Teaching at a distance: “Déjà vu all over again!” or “Here to stay”?

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Abstract. Computer scientists are well-accustomed to thinking of technology as a disruptor; for more than 100 years, new technologies have been predicted to be disruptors of higher education. And yet for all of these new technologies and predictions, the primary model of teaching – synchronous, on-campus classes with in-class students – have remained more or less unchanged at many colleges and universities. The COVID-19 pandemic necessitated an unanticipated and abrupt switch to virtual classes and will likely result in an increasingly hybrid mix of on-campus, in-person students, and off-campus students who participate synchronously or asynchronously in the near-term future. We believe this heterogenous mix of students is “here to stay.” In addition, rather than disruption coming from “technology push,” it is broader societal change, i.e., “demand pull,” that will drive longer-term changes, enabled by technology. In this whitepaper, we outline these driving changes, and speculate on what this will mean for teaching and learning computer networking, and as well as other computing subjects.

Introduction

Some 25 years ago, the renowned computer scientist, Jeffrey Ullman, gave a talk that began with a parable of a 19th century button maker, whose business was being disrupted by technology – industrialization, the railroad, and the ability to manufacture and transport goods remotely:

“It's New Year's Day, 1895. My name is Hans. For seven generations my family has made the finest buttons in the region, using the good local horn. Today I learned that the railroad is coming to our village. My friend Olaf says that cheap factory buttons will come on the trains, but they will never compete with my craftsmanship. I think he is right, and wrong. They will come, but they will compete with my buttons. I must make some choices. I can become a distributor for the new buttons, or I can invest in the machinery to make buttons and export them. Or, closest to my heart, I can refine my craft and sell exceptional buttons to the wealthy. My family's business is dead. I cannot stop the train; I must change.” Jeffrey Ullman, as retold in [1], and as also remembered by one of this article’s authors.

Ullman’s talk, as we remember it, was about how computing technologies would soon disrupt education. A tale of technology disruption is one that is particularly familiar to computer scientists, as computing and communication technologies have been central in many recent disruptions. And for more than 100 years before Ullman’s talk, new technologies have been predicted to be disruptors of higher education. The following quote (with the exception of

1 With a “tip of the cap” and apologies to Yogi Berra.
bracketed terms) is attributed to William Rainey Harper, a former president of the University of Chicago:

“The day is coming when the work done by [distance education] will be greater in amount than that done in the classrooms of our academies and colleges; when the students who [learn via distance] will far outnumber those who [are physically present in the classroom].”

Harper made this prediction in 1885; the technology he saw disrupting education was the correspondence course (i.e., a course done by what we would now call “snail mail”). Here is his full quote [2]:

“The day is coming when the work done by correspondence will be greater in amount than that done in the classrooms of our academies and colleges; when the students who shall recite by correspondence will far outnumber those who make oral presentations.”

From correspondence courses in the 19th century; to radio, broadcast TV, and cable TV in the 20th century; and now the WWW and MOOCs in the 21st century, futurists have predicted that technology-enabled distance education would significantly impact the “standard model” of synchronous, on-campus classes with in-class students. And yet for all of these new technologies and predictions, this standard model of teaching has remained more or less unchanged at most colleges and universities.

The COVID-19 pandemic necessitated a nearly overnight switch from this standard model to strictly virtual classes. With little-to-no time for preparation, amazing effort and creativity was needed simply to finish up ongoing courses. There was a tremendous amount of innovation, improvisation, and learning-by-doing. But, understandably, few educators were prepared to leverage technology – to use the railroad and the services on that railroad – to effectively teach students synchronously or asynchronously at a distance [3]. In a recent poll, a majority of “Faculty members and administrators agreed that their institutions’ online courses in the spring were inferior to what had been offered in person.” [4]. This fall, we will likely see an increasingly hybrid mix of students – some students will be present on campus while others will be remote; some students will participate synchronously in class activities, while others will participate asynchronously.

We believe this heterogenous mix of students who are present and/or remote, synchronously and/or asynchronously, is here to stay. This change is not due specifically to COVID-19, although the pandemic has necessarily accelerated the increase of so-called hybrid, blended or hybrid-flexible “hyflex” courses. Nor is this change a technology-push disruption, although communication and computing technologies – the Internet and applications such as Zoom and learning management systems for computing – make such hybrid courses feasible. Instead, we believe that broader, deeper societal changes, and changing student needs, are driving longer-term changes in how and who we teach. These changes are enabled by, but not fundamentally driven, by, technology. We next outline these driving changes, and then discuss the implications and challenges of these changes for teaching and learning computer networking, and other computing subjects as well.
Drivers for Change

For quite some time, the “standard model” for much university undergraduate teaching has been face-to-face teaching of 18-to-22-year-old students, who were physically present, on-campus, tuition-paying (at least in the US) students. Within this model, there’s been tremendous diversity in teaching, from large, lecture-only classes to lab-based courses, to small, discussion-oriented classes, with active learning in the classroom.

