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Viewpoint
From MOOCs to SPOCs

Supplementing the classroom experience with small private online courses.

As the media's infatuation with massive open online courses (MOOCs) continues unabated, some academics seem to be succumbing to the hand-wringing about whether MOOCs will destroy higher education as we know it (see "Will MOOCs Destroy Academia?" by Moshe Vardi in the November 2012 issue of *Communications*). Is it a bad thing that we "have let the genie out of the bottle," as Vardi suggested in his Editor's Letter? I argue that a close, systematic, and sustained look at how MOOCs are actually being used should persuade the careful observer that tasteful use of MOOC technology can strengthen academia.

Note I do not say "MOOCs *will* strengthen academia." They certainly *can*, but whether they do depends on how they are received and used by academics. Full disclosure: besides being a MOOC instructor myself, I am the recently appointed faculty director of Berkeley's MOOCLab, which extends Berkeley's existing online education programs with MOOC research and practice. But I am not cheering for MOOCs because I have this position; rather, I agreed to take the position because I am excited about the possibilities of MOOCs and other online education. In particular, if MOOCs are used as a supplement to classroom teaching rather than being viewed a replacement for it, they can increase instructor leverage, student throughput, student mastery, and student engagement. I call this model the SPOC: small private online course.

To set the context for this discussion, let me use the SPOC idea to offer counterexamples to some "MOOC myths" in recent media coverage. While most myths are based on a kernel of truth and may be true of at least some MOOCs, they are just as often untrue and it is a disservice to interested readers to present them as foregone conclusions.

IMAGE COLLAGE BY ALICIA KUBISTA/ANDRIJ BORYS ASSOCIATES

Myth: Universities will use MOOCs to lower costs by firing faculty and teaching assistants, thus sacrificing educational quality. If universities were looking to replace existing courses partially or entirely with MOOCs, this might be true. However, many universities are successfully using MOOC technology quite differently. For example, in a recent pilot program at San José State University in California, students in an analog circuits course used MIT-authored MOOC lectures and homework assignments created by Anant Agarwal.[1] The students' in-classroom time was spent working on lab and design problems with local faculty and teaching assistants. The students in this SPOC scored five percentage points higher on the first exam and 10 points on the second exam than the previous cohort that had used the traditional material. Even more strikingly, the

proportion of students receiving credit for the course ("C" or better grade) increased from 59% to 91%. So educational quality arguably increased, and costs were lowered by helping students graduate more quickly, rather than by firing people. Productivity was enhanced because the on-campus instructors shifted their time from what they perceived as a lower-value activity—creating and delivering lectures on content that has not changed much—to the higher-value activity of working directly with students on the material. Several of my colleagues in the California State University system and the community college system have expressed similar enthusiasm. This model takes advantage of important MOOC features, including access to high-quality materials and rapid feedback to students via autograding, to maximize the leverage of the scarce resource—instructor time.

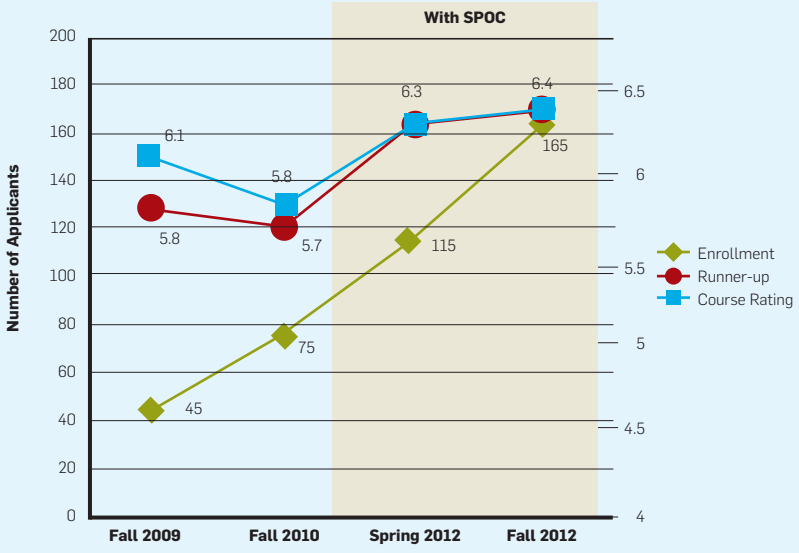
Closer to home, my colleague David Patterson and I created a MOOC based on our upper-division software engineering course at Berkeley, and subsequently used the MOOC material as a SPOC in our on-campus course. A key feature of this course is four different autograders for different types of software engineering assignments. These autograders were created by investing several hundred engineer-hours in repurposing tools used by professional programmers. Students not only get finer-grained feedback than they would get from human teaching assistants, who can spend at most a few minutes per assignment, but now have the opportunity to resubmit homework to improve on their previous score and increase mastery. The autograders test both code completeness and code correctness, and will soon give feedback on code style. As the accompanying figure shows, the SPOC model has allowed us to increase the enrollment of the course nearly fourfold while yielding higher instructor and course ratings (in fact, the highest in the course's 20-year history) even though the fundamental material covered has changed very little. (The MOOC version of the course is available as "BerkeleyX CS169.1x" on edx.org.)

Under what conditions and with what types of material do online communities foster learning?

