Dædalus

Journal of the American Academy of Arts & Sciences

Fall 2019

Improving Teaching: Strengthening the College Learning Experience

Sandy Baum & Michael McPherson, guest editors

with Harry Brighouse · Mary Sue Coleman
Tobin L. Smith · Emily R. Miller
Carl Edwin Wieman · Beverly Daniel Tatum
Sylvia Hurtado · Daniel I. Greenstein
Sally G. Hoskins · Thomas R. Bailey
Clive R. Belfield · Jennifer M. Morton
Benjamin Castleman · Katharine Meyer · Earl Lewis

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Inside front cover: Participants discuss bioluminescent bacteria at the "Let It Glow! Nurturing the Social Life of Photobacteria from the Sea" makerspace workshop. Berlin, September 5, 2017. Photo by Jan Michalko/re:publica.

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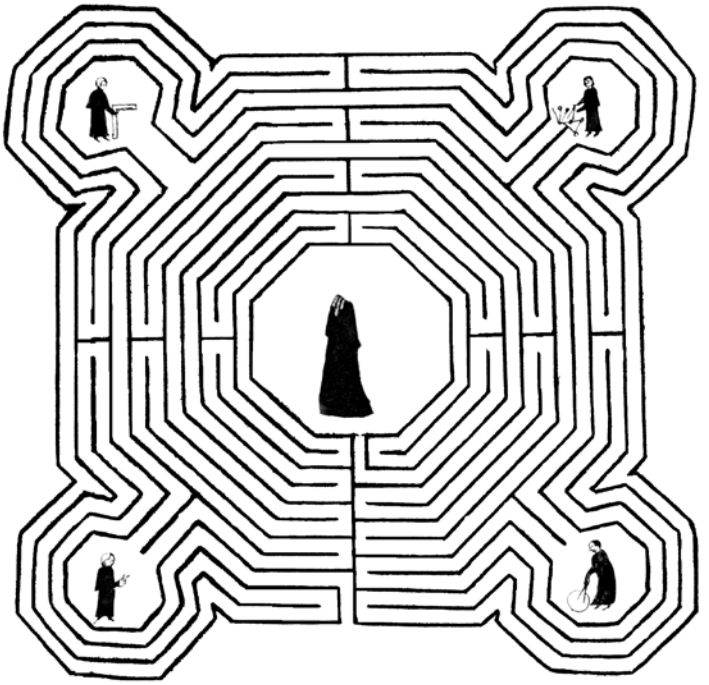

The pavement labyrinth once in the nave of Reims Cathedral (1240), in a drawing, with figures of the architects, by Jacques Cellier (c. 1550–1620)

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Improving Teaching: Strengthening the College Learning Experience

Sandy Baum & Michael McPherson

An odd feature of the public policy discussion of higher education is the near absence of attention to the quality of teaching. In marked contrast, in the discourse around K–12 education, issues of teacher training and recruitment, evidence about the impact of teaching quality on student test scores, and debates about the role of classroom observation in assessing teacher quality are prominent. Economist Raj Chetty made headlines several years ago by estimating that a high-quality kindergarten teacher could wind up adding hundreds of thousands of dollars to a child's lifetime income.[1] In K–12, all agree: teachers and teaching matter.

But in higher education, questions about what and how much students are learning and how their learning is related to the quality of instruction they receive tend to take a back seat.[2] Instead, questions about college admissions, pricing and cost, debt, and financial returns dominate the news and policy discussion. These are worthy topics of study, but they sidestep examination of what goes on inside the "black box" of teaching and learning that college students actually experience.

College teaching and learning are about more than the mastery of academic subject matter, important as that is. Classrooms provide occasions for the development of interpersonal and cross-cultural competences, and skilled teaching involves taking advantage of those learning opportunities as well as more-narrowly academic learning. At the same time, the larger life of the campus, including extracurriculars and, for some students, residential life, can also be a deliberately designed instructional space for students.

The lack of attention to college teaching is consistent with how we prepare faculty for their profession. An observer from another planet visiting

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American Ph.D. programs might well conclude that the graduate students there are being prepared for full-time careers in academic research. Rarely will doctoral students have more than one course on teaching, if any, and their work as teaching assistants is likely to be less an apprenticeship than a part-time job. Yet after graduating, typical faculty members in the United States actually spend the majority of their professional time on undergraduate teaching and related activities, spending less than one-quarter of their time on graduate instruction and research combined. The "theory" that would justify this mismatch between what faculty are prepared for and what they actually do is that the hard part of being a good teacher is knowing the subject matter, and the rest can be picked up "on the job." This is not an assumption we would readily accept in other professions like aviation or surgery, as Harry Brighouse argues in his essay in this volume. There is a good deal of evidence that high-quality preparation matters for grade school and high school teachers, and there is no reason for this to be any less true of college teachers.

