Online Postsecondary Education

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Introduction

Online coursework has been heralded as potentially transformative for postsecondary education to the extent that it may lower delivery costs and increase access for disadvantaged students. The U.S. federal government estimates that, in fall 2022, 54 percent of undergraduate students were taking at least some of their coursework online.[1] Among these, more than two-fifths, i.e., nearly one-fourth of all undergraduates, were taking all their coursework online.

Many fully online programs are run by for-profit institutions, whose role has expanded with the rise of online education. In fall 2022, over 70 percent of undergraduate students at four-year for-profit institutions were studying exclusively online.[2]

Online education is widely prevalent at public and nonprofit colleges and universities as well: 32 percent of community college undergraduates were studying exclusively online in fall 2022, along with approximately 20 percent of undergraduates enrolled at four-year public and nonprofit institutions. At public and nonprofit institutions, approximately 35 percent of graduate students enrolled in fall 2022 were taking their coursework exclusively online, while this figure was 87 percent for graduate students at for-profit institutions.

Massive open online courses (MOOCs), many unconnected to specific degree programs, have also expanded dramatically. The first MOOC was offered in late 2011. A decade later, in 2021, 40 million new learners enrolled in a MOOC, while providers created over 3,000 new courses and 500 new microcredentials, that is, certificates given after a student completes a fraction of the courses comprising a typical master's degree.[3]

Proponents of online postsecondary options highlight several potential advantages that they may confer, particularly relative to traditional, in-person options. Among other benefits, online coursework may provide:

- Flexibility, in that it allows students to access materials and lectures at their own convenience, an option particularly valuable for those with work or family commitments;
- Cost savings, both for institutions, which may reduce tuition given the economies of scale and lower need for physical facilities that may be associated with online enrollment, and for students, who can save on commuting and housing costs;

- Accessibility for those unable to attend in-person classes because of geographical constraints or physical disabilities and for those who cannot afford costlier in-person options; and

- Personalized learning, to the extent that the online format leverages technology through interactive multimedia materials, web forums for discussion and collaboration, and real-time feedback mechanisms.

However, skeptics of online postsecondary coursework caution that it may have potential disadvantages, including:

- Lower engagement, both because a lack of in-person interaction with instructors and peers can reduce opportunities for seeking feedback and because a lack of face-to-face accountability means that online learners can become more easily distracted from their studies;

- Technological barriers, as disparities in the quality of internet and computer access can disrupt the learning process or prevent participation entirely;

- Lack of credibility, as some employers and academic institutions view online coursework as less rigorous than in-person coursework; and

- Quality and cost challenges, as creating a high-quality online experience may require large investment even relative to in-person coursework, potentially negating any cost savings.

Evaluating the effects of online postsecondary coursework and degrees is challenging for two main reasons. First, students who choose online options are often quite different at baseline from those who choose in-person options, making it difficult for researchers to separate the impact of the online format from other preexisting differences between students. Further complicating this issue, some students are choosing between online and face-to-face options, whereas others may be on the margin between taking online coursework and not enrolling at all. Second, the term "online learning" encompasses a wide variety of educational experiences, with evolving technology further complicating the meaning of the term. Online courses can be fully or only partly online, synchronous or asynchronous, small or massive, rigidly structured or self-paced, and stand-alone or connected to a larger degree program.

Adding to this complexity, the quality of online course design varies substantially. Research suggests that well-designed online learning—which includes interactive elements, regular feedback, clear structure, and opportunities for engagement—can produce outcomes comparable to face-to-face instruction, particularly for academically prepared students. However, poorly designed online experiences, such as simply recording and streaming traditional lectures without adaptation to the medium, may fall short of these outcomes. The studies reviewed below vary in the extent to which they capture this design quality dimension.

The evidence reviewed below comes from a variety of postsecondary settings and a variety of flavors of online learning. All of the research reviewed has in common that it attempts

to take seriously the issue of who selects into online coursework. Relatively recent and more technical reviews of this literature are also available.[45]

Key findings

Key finding #1: *For academically stronger students, well-designed online postsecondary education can generate learning outcomes similar to those associated with in-person coursework.*

There are examples, though often relatively small in scale, of online college courses that appear to be as effective as their traditional in-person versions. Rarely, if ever, do online courses achieve better learning outcomes for any students.