Myth: MOOCs will fail because many aspects of traditional classes, such as small-group discussions and face-to-face time with instructors, do not work in the MOOC format. This assertion is true, but it implicitly and incorrectly assumes that replicating the classroom experience is the proper goal for an online course. If that were an appropriate goal, then MOOCs would indeed fail to meet it. However, as educators, a better question for us to ask is this: What can be delivered effectively through this medium in a way that helps our on-campus students, and has the valuable side effect of helping the hundreds of thousands who will not have the privilege of attending our universities in person? (Indeed, many of our MOOC students reported that our course was better than anything available at the brick-and-mortar campuses to which they had access.) Using MOOC materials in a SPOC format is one way that MOOCs can indeed be successful in helping to answer this broader question.

For example, rather than asking whether automatic graders (which, by the way, have been around since at least 1960[4]) can replace individual instructor attention, we can ask: When can they relieve teaching staff of drudgery, allowing scarce instructor time to focus on higher-value interactions such as tutoring and design reviews? Rather than worrying whether MOOC-based social networking will replace face-to-face peer interactions, we can ask and experimentally answer: Under what conditions and with what types of material do online communities help foster learning, and how can social networking technology help foster both online and in-person community building? And learning activities that do not appear to be "MOOCable"—discussion-based learning, open-ended design projects, and so on—can just be omitted from the MOOC but covered in the classroom setting, as we have done in our software engineering course, whose MOOC version lacks the on-campus

Course enrollment and instructor and course ratings (given anonymously by enrolled students, solicited by Eta Kappa Nu Engineering Honor Society each semester within Berkeley Engineering) of CS 169 Software Engineering with and without SPOC supplement.



course's open-ended design project. Indeed, at universities on the quarter system, it is common to offer a two-quarter sequence in which the first quarter focuses on well-circumscribed assignments and the second quarter focuses on a design project, since a single quarter cannot cover both. The first course clearly has value despite lacking a design project, and could be offered as either a MOOC or a SPOC. By analogy, MOOCs that do not offer "the same" experience as a complete residential course also have value, and our job as educators is to make judgments about where that value lies and how to combine it with the other education modalities we offer our students.

Myth: MOOCs distract faculty who should be focusing on improving their on-campus pedagogy. Even if using a SPOC in the classroom, faculty can still leverage the scale of an (open) MOOC to enhance their classroom teaching. In fact, the large enrollments of MOOCs offer us new and unprecedented opportunities to improve our on-campus courses using inferential statistics techniques that just do not work at smaller scales, and so were previously available only to large-enrollment "high stakes" exams such as the GRE or SAT.[a] For example, exploratory factor analysis[5] lets us identify questions that test comparable concepts, giving instructors a way to vary exam content. Item response theory[6] allows us to discover which questions are more difficult (in the statistical sense that higher-performing students are more likely to get them right). A/B testing gives us a controlled way to evaluate which approaches have better effects on learning outcomes, just as high-volume e-commerce sites evaluate which user experience results in more purchases. None of these techniques works on classroom-sized cohorts (say, 200 or fewer students), but we are applying all of them to our current MOOC. Indeed, not all instructors will be eager to receive the avalanche of MOOC data telling us what is not working in our courses and how we can improve them, but our sense at Berkeley is that MOOCs may well raise the bar for acceptable teaching on campus, as well as improve the recognition of good teaching, perhaps finally bringing to a close the era of recycled PowerPoint slides.

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In addition, in each of four offerings of our software engineering MOOC totaling over 100,000 enrollees, about 8%, or nearly 32,000 total, identified themselves as instructors, suggesting that MOOCs may be even more effective than traditional textbooks at "teaching the teachers" and getting innovative new pedagogy out to a large audience. In fact, our faculty colleagues who are classroom-testing our unconventional new textbook *Engineering Long-Lasting Software: An Agile Approach Using SaaS & Cloud Computing* are all doing so in conjunction with our MOOC (EdX CS 169.1x), so they can take advantage of the autograders, screencasts, and other materials.

Myth: MOOCs will reduce diversity in instructors and teaching approaches because economics will favor a "winner takes all" scenario in which one specific MOOC will dominate each course. In her widely cited *Tools For Teaching*,[2] Davis recommends that lecture styles and teaching strategies should vary depending on the nature of the material and the target audience of students. Even if one or a few MOOCs dominate a particular course, thereby replacing various instructors' different teaching approaches with the MOOC instructor's single approach, we can, like Doug Fisher and others,[3] selectively adapt the content for SPOC use in our own on-campus courses, as we have long done with textbooks. Indeed, one could have raised a similar complaint about the printing press: it homogenized book production and eliminated the social rituals associated with acquiring books. Yet it also created vastly more readers, gave voices to authors who would never have had them, and introduced new tools that teachers could use in conjunction with their lecturing. In a similar way, MOOCs will not replace high-quality face-to-face instruction, but we can reach many more learners, leading to a net social and economic benefit, and we can give many great teachers a more prominent voice than they have had since Socrates.

Conclusion

MOOCs represent a new technology opportunity whose potential pedagogical impact needs to be researched. I have argued that MOOCs themselves can yield valuable information because of their scale, and that MOOC materials can be used in a blended small private online course setting to supplement the classroom experience. Both MOOCs and SPOCs are two design points in a wider space in which experiments are possible. To be sure, many bad experiments will be tried—some are probably already under way—and many worthy experiments will fail or have a different outcome than desired. But if failed experiments were an obstacle to doing world-changing research, we academics would probably choose a different job. C

a The Graduate Record Exam (GRE) and Scholastic Aptitude Test (SAT) are standardized tests that are part of most students' applications to U.S. graduate and undergraduate programs respectively.

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