The American Academy's Commission on the Future of Undergraduate Education, recognizing how important a strong postsecondary education sector is to the future of our nation and its citizens, reached the conclusion that serious examination of the quality of the college education students are receiving needs to take a central place in deliberations about higher education's future.[3] Attending to quality is at least as important for the future of higher education as ensuring the affordability of college and strengthening the likelihood of students successfully completing the educational programs they start. Paying for college and even getting a credential ultimately will not mean much unless college students have high-quality educational experiences that add real value for them in their careers and in their civic and personal lives.

By "quality" we do not mean the prestige and resources measured by U.S. News & World Report and other college ranking systems, or the attributes sought in the overheated struggle by some, usually privileged, Americans for a place in the "best" university or college: a scramble that in reality affects fewer than 5 percent of the students in U.S. higher education. The U.S. News rankings aim principally to capture, on one hand, how "good" students are when they arrive (notably not when they leave) according to conventional measures and, on the other hand, how resource rich the environment is where they land (essentially, how much money will be spent on them). Rather, our interest is in the quality of students' college experience: how the college classroom and the broader educational environment shape what students know and are able to do, what they value, and how they approach life. No doubt the "quality" of one's peers and the ability of a wealthy institution to provide small classes and modern facilities bear some relationship to what students learn and how they

develop as human beings. But high-quality educational experiences and deep learning can occur in a variety of institutional settings. The best environment depends on the student's characteristics and circumstances.

Existing rankings – as well as most discussions on the strengths and weaknesses of our higher education system – lack any indication of what work is being done inside the university to educate undergraduates or how well that work is being done. What kinds of knowledge and skills are students gaining? How are students developing as human beings and as members of society? How do faculty prepare for their work, get feedback on it, and improve their teaching? How does the larger educational environment within which students are embedded meet their needs? These outcomes may be difficult to quantify and rank, but in this volume, leading researchers and practitioners give attention to these questions.

In their magnificent history of the coevolution of technology, wages, and education, economists Claudia Goldin and Lawrence Katz show that quality has long taken a back seat to quantity in American higher education.[4] In the nineteenth century, while European countries introduced national examinations and other centralized requirements to control access to secondary education, the United States developed a highly decentralized, open, and forgiving system of elementary and, in the twentieth century, secondary education. From the beginning, America's founders saw that the success of their democratic republic depended on citizens prepared not only to vote, but also to run for and staff public offices; as a result, throughout the nineteenth century, America far outpaced Europe in the percent of citizens getting a basic education. In the early twentieth century, the United States led the high school movement that would equip people to work with the high technology of the day: electricity, chemicals, locomotion, and medicine. High schools were locally founded and supported, and states imposed few regulations or requirements on performance. This "open and forgiving" American system supported rapid expansion in numbers of educated Americans prepared for the ballot box and the factory but, as Goldin and Katz acknowledge, did "little to increase the quality of education."[5]

The momentum of this quantitative expansion led to widespread high school completion after World War II and the beginnings of mass higher education in the 1950s and 1960s. But growth in education levels of the U.S. population slowed sharply at the end of the 1970s: while Americans were beginning college in large numbers, disappointingly few were completing college credentials. Even today, about one-third of the students who begin a bachelor's degree program fail to complete it, and only about 40 percent of students

who enter a community college (where the majority of all higher education students start) have any kind of degree or certificate six years later.

As high school graduation became more common and more working adults and students from low-income families sought college degrees, the cost of college became a major obstacle to student success. Beginning in the 1960s, the federal government began to address this problem through federal student aid grants and loans, but managing the costs of providing postsecondary education to a large fraction of the population continues to be a national challenge.

A second obstacle to student success, in Goldin and Katz's view and in ours, has been educational quality. As more students aspired to postsecondary education, it became apparent that too many high school graduates were arriving at college ill-prepared by their earlier education, with as many as half being assigned to some form of remedial instruction. Colleges and universities have proved to be highly varied in their capacity to meet effectively the needs of underprepared students. Real educational success for the much larger numbers and greater diversity of students now pursuing higher education requires careful attention to educational quality and the student experience.