Key finding #2: *For academically weaker students, online postsecondary coursework typically leads to substantially worse learning outcomes, persistence, and degree completion rates than in-person coursework.*

The evidence suggests a need for caution in drawing conclusions about the impact of online postsecondary education on all but the strongest students.

Key finding #3: *The labor market values some online postsecondary coursework and degrees but does so much less than it values in-person coursework and degrees.*

Employers appear skeptical about the value of online relative to that of in-person degrees, though it is unclear whether such skepticism stems from concerns about the value added of such programs or the baseline skills of the students who choose them.

Key finding #4: *Online options can increase access to postsecondary education, though not always in ways that reduce socioeconomic inequalities in such access.*

There are students for whom the financial costs or geographical and temporal constraints of face-to-face learning would have made enrollment anywhere impossible; thus, online options can make educational opportunities available for additional students. What little evidence we have suggests that those with preexisting advantages are more able to take advantage of the opportunities offered by online education. However, this is an area of inquiry in which we still need more evidence.

Key finding #5: *Shifts to emergency remote instruction during the COVID-19 pandemic hurt student learning.*

The hurried shift to online college coursework in response to the shock of the pandemic was not fully successful at replicating the outcomes of in-person learning. How to apply the evidence from this period to questions about the efficacy of online learning during times that are more typical is less clear.

Key finding #6: *It is unclear whether high-quality online coursework is less costly to deliver than similarly effective in-person coursework.*

The creation of effective online materials can be expensive, while some courses appear to exhibit tradeoffs between scale and the level of student engagement.

Understudied aspects of online postsecondary education

We have relatively little evidence about how the availability of online options changes access to education and, thus, which students are engaged in postsecondary learning. If a substantial portion of online students would not have pursued any postsecondary education absent online options, then direct comparisons to in-person students may understate the value of online education for this population. None of the policy research discussed below explores the impact of the quality of online postsecondary education or the specific ways in which technology can be used effectively or ineffectively. We have less evidence for newer online technologies than for older ones. Most research focused on the impact of online postsecondary education does not engage with the question of its cost effectiveness relative to that of in-person options. There is nearly no evidence on the impact of newer, smaller online credentials such as certificates or other short courses.

Policy considerations

Policymakers considering expanding the role of online postsecondary education should consider which students are targeted by such expansions and the potential tradeoffs between scale, cost, and quality. Online coursework that draws students away from in-person options risks harming learning and economic outcomes, particularly those of academically weaker students. Online coursework that attracts new students who would not otherwise have pursued postsecondary education can benefit them. Thus, appropriately targeting online coursework is key to increasing its benefits. Relatedly, providing high-quality online experiences can be expensive, with the associated costs more likely to be recouped if the coursework is delivered at large scale. It is unlikely that online education can be delivered to small numbers of students at a quality similar to that of in-person equivalents but at a lower cost.

Evidence

Key finding #1: *For academically stronger students, well-designed online postsecondary education can generate learning outcomes similar to those associated with in-person coursework.*

There are examples, though often relatively small in scale, of online versions of college courses that appear equally as effective as their traditional in-person counterparts. Rarely, if ever, do online courses achieve better learning outcomes for any students.

The best evidence on this issue comes from experiments randomizing the instructional mode within a given college course, though the studies suffer somewhat from relatively small samples; a heavy focus on one course, often in economics; a reliance on online technology that is now a decade old; and inconsistency in the online options studied.

For example, researchers at one large selective university randomized the instructional mode for those in a roughly 2,000-student introductory microeconomics course taught by a single instructor.[6] All students were given the same assignments and instructional materials; however, some were randomly assigned to watch the lectures live in a classroom with approximately 100 students, while others were assigned to watch recordings of those same lectures on the internet. For the higher-achieving half of the student body, there was no significant difference in students' final exam scores between these instructional modes.

