time in many different ways. At one extreme, an instructor chose to forego the synchronous aspect entirely. Other instructors are using synchronous in-class time to do more practice exercises. Some instructors vary the use of the synchronous classes, utilizing different meeting days for different purposes: one part for interactive tutorial sections with students, another giving students the choice to work independently or in small breakout groups with other students (i.e. peer instruction); sometimes portions of class time are used as additional office hours.

B. Course Staff

A significant number of instructors mention how important their teaching staff has been to the success of their courses.

Two trends are emerging about TAs: (1) a need for a more codified and uniform TA training, and (2) a benefit of shifting TA responsibilities to better suit the needs of the online courses.

As a result of a last minute spike in enrollment, additional TAs were hired in a way that created a larger teaching staff for some courses and increased in the number of first time TAs. Instructors report that this resulted in a mixture of TAs surpassing and not quite meeting expectations. Meanwhile, the TAs we spoke with are finding it challenging to know what they are expected to do without consistent and codified protocols. Accordingly, it appears that instructors and TAs alike would benefit from a more consistent departmental training, one catered to the realities of online teaching.

Adding to the complexity of the issue, many instructors are shifting the responsibilities of the TAs for this term relative to past ones. Typically, TAs are expected to hold office hours, grade, lead discussion sections and conduct ‘code reviews.’ During the online quarter, instructors adapted these responsibilities to better suit the needs of their courses, using more of the TAs time to help students synchronously. Some course-specific changes in policy include an instructor who eliminated code reviews so that TAs could spend more time helping students in smaller discussion sections. Another instructor eliminated homework feedback meetings so that TAs could spend more of their time in office hours. Overall, instructors are increasingly using the TAs to be their “eyes and ears” to keep a pulse on their students’ experience in the course, whereas they are usually asked to focus exclusively on instructional assistance. Based on an internal survey of departmental TAs, they are reporting that the workload has largely stayed constant relative to previous terms despite the shift in responsibilities; however, technological challenges have been a major source of frustration.

C. Online Tools

Instructors are using a variety of tools in both accepted and innovative ways to support their online classes. Discussion forums such as *Piazza* remain a staple of the CS department, with some instructors using their class forum as a way for students to engage in dialogue during class meetings. A significant number of classes have created class *Slack* workspaces, although most instructors reported that the level of activity on these channels is low, particularly relative to class discussion forums. *Gradescope* has also been used for grading for a number of years in the CS department. Instructors are now experimenting with its auto-graded quizzes for rapid and frequent formative assessment. One instructor reported that *Perusall* is a key feature of their class because of its ability for students to post public questions and comments on the reading for classmates and course staff to answer. Additionally, they report the advantage of being able to see how many students actually did the reading prior to class meetings, which is a helpful gauge for how they use their allotted class time. There are still clear gaps in the technology available. In particular, instructors struggle with the inability to “read a room” while

teaching, and a few instructors we spoke with discussed the need for a tool that could gauge student reactions (i.e. laughter versus silence) and to (cold) call on students in a way that would ensure a response.

D. *Mastery-Based Learning/Resubmitting Work*

An emerging trend from this term is the willingness to allow students to resubmit work to allow for a mastery-based approach to grading. At least three instructors we spoke to allow for resubmissions in their courses through a variety of policies. One instructor made it the exam policy for students whose work was deemed “unsatisfactory” (i.e. not passing) to have an opportunity to revise and resubmit their work as many times as needed with extensive feedback and staff support. This instructor admitted that in previous terms, “my attitude towards regrade requests is that they’re somewhere between a bit of a bother and obnoxious, but this is a pretty satisfying process [now] when I can see students are trying.” Another instructor that previously did not allow for any resubmissions adjusted the course policy to allow any student that did not get a passing grade to resubmit their work. Both of these instructors plan to keep allowing for resubmission in future quarters given the value that they see for student learning.

VI. DISCUSSION

Although the widespread disruption of 2020 is unlikely to recur in the same form, the Spring term nevertheless taught our department and our institution many valuable lessons that suggest a new era of online learning. In spite of 25 years of online MS degrees and professional education programs, and a leading role in the MOOC movement, this department looked for new ways to provide meaningful courses to a selective student body. Reinforcing research of the past decade, experiments from Spring 2020 suggest three instructional categories central to effective online education: (1) responsive course design, (2) empathy for a heterogeneous student experience, and (3) course resources adapted to fit the medium. Below we present recommendations to instructors, instructional designers, strategists and researchers based on our findings and the learning at scale literature.