There are compelling reasons for our nation to face up to the challenge of improved educational quality, at the precollege and college level. In simple economic terms, the earnings advantage gained by college graduates over those with less education remains high compared with past eras. Increasing the number of low-income and minority students with a college education will both expand the economy and reduce economic inequality. Beyond the economic gains for individuals, economists have found that communities with higher education levels benefit from the greater ability of people with more education to work together and communicate well.[6] A study sponsored by the Commission on the Future of Undergraduate Education showed that well-designed investments in students' college success more than paid for themselves over a thirty-year time horizon.[7] Numerous studies have demonstrated the societal value of increasing the share of adults who earn meaningful college credentials.[8]

A college education is about far more than getting a job; but even focusing on employment outcomes, building a career in the Internet age is less about landing and holding a job than it is about acquiring the flexibility, problem-solving ability, and capacity for nonroutine work demanded by a rapidly evolving economy. In this volume, Earl Lewis's essay "Toward a 2.0 Compact for the Liberal Arts" and Thomas Bailey and Clive Belfield's contribution "The False Dichotomy between Academic Learning & Occupational Skills" address the familiar but false dichotomy of academic or liberal arts learning and vocational training. The clear message is that efforts to narrow education to specific occupational preparation are counterproductive.

The country's founders showed admirable forethought in recognizing that U.S. citizens needed education both to be able to vote intelligently and to serve as office-holders such as legislators, cabinet officials, and judges. Early in the nation's history, the ability to read and write might have sufficed, but in today's technologically advanced, environmentally challenged, culturally diverse, and globally connected society, the educational requirements to be a discerning voter and effective participant in public discourse, let alone to serve as a responsible government official, are substantially greater than in the past. Preparing for active citizenship needs to be an element in all high-quality education, as Sylvia Hurtado discusses in her essay "'Now Is the Time': Civic Learning for a Strong Democracy."

Sustaining focus on improving the quality of undergraduate education is a challenging goal, but there are some encouraging signs. As K–12 education research has shown, improvements in technology make it easier and cheaper to observe classroom practice and to measure and assess student outcomes (including but not limited to test scores). An increasing number of well-documented examples of schools and school systems that have adopted observation practices have shown that such practices yield consistent success in improving teaching.[9] A growing number of college case studies and research projects have begun to demonstrate the possibilities for higher education as well.[10]

Several essays in this volume focus specifically on the question of how to improve academic classroom teaching. In addition to Brighouse's "Becoming a Better College Teacher (If You're Lucky)," Carl Wieman discusses the necessity of establishing expertise in university teaching, and introduces readers to the growing field of discipline-based education research in "Expertise in University Teaching & the Implications for Teaching Effectiveness, Evaluation & Training." Sally Hoskins writes about a distinctive approach to teaching biology in "CREATE a Revolution in Undergraduates' Understanding of Science: Teach through Close Analysis of Scientific Literature," and Mary Sue Coleman, Tobin Smith, and Emily Miller discuss the Association of American Universities' efforts to help science departments improve their faculty's teaching. It is not entirely an accident that these essays are focused in the natural sciences. Systematic efforts at undergraduate teaching improvement seem to have moved further in the sciences than in other parts of the curriculum, perhaps in part because scientists may find it more congenial to rely on the kinds of quantitative evidence that can help guide improvement, but probably also because the National Science Foundation has been willing to spend money on funding improvement efforts in the sciences and studying their results.[11] Who will fund comparable research in the humanities and social sciences?

As we noted earlier, the classroom and the campus environment matter to student development in ways that go beyond mastery of specific academic subjects. In her essay "Mitigating Ethical Costs in the Classroom," Jennifer Morton talks about the tensions that often exist, especially for first-generation students, between the expectations of the academic communities they are joining and those that prevail in their families and neighborhoods. To the degree that these tensions concern differing cultural values, they have a moral as well as emotional valence. She highlights the personal costs of social advancement overwhelmingly borne by less privileged students. Morton argues that, especially at a commuter college, the classroom is likely to be a critical venue for addressing these cultural tensions and ethical costs in a supportive way. We also consider the value of the classroom experience, but through analysis of online technology and education delivery. In "The Human Factor: The Promise & Limits of Online Education," we report evidence that less-prepared students do particularly badly in purely online settings, suggesting that the absence of personal instructor contact and a supportive community is especially costly to these students' learning. Attempts to overcome this problem of isolation through online strategies have so far not succeeded on a large scale.