Hybrid learning experiences, which combine in-person and online modalities, also have some track record of success with respect to learning, at least for the average student. Across six public university campuses, statistics students randomly assigned to a hybrid format with extensive online resources but only one hour per week of face-to-face instruction appeared to learn as much as those assigned to three hours per week of face-to-face instruction.[7] In two other randomized experiments at large public universities, the learning of introductory microeconomics students appeared no different between a traditional face-to-face option and an option that reduced face-to-face instructor time but made online support materials available.[8][9] High-quality online resources appeared to be able to effectively substitute for at least some instructional time.

One piece of evidence suggests that modern online options have the potential to improve student learning, at least for high-achieving students. Researchers in a public university in Switzerland randomized access to a live-streaming option for first-year lectures across multiple subjects.[10] All students had the option to attend live lectures, but only some could attend via live streaming. The researchers found that access to this online option improved high-achieving students' learning outcomes, in part by giving them the flexibility to attend lectures when they might not otherwise have been able to do so.

Key finding #2: *For academically weaker students, online postsecondary coursework often leads to substantially worse learning outcomes, persistence, and degree completion rates than in-person coursework.*

The evidence suggests caution with regard to the impact of online postsecondary education on all but the strongest students.

The extensive evidence on this issue comes from experiments randomizing the instructional mode within a given college course and from quasi-experimental analyses of large-scale administrative data on all coursework at a given college or college system.

Nearly all the randomized experiments cited in the previous section also showed that online options harm the learning of academically weaker students. At the large selective university that randomized introductory microeconomics students to live or recorded versions of lectures, the lower-achieving half of the student body had substantially lower final exam scores if assigned to recorded lectures.[11] Similarly, at one of the public universities that experimented with hybrid and face-to-face options, academically weaker students saw their learning suffer if they were assigned to the hybrid option.[12] At the other public university previously discussed, a fully online option hurt even the average student's learning relative to a traditional in-person format.[13] Providing students a live-streaming option reduced the learning of academically weaker students in the class, potentially because these students stopped attending live lectures, where they would have been more engaged.[14]

Larger-scale evidence from entire colleges or college systems, particularly those serving students at community colleges and less selective four-year colleges, consistently finds damaging impacts of online coursework on student learning. Such studies use administrative data on all students at a given college or set of colleges, attempting to identify the causal impacts of online coursework by exploiting plausibly random variation in the timing of course offerings and the distance that students live from campus or by comparing students to themselves across different types of coursework. Such evidence comes from colleges where online coursework is more common, such as community colleges, for-profit colleges, and regional public four-year colleges. All serve student bodies that are, on average, academically weaker than the typical four-year college student, though other institutional and demographic differences may also influence the quality and effectiveness of online education in these settings.

The clearest evidence comes from research on a large for-profit university, where researchers used the variation in course availability and distance from campus to compare otherwise identical students who enrolled in online and in-person versions of the same course, with the same assignments, tests, and grading rubrics.[15] The researchers found that the average student who enrolled in the online version had lower grades both in that course and in future courses taken, with even larger effects for academically weaker students. The online option also lowered the student's probability of remaining enrolled a year later by 10 percentage points. Researchers using data from a medium-sized regional university found similar long-term learning damage from taking courses online.[16] Holding constant all factors associated with a given student, instructor, and course, students who take an initial course online rather than in-person have grades in follow-up courses that are roughly one-twelfth of a grade point lower.

Community college students' learning also appears to suffer in online courses relative to in-person courses. Using data from California's community college system to control for a variety of student and course characteristics, researchers found that students have lower grades and course completion rates if they take a given course online rather than in-person.[17] Some, but not all, of this difference is explained by differing levels of instructor quality across the two modalities. Such students are also more likely to repeat courses initially taken online, which is likely to slow their progress toward degree completion. Using data from Virginia's community college system, researchers used students' proximity to campus as a source of randomness in whether they choose online or in-person courses.[18] Those taking courses online have lower course persistence and grades. Community college students in Washington are approximately 2 percentage points less likely to earn a degree if they take an online version of a course rather than an in-person version, an effect that the authors estimated by using plausibly random variation in the quality of local internet service as a reason why otherwise similar students make different choices.[19]

Key finding #3: *The labor market values some online postsecondary coursework and degrees but does so much less than it values in-person coursework and degrees.*

Employers appear skeptical about the value of online degrees relative to that of in-person degrees, though it is unclear whether such skepticism stems from concerns about the value added of such programs or the baseline skills of students who choose such programs.