A. *Recommendations for Instructors*

As **course designers**, we recommend that instructors:

- Find ways to strategically combine synchronous and asynchronous elements of their classes: give all students opportunities to engage in synchronous learning with classmates and instructors, while providing access to (a variety of) asynchronous material that is adaptable to the student’s particular circumstances.
- Recognize the limitations of the online medium, and compensate as best possible for the elements of a residential education that cannot be reproduced online. In doing so, instructors may take advantage of the unique opportunities available online to create learning experiences and sociotechnical systems that go “beyond being there” [5].

- Adjust course expectations without sacrificing quality or rigor to accommodate students as they adapt to online learning without the resources typically available to them while on campus. Such adjustments might alter grading and exam formats and policies.
- Adaptively and iteratively experiment with course design in response to feedback collected from students about their academic and non-academic needs.

As **empathetic, student-centered educators** we recommend that instructors:

- Seek an understanding of the wide variety of non-academic student experiences, in order to be responsive to shifting demands on learners in heterogeneous (and often challenging) situations.
- Build empathy for their students, shifting as much as possible from a focus on personalized instruction to one that is personal.

As **leaders of teaching teams and curators of tools**, we recommend that instructors should:

- Reconceptualize the roles and responsibilities of course staff to expand the capacity of the teaching team, especially with regard to synchronous instruction. In particular, instructors should recognize and take advantage of what technology does well, drawing on teaching assistants and co-instructors to bring human elements to blended forms of instruction.
- Create clear staff protocols and invest in training TAs, potentially as a way to give them more instructional responsibilities.
- Carefully choose course technologies based on the most appropriate and effective tools for any needed task, based on the growing community knowledge about what is best suited for specific educational purposes.

B. *Lessons for Higher Education from Learning at Scale*

It is evident that MOOC research has greatly informed the new era of online instruction. Similarly, the magnitude of 2020-21 experiments underway will be highly valuable in future efforts toward effective learning at scale. We highlight a few areas where traditional institutions have the most to learn from MOOC experience, and the areas that efforts at scale may learn from ongoing truly massive experiments. We use the taxonomy developed by Kross and Guo [6] as a convenient proxy for topics of interest in the MOOC and wider online learning community.

The areas from MOOCs that appear most relevant to traditional instructors are:

- Course systems and technologies that enable mastery based learning [7], [8], increased engagement with pre-recorded lectures [9], [10] and leverage the power of technology to free up instructor time [11], [12].
- Insight about student-to-student interaction through messaging [13], online communities [14], [15] and discussion channels [16], [17].
- Designing courses for diverse student populations [18], [19].

- Using technological tools and data to gain an increased understanding of student learning trajectories [20]–[22]. Future MOOCs and efforts at scale may benefit from:
 - A richer understanding of student personas [23], and how online learners differ from residential ones.
 - New and effective means of student engagement and interaction.
 - A shift in focus from personalized learning and feedback [24] to *personal* course elements designed to show empathy for students.
 - The gaps in tools that would support online educators and students.

C. Future Research

Pressing needs and directions for future research include:

- How to conduct effective office hours in an online format?
- How to facilitate meaningful student-to-student interaction and create psychological safety in online formats?
- What learning tools might be most effective for supporting the types of online instruction recommended above?

VII. CONCLUSION

World events have catapulted thousands of colleges into an unfamiliar world of teaching online. The shared experience of universal disruption – for instructors, students and institutions – will profoundly reshape online learning and higher education forever. In the department addressed in our case study, the experiments and initial results are clear: approaches such as flipped classrooms, mastery-based learning, and student empathy increase course success, while a number of areas present unresolved problems, including student interaction, office hours, and responsive learning tools. Looking ahead, we expect to see more experimentation as online learning remains the most feasible option for the coming academic year. In light of the ways so many institutions worked independently [2], we hope to see more collaboration, informed course development, and the clear emergence of best practices.

While the results of continuing course experimentation and evaluation will become clear over time, the use of these results are completely unknown. Significant questions remain: How will educational institutions leverage these new findings over the longer term? Will revered residential institutions retreat from online instruction when it is no longer required? How will students respond and what will they expect in the future?

In spite of clear and increasingly evident benefits of residential education, current educational institutions serve only a small fraction of the need for learning worldwide. We believe the demand for online courses can only increase as a result of increasing familiarity, improving quality, and apparent endorsement by even the most elite universities. Regardless of how most elite and established universities proceed, we expect adventurous and innovative organizations will leverage the lessons of the day, see the opportunity and rise to meet it.

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