College often places heavy psychological demands on students. Young students may confront new adult demands and responsibilities in a setting of new social norms and a community of people with more diverse backgrounds than they have previously come into contact with. For older adults, who constitute about 40 percent of all students, managing academic responsibilities in the midst of a full life often involving children and employment is taxing. In their contribution to the issue, "Financial Constraints & Collegiate Student Learning: A Behavioral Economics Perspective," Benjamin Castleman and Katharine Meyer review insights from psychology and behavioral economics showing how faculty and staff and thoughtful university policies can address some of these challenges. Vital psychological, cultural, and moral challenges arise from the fact that colleges and universities are among the few places where people from different races and ethnic and cultural groups commonly work and live together. It is a mistake, though, as Beverly Tatum points out in her essay "Together *and* Alone? The Challenge of Talking about Racism on Campus," to assume that this proximity will automatically contribute to a constructive learning environment. Tatum describes a program of intercultural communication and dialogue that has demonstrated effectiveness in moving participants out of their comfort zones toward relationships of genuine sharing and mutual learning.

Dan Greenstein – in his essay "The Future of Undergraduate Education: Will Differences across Sectors Exacerbate Inequality?" – draws on his per-

spective as longtime head of the Gates Foundation's work on higher education to describe the substantial pressures and challenges that the higher education industry has been subject to in recent decades, and will continue to face. Yet through all these changes, colleges and universities remain among the most conservative of institutions, in ways good and bad.

The essential work of an undergraduate college is to open students' minds to important ideas, to help them acquire knowledge and skills in areas of lasting value, and to develop capacities that will help them succeed in their careers but also improve their society. However much the settings for and technologies of delivery of instruction change, this basic work does and should remain the same. We applaud the conservatism that resists reducing college to vocational training or the acquisition of specific skills.

But universities and colleges remain highly conservative in another, less creditable way. Educators tend to teach in the way they were taught. There is some irony in the fact that most college teachers were formerly the students most adept at benefiting from (or at least surviving) the educational practices their teachers inflicted on them; it is easy to see how those practices reproduce across generations in an environment where there is little training for or monitoring of teaching, even if the practices have limited effectiveness for most students. This is just one of the factors that makes it hard to motivate institutional change, despite the evidence that improving educational practices actually makes faculty enjoy their work more. A more unsettling form of conservatism in higher education is a tendency to reproduce unthinkingly cultural biases and prejudices inherited from the past, such as allowing men to barge in while women wait to be called on, or discouraging a student of color from majoring in math. There is room for a good deal of improvement in how higher education faculty and institutions do their work, even as the work they need to do remains in many ways the same.

Taken together, the essays in this volume make a persuasive case for the importance of broadening the scope of discussions on the future of higher education. Ensuring widespread access to affordable college education is vital. But as the inconsistent outcomes of today's students suggest, getting people into college is not enough. Nor is just getting them through their programs. We have to understand more about how students learn, about how to develop and support effective teaching at the college level, and about how to ensure that we are truly educating students, not just providing them with credentials.

ABOUT THE AUTHORS

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ENDNOTES

[1] David Leonhardt, "The Case for $320,000 Kindergarten Teachers," *The New York Times*, July 27, 2010, https://www.nytimes.com/2010/07/28/business/economy/28leonhardt.html.

[2] An important exception is Richard Arum and Josipa Roksa, *Academically Adrift: Limited Learning on College Campuses* (Chicago: University of Chicago Press, 2010), which examines student performance across colleges on a well-known test of critical thinking, with discouraging results.

[3] Commission on the Future of Undergraduate Education, *The Future of Undergraduate Education, The Future of America* (Cambridge, Mass.: American Academy of Arts and Sciences, 2017).

[4] Claudia Goldin and Lawrence F. Katz, *The Race Between Education and Technology* (Cambridge, Mass.: Belknap Press, 2010).

[5] Ibid., 345.

[6] Enrico Moretti, *The New Geography of Jobs* (Boston: Mariner Books, 2013); and Paul Romer, "Endogenous Technological Change," *Journal of Political Economy* 98 (5) (1990).

[7] Sophia Koropeckyj, Chris Lafakis, and Adam Ozimek, *The Economic Impact of Increasing College Completion* (Cambridge, Mass.: American Academy of Arts and Sciences, 2017).

[8] See Jennifer Ma, Matea Pender, and Meredith Welch, *Education Pays 2016: The Benefits of Higher Education for Individuals and Society* (New York: The College Board, 2016) and the references therein.