Understanding whether online degrees and coursework improve students' job prospects requires disentangling the effect of online education from the other preexisting

differences between students who choose to use online options. The most compelling research on this question comes from résumé audit studies, consisting of experiments where researchers send employers the résumés of fictional job applicants but randomly vary the educational background listed in such applications between online programs and other alternatives. Whether employers request an interview of the applicant is then taken as evidence of the perceived value of the given degree.

The most extensive study of this kind randomized the résumés of fictional applicants to business and health jobs in five major U.S. metropolitan areas, focusing on comparisons between BAs earned at large online for-profit institutions versus non-selective in-person public institutions.[20] The authors found that applicants to business jobs were 22 percent (2 percentage points) less likely to receive a callback if their BA came from a large online for-profit institution than from a non-selective in-person public institution. Applicants with degrees from smaller in-person for-profit colleges did not see such a callback penalty, though callback rate differences between face-to-face for-profits and online for-profits were not statistically significant. Applicants to health jobs were 57 percent less likely to receive callbacks if their certificate came from an online institution rather than an in-person one. These findings suggest the online nature of the degrees was one potential source of the labor market penalty, though the penalty may also arise from the for-profit nature of those institutions.

Another study of online BAs created fictitious résumés for recent graduates from established nonprofit institutions that offered both in-person and online versions of degrees in business, engineering, nursing, and accounting.[21] For a random subset of these applications, the author inserted the word “online” in parentheses next to the college’s name. Those applicants with the word “online” added to their résumé received approximately half as many callbacks as those without the word, suggesting that employers viewed the online degree as a signal of fewer skills even conditional on an applicant's having attended the same institution.

Studies of online credentials other than BAs show that employers do sometimes value such credentials but less so than they value more extensive in-person credentials. Researchers studying the labor market returns to MOOCs randomized the profiles of fictional applicants to freelance web development jobs on Amazon’s Mechanical Turk, an online market for hiring short-term workers.[22] Applicants with only a MOOC credential were less appealing to potential employers than those with a BA, an AA, or a community college certificate, suggesting that MOOCs did not fully substitute for traditional credentials. However, applicants’ listing of a MOOC credential substantially boosted employer interest relative to their having no credential at all.

MOOC credentials may be particularly valuable for those without good alternative educational options. A recent study focused on over 800,000 people who had completed technology or business courses on Coursera.[23] Most were from developing countries and lacked college degrees. The researchers randomized encouragement to share their MOOC credentials and then later found these individuals’ profiles on LinkedIn. Those encouraged to share their credentials were 6 percent more likely to report new employment, an effect that was larger for those who appeared less employable at baseline. Though imprecise, the authors’ estimates suggest that for this sample, MOOC credential sharing more than doubled the probability of landing a new job. Another recent study in Colombia showed that receipt of a free certificate proving completion of a Coursera MOOC boosted the probability of formal employment by 5 percent, and even more so for low-income

participants.[24] Nonetheless, take-up of the offer of such a certificate was low, suggesting potential students may undervalue such credentials. In Costa Rica, randomized access to a job training program through Coursera MOOCs increased participants' postsecondary education enrollment but had no impacts on labor market outcomes after two years, suggesting that labor market impacts of MOOCs may be context and coursework dependent.[25]

Key finding #4: *Online options can increase access to postsecondary education, though not always in ways that reduce socioeconomic inequalities in such access.*

What little evidence we have suggests that those with preexisting advantages are more able to take advantage of the opportunities offered by online education. However, this is an area in need of more evidence.