But changes have been afoot for some time:

- **Students both on-campus and at a distance.** Even students enrolled in a traditional on-campus degree program may be physically distant from campus when taking a course. This may be because a student is participating in an international learning experience, or an internship program that requires the student to live elsewhere. A student may be off-campus for some period of time for family, financial, work, or (as in the case of COVID-19) health reasons. Some university campuses and systems have multiple campuses, where a course physically offered at one campus may be taken remotely by students at another campus. All of these scenarios involve teaching at least some students at a distance, whether synchronously or asynchronously.

- **Evolving educational programmatic.** The way in which educational programs are conceived is currently undergoing a significant shift in terms of both content and structure. In a world where the pace of change is increasing and many of tomorrow’s jobs have not yet been invented, traditional, “one-and-done” discipline-based degree programs (and courses) are being augmented by lifelong learning, competency-based, and challenge-oriented programs. In these programs, students can personalize their education, choosing what to study and when, combining full degrees with micro-credentials and material drawn from a range of disciplines, often at a finer level of granularity than a traditional 3-credit course.

- **Life-long learning, changing demographics.** Particularly in fast-changing technology-rich fields like computer science, learning is necessarily a lifelong activity; interests and career goals will also evolve over time, requiring new expertise. Students must be lifelong learners, with consequent family, financial, and time considerations that differ significantly from traditional campus-resident 18-to-22-year-olds; such considerations may result in a preference for courses that offer online, asynchronous opportunities. Of course, life-long-learning has been a driver for distance education for decades. But whether it is improved technologies for delivering courses as a distance, an increased need for lifelong-learning, or an increased need for learning beyond campus walls, we’ve witnessed an increased emphasis on learning at a distance [13]. Many campuses offer online graduate-level MS and certificate courses in Computer Science (perhaps most notably Georgia Tech’s online MS program) for such students. More recently, massive “mega-universities” [5,6] such as Southern New Hampshire University and Western Governors University have grown, focusing primarily on online learning for lifelong
learners. A declining population of traditional college-aged students in the US [7] and elsewhere, and an increasing cost of an on-campus education (at least in the US), may serve to further increase the percentage of life-long learners that faculty see in their classes.

- **Booming enrollments in computing.** Undergraduate enrollments in computing continue to boom [8]. Many colleges and universities have been unable to correspondingly scale teaching, staffing (e.g., teaching assistants), and facilities. In some cases, online and blended courses help scale resources to meet rising demand, even when students are all physically present on campus.

With these strong social and economic drivers, we believe the debate [9,10] between whether on-campus classes with in-person residential students are better or worse than classes with students at a distance is the wrong question to be debating. Clearly, few would argue that a well-taught course with students at a distance is somehow inherently worse than a poorly taught in-person course, or vice versa.

Between the extremes of “this is just déjà vu all over again” and “innovate or die,” our more pragmatic view is that there will certainly continue to be completely on-campus courses as well as courses that are taught completely at a distance. As long-time faculty who have taught in both models, we understand the advantages, challenges and joys of each. Some students will be fortunate enough to choose between the two; others may not. A student’s needs and circumstances will drive which of the myriad options are taken. But we believe that hybrid (or “blended” or “hyflex”) courses and educational experiences that mix in-person and at-distance learners, and do so synchronously and asynchronously are “here to stay” and that we’ll see an increasing mix of on-campus and off-campus students.

**What does all this mean for faculty, departments and colleges of computer and information science (and universities more broadly)?**

Of course, there are fewer answers than question here, as many questions will only be answered by innovation and experimentation as broader and more flexible forms of student engagement are undertaken more widely. Here are a few of the key challenges to be addressed:

- **What happens in the “classroom”?** With hybrid forms of teaching, the classroom itself becomes a mix of the virtual and the physical. What will become of “sage on the stage,” lecture-style teaching, particularly as high-quality pre-recorded lectures become available online, often as textbook supplements (see e.g., whitepapers by L. Peterson; N. Feamster; and Kurose and Ross in this workshop)? This was a question implicit in Ullman’s original parable. But such pre-recorded material, like a textbook, is generic – not tailored to students in a specific teacher’s “classroom.” How can/will this generic material be personalized – tailored to best fit the needs of students in a particular class at a particular point in time?
Centers for teaching and learning at many universities have advocated for active learning and team-based learning in the classroom that actively engage students. How do these notions translate to hybrid classes?