[9] Greg J. Duncan and Richard J. Murnane, "Rising Inequality in Family Incomes and Children's Educational Outcomes," *RSF: The Russell Sage Foundation Journal of the Social Sciences* 2 (2) (2016); Elizabeth McGhee Hassrick, Stephen W. Raudenbush, and Lisa Rosen, *The Ambitious Elementary School* (Chicago: University of Chicago Press, 2017);

and Robert E. Slavin, Nancy A. Madden, Bette Chambers, and Barbara Haxby, *Two Million Children, Success for All* (Thousand Oaks, Calif.: Corwin Press, 2008).

[10] Commission on the Future of Undergraduate Education, *The Future of Undergraduate Education, The Future of America*, chap. 1, endnote 23; and Aaron M. Pallas, Anna Neumann, and Corbin M. Campbell, *Policies and Practices to Support Undergraduate Teaching Improvement* (Cambridge, Mass.: American Academy of Arts and Sciences, 2017).

[11] There are certainly improvement efforts in other fields, some at individual institutions and some that are broader. One notable effort is the History Tuning Project sponsored by the American Historical Association; see https://www.historians.org/teaching-and-learning/tuning-the-history-discipline.

Becoming a Better College Teacher (If You're Lucky)

Harry Brighouse

This contribution is a narrative of how a professor attempted to improve as a teacher over time. The narrator noticed the need for improvement through teaching a new class badly, and learning that he had no reason to trust that he, or many others, were teaching other classes better. The contribution describes in some detail the steps he took, and continues to take, including observing colleagues, hiring a coach, reviewing videos of his classes, and participating in department workshops. There is no empirical evidence that he has improved, but the narrator provides some reasons for optimism.

Imagine that you call a plumber.

The plumber, a new hire, has never done any plumbing. She has never read any books about plumbing or attended any classes about how to fix pipes or faucets or toilets or garbage disposal units. The house she grew up in had running water, so it's not as if she knows *nothing* about plumbing. And, incidentally, she has been in the same room with some professional plumbers when they were working. Unfortunately, she never saw the *results* of their work; she always left before the water was turned back on, was not privy to reports about whether the pipes and faucets subsequently leaked, and didn't ask the clients how satisfied they were with the outcomes. On further questioning, though, she reveals to you that she is actually a highly skilled baker.

On calling the firm you discover that they *routinely* hire new plumbers with no experience or training, and don't seek evidence about their potential to become good plumbers. You learn that all the frontline employees are experts at something else: they are trained as electricians, ice-sculptors, coopers, roofers, literary critics, physicists, and more. But not as plumbers.

The firm does not assess employee performance based on results. Clients fill in a short "customer satisfaction" form before the water is turned back on. But, unless a plumber regularly receives truly awful ratings, they just file the forms away. Pay raises are related to neither the results of the plumbing nor the customer satisfaction ratings. After six years of employment, the firm fires

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some of the underperformers and gives unparalleled job security to the others. Curiously, the main criteria for promotion, pay raises, and even job security concern excellence in whatever they are actually trained in. Not plumbing.

You then discover that, far from being an outlier, this firm has exactly the same hiring and promotion practices as all the other plumbing firms. You ask your neighbors about their plumbers. Some have only had terrible experiences, though many blame themselves. Several report one plumber for whom they have the greatest praise because the drinking water was mainly clean and nothing leaked again for days. And, rather surprisingly given the circumstances, a few can identify a single plumber whose work was impeccable and whom they expect to remember for the rest of their lives.

Now imagine that you are the plumber. If you are a professor in a research university, it shouldn't be too much of a stretch. I certainly identify with her predicament. Of course, the analogy is highly imperfect. Baking is *entirely* unrelated to plumbing, whereas knowing how to *do* philosophy is a prerequisite for being able to *teach* philosophy, and at least I was trained in *that*. I had been the target of numerous attempts, many of them successful, to get *me* to learn. So professors at least have something to build on. But being able to do philosophy is only a prerequisite for being able to teach it, and being a student does not automatically give one insight into teaching.