The previously cited evidence on the economic returns to MOOCs suggests that such online options can provide educational opportunities otherwise inaccessible to some students, particularly those in developing countries. However, descriptive evidence from within the U.S., albeit somewhat dated, suggests that the opportunities created by the rise of MOOCs did not close domestic socioeconomic disparities in educational access. Researchers studying some of the earliest MOOCs, offered by Harvard and MIT between 2012 and 2014, found that U.S. participants tended to come from higher-income and better-educated neighborhoods than those that the average American lives in.[26] The students in those courses were more likely to complete them if they lived in wealthier areas, and all these socioeconomic disparities were larger for the younger students in the sample. This finding raises concerns that while MOOCs provide opportunities to some, they might also widen inequalities in access to cutting-edge educational experiences.

However, almost no causal evidence exists on the question of whether the creation of online options increases access for any subset of students. The challenge is that the rise of a given online educational option is difficult to isolate from other factors changing in the educational marketplace. The fact that online options are theoretically available to students across geographies makes it particularly difficult to identify treatment and comparison groups for any given program.

The one exception to this issue is research on the Online Master of Science in Computer Science (OMSCS) at the Georgia Institute of Technology (Georgia Tech), arguably the first model to combine the inexpensive nature of online education with a degree program at a highly ranked institution.[27] In spring 2014, Georgia Tech's School of Computer Science, which is regularly ranked in the top 10 in the United States, started enrolling students in a fully online version of its highly regarded master's program. The online pathway charged less than one-sixth the tuition of the in-person version and, importantly, was in name fully equivalent to the in-person degree. Georgia Tech designed the OMSCS such that its courses were online versions of the same courses that in-person students take, were designed by the same faculty teaching those courses, and were graded using the same standards.

The authors found large demand for the online program, now the nation's largest master's degree program in computer science, with nearly no overlap between the applicant pools for the in-person and online options. The average in-person applicant was a 24-year-old non-American recently out of college, whereas the average online applicant was a 34-year-old mid-career American. To estimate whether this online option expands access to education for students who would not otherwise enroll, the authors compared nearly

identical applicants just above and below a GPA threshold used during the initial admissions process. Nearly all of those who were barely admitted enrolled in the OMSCS program, and those who were barely rejected rarely enrolled elsewhere. Therefore, access to the online program did not substitute for other educational options.

Access to this online option thus substantially increased the number of students enrolling at all, likely because mid-career Americans with existing family and work obligations found no comparably flexible and high-quality program on the market. The authors estimated that the OMSCS program will boost the number of Americans earning computer science master's degrees by approximately 7 percent. This result provides one example of an online program improving access, albeit to a population that already has BAs, often in computer science or other related STEM fields. The extent to which online options broaden access beyond such populations is an open question.

Key finding #5: *Shifts to emergency remote instruction during the COVID-19 pandemic hurt student learning.*

The hurried shift to online college coursework in response to the shock of the pandemic was not fully successful at replicating in-person learning. How to apply evidence from this period to questions about the efficacy of online learning during times that are more typical is less clear.

The clearest evidence of the learning impacts of online delivery during the pandemic comes from an experiment run at West Point, a military academy where, in fall 2020, students were randomized to online or in-person versions of an introductory economics course.[28] Across both assignments and exams, the students placed in the online course earned substantially lower grades than those in the in-person version. The disparities in performance between online and in-person coursework were largest for academically at-risk students. The researcher surveyed students after the course had finished and found that relative to in-person students, online students were more likely to mention challenges concentrating and difficulties connecting to teachers and peers.