- **How can community be created in a hybrid classroom?** At its best, a classroom is a learning community for students and faculty. How can teachers create community among students who may seldom, if ever, be physically together? Group- and team-based projects, even when carried out over a distance, can be used to introduce students to each other, and can help to create a community of students. Discussion groups, whether synchronous or asynchronous, can also foster community, with appropriate faculty monitoring and participation [11].

- **Student-centered and personalized.** Tailoring existing material for a specific class and creating community both speak to the need to create a unique, personalized learning experience for students. Without such attention and personalization, one offering of a course on a particular topic would seem indistinguishable from another course on that topic. We believe it is here, in personalizing a course and a learning experience to the students in that class, that teachers’ time and effort might best be focused. Personalization would allow a teacher to re-purpose and adapt existing material (whether their own or not) for reuse in different settings, from online micro-credentialing to in-class-only fully synchronous full semester courses. Material can be contextualized for particular students in a class. Such personalization becomes the true “value added” by the teacher for the student. Time spent on such personalization is likely be more valuable (and require more creativity and effort) than time spent on generic lecturing or grading, suggesting that existing resources and online grading be used whenever feasible from a learning perspective.

Tailoring class-specific material, creating community, and personizing student-centered learning will require continuous and active engagement by the teacher, and will require significant time, effort and creativity. Effective and active online teaching is the opposite of a “set and forget,” “slow-cooker” approach to online teaching [11].

- **A different administrative view of who our students are.** An increase in hybrid courses means that, from an academic-credit-for-teaching point-of-view, it won’t matter whether students are online or on-campus, enrolled in a degree/certificate program or not – students are simply students. However, from a pedagogical point of view students may be very different from a “where they are in life” point of view. Our own experience is that an older student with a job and a family often has different constraints and needs than a residential 20-year-old student. This again illustrates that personalization and the creation of a learning community with diverse needs and constraints will be crucial.

- **Infrastructure, digital delivery, online resources, and teaching with digital tools.** We’ve taken it as a given in our discussion above that students have access to the infrastructure (computing, high-bandwidth connectivity) to participate in a hybrid course. Just as universities commit to providing all students have equitable access to on-campus learning resource and services in traditional face-to-face learning, so too must off-campus
students have equitable access. This follows as a foundational requirement of the view that “students are simply students.” Faculty must also be provided with access to, and training with, online resources, as well as resources that help foster effective teaching and learning in a hybrid setting.

Conclusion

While still in the midst of the COVID-19 pandemic, and with plans for the Fall 2020 teaching changing, it is often difficult to think beyond the current, pressing needs to adapt to teaching in a hybrid setting. The pandemic has massively exposed our networking education community to online and hybrid teaching. As we’ve argued above, we think this increasingly hybrid mix of on-campus, in-person students, and off-campus students who participate synchronously or asynchronously is “here to stay” – not everywhere, not everyone, and not all of the time, but increasingly in more colleges and universities and increasingly more often.

With this increase comes the opportunity for our networking education community to work together, to both ease our collective load and to move towards better learning outcomes for our students. Shared online resources in actively curated repositories can become the “go-to” location for teachers wanting to leverage and build on the work of others, possibly in an open-source style.

But beyond shared community resources, is shared community experience. We are still learning how to teach in a hybrid setting, learning how to personalize our teaching. Sharing best practices, fun and interesting ideas that worked well (or didn’t) are at least as valuable as shared resources. These shared experiences can help and inspire us all become better teachers and should also be actively curated.

We close with a modern-day parable (updated from [12]):

It's New Year's Day, 2030. My name is Hans XII. My great-grandfather, Hans IX, made buttons, as his great-grandfather before him. Button-making became commoditized, and I moved “up the stack.” I now buy buttons, threads, laces, and cloths – materials I weave together to create unique, personalized clothing, quilts, and sewn goods for my clients. I work closely with my clients, and tailor my work to their needs. My clients come from all walks of life, a change from my great-grandfather who changed to “sell exceptional buttons to the wealthy.” I find that my clients also interact with each other to appreciate new sewn goods. What defines my craft is how I weave these together for my clients, each one unique. The railroad still comes to my town, and I use it to travel, and to learn from others who practice the art of fine sewn goods.

References