Other researchers have attempted to estimate the impact of the shift to online learning using various quasi-experimental strategies, though such approaches depend on convincingly isolating the shock of the transition to virtual learning from other shocks that may have differently affected different sets of students. Using data on community college students in Virginia, researchers conducted a difference-in-differences study comparing students in fall 2020 who were enrolled in in-person courses, which had to transition to online formats, to students enrolled in online courses, which did not have to transition.[29] They estimated that the transition to virtual instruction lowered course completion rates by 6 percent due to a combination of increased course withdrawal and course failure. The impacts were larger on academically weaker students. Using data from one public R1 university, other researchers found that the apparent online penalty to course grades has diminished somewhat in the post-pandemic era, perhaps because a different set of students began taking courses online or because grading standards may have changed in other ways.[30]

Further quasi-experimental evidence on learning comes from Israeli vocational colleges, which administered high-stakes exams that were in-person and centrally graded, even during the pandemic.[31] Within these programs, students took exams at multiple times, allowing researchers to compare each student's performance in "late" versus "early" exams

across pre- and post-pandemic cohorts. The shift to virtual learning substantially decreased student performance on these exams, which were intended to measure skills directly related to the occupation that a student was being certified in. The researchers argued that poor internet access is primarily responsible for these effects.

Importantly, the rapid shift to online delivery during COVID-19 involved courses that were designed for in-person delivery and hastily adapted to remote formats. This differs substantially from purpose-built online courses designed with appropriate pedagogy, student support, and technological infrastructure. Thus, while the pandemic studies provide valuable causal evidence about the effects of sudden shifts to remote delivery, they may have limited implications for evaluating well-designed online programs developed intentionally for distance education.

Key finding #6: *It is unclear whether high-quality online coursework is less costly to deliver than similarly effective in-person coursework.*

The creation of effective online materials can be expensive, while some courses appear to exhibit tradeoffs between scale and the level of student engagement.

One argument often made in favor of online postsecondary education is its potential to "bend the cost curve" because online courses do not require expensive physical classrooms and can, in theory, expand enrollment to higher levels per instructor than in-person coursework can.[32] Among open access and less selective postsecondary institutions, those with higher shares of online students tend to charge lower tuition than their within-sector counterparts with fewer online students, though such analysis does not account for the quality of the coursework offered.[33] Evidence from one randomized experiment at a large for-profit university, for example, suggests that modestly increasing the class sizes in online classes does not appear to harm student learning, in contrast to at least some studies on class size in in-person classes.[34]

The online computer science degree program at Georgia Tech mentioned above costs substantially less than the in-person version.[35] However, building high-quality coursework for that program required $4 million in start-up funding (from AT&T), as it initially cost on the order of $200,000 per course to create online materials as equivalently effective as the in-person materials. Given that large initial investment, the economics of the program work only by bringing it to large scale and enrolling hundreds of students in each course and thousands of students in total. Given the high initial fixed costs and the low marginal costs of enrolling additional students, achieving high quality at low cost per student may require such scale.

Much online coursework does not appear to follow this model of high quality and low cost brought to scale. The negative impacts on learning outcomes discussed above suggest that many online courses are of lower quality than their in-person equivalents. For example, one report from the University of North Carolina system suggests that high-quality online courses are more expensive to develop than their in-person counterparts and that average class sizes are notably smaller in online courses than in in-person courses, perhaps because of the increased need to engage students in the online format.[36] Outside of Georgia Tech's OMSCS program and some MOOCs, we have little evidence of high-quality online postsecondary coursework that dramatically lowers the costs for students by taking advantage of online technology's potential economics of scale.

More evidence on the potential tradeoffs between cost and quality in online postsecondary coursework is needed. One question is whether online coursework can be less costly to students while maintaining the quality of its in-person equivalent. Another is whether there are some students who may prefer an online option, even if it is of lower quality, given sufficiently high cost savings. Such questions have rarely been the focus of impact evaluations common in education policy research.

Conclusion

The evidence reviewed above suggests that at least some forms of online education have the potential to be effective for at least some groups of students. However, it also suggests that many online postsecondary experiences as currently constituted achieve neither substantial cost savings nor equivalent learning or labor market outcomes relative to those of in-person coursework. Policymakers considering expanding the role of online postsecondary education should carefully consider which students are targeted by such expansions and the potential tradeoffs between scale, cost, and quality. The technology enabling online education has the potential to be deployed effectively, but benefits will not be automatically realized without substantial thoughtfulness and investment.

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