Most professors in research universities teach. Even the small proportion whose research funding generates consistent "buy-outs" are hired on a tenure line, which, at least after they get tenure, provides security; they keep their jobs and salaries even if they don't win grants. Most professors have received little to no training as teachers, were hired for their potential not as teachers but as researchers, and receive promotions and pay raises mainly for their performance in research rather than in teaching. Once someone has tenure, their teaching must generate numerous complaints in order for it to have negative professional consequences of any significance. Few professors engage systematically in ongoing professional learning as instructors: they don't read books about teaching and learning, they don't seek out more successful teachers and observe them, and they don't engage colleagues or professional observers to help them improve their own instruction. Ask ten professors in research institutions – those who are expected to split their efforts equally between teaching and research – how many of the last ten conferences and workshops they attended and how many of the last ten publications they read were primarily concerned with teaching rather than research. I predict that of those two hundred conferences, workshops, and publications, fewer than one hundred will be about teaching. I'd be surprised if the number were as high as ten.

To state the obvious, the plumber's incentives are all wrong: she is rewarded for her performance in something other than plumbing, despite the fact that plumbing is her job. Professors in research universities are paid to research and teach, but they, naturally, take the research more seriously because they have trained in it and know they will be rewarded for it. Administrators should change the incentives, thus creating self-interested reasons for professors to take teaching more seriously.[1]

But assume they don't. Most professors already have *non*-self-interested reasons to take teaching more seriously: both their students and the public suffer from the effects of suboptimal teaching. And many professors like to think of themselves as capable of making choices that align somewhat with the general good, rather than entirely with their own self-interest. How can they improve?

The first stage in recovery is to admit there is a problem. The structure of the profession makes the problem rather obvious, when you think about it, but for many years, I didn't. If you have fairly good command of the material you are teaching, are okay at explaining things, have some patience, and have a friendly affect, you can go a long time without realizing you are not teaching well. Add in the English accent at a Midwestern university, and you might never notice at all. I was shaken from my complacency only by the confluence of two events.

First, a friend sent me chapter six of former Harvard President Derek Bok's *Our Underachieving Colleges* to read for a research project we were planning. Here's the passage that made me blanch with embarrassment and immediately purchase the book to read in its entirety:

> Teaching by discussion can also seem forbidding because it makes instructors uncomfortably aware of their shortcomings. Lecturers can delude themselves that their courses are going well, but discussion leaders know when their teaching is failing to rouse the students' interest by the indifferent quality of responses and the general torpor of the class. Trying to conduct a discussion with apathetic students is much like giving a bad dinner party.[2]

I was accustomed to talking a lot in my large lecture classes (with eighty-plus students), knowing that the students (mainly juniors and seniors) could punctuate my lecture by answering my questions, and to presenting material in my smaller classes for philosophy majors, knowing that those students would regularly interrupt with queries. I was used to good student evaluations of my teaching because, well, I am moderately well-organized, I key my talk to the material they should have read, I'm reasonably friendly, and they like my

accent. But the passage hit home because I recognized my own talk as a way of evading responsibility of ensuring they were fully engaged, and it crystallized that the more I talk, the less I know what is going on in the students' heads. I wondered whether my high student evaluations might reflect the soft bigotry of low expectations.[3]

Still: nothing might have changed had I not, that fall, been teaching, for the first time, a First-Year Interest Group (FIG) seminar. The FIG program induces groups of twenty first-year students to take three thematically linked courses, one of which is a seminar just for them, together in the same semester. I taught the central, twenty-person seminar on "Children, Marriage, and the Family," which attracted students with ambitions to become early childhood educators, nurses, social workers, and clinical psychologists, not philosophers.

The first few weeks of class were . . . awful. The readings were too difficult, I had assigned too much, and while I talked from my carefully prepared notes, the students stared in silence, trying to take notes, and wondering what on Earth was going on. They were aliens who, as far as I could tell, might be thinking just about anything. How could I figure out what was going on in their heads? And, until I did, how could I calibrate my talk to their learning needs?

At last I understood there was a problem.

Even without Bok's book, I would have known something was wrong with the class. It was *that* bad. But I might well have persisted; I'd have had nothing else to do. Knowing something's going badly is good. But it does not, in itself, spur improvement. I was *motivated*. But improvement requires access to knowledge about how to do better. And when it comes to college instruction, gaining knowledge is not straightforward.

How do people learn complex skills? Think about playing the guitar. The aspirant guitarist observes (and listens to) expert guitarists. She seeks out instruction. She tries to mimic some of what the experts do. She gets feedback – some from her own ears and some from other people – then tries again. Then she observes and listens again, mimics again, and gets more feedback. This is roughly what professors do when they are learning to become, and trying to improve as, researchers. As graduate students, they take seminars in which they are inducted into the practices of research, and various skills are modeled by their teachers and advisors. They read vast amounts of research by other, already accomplished researchers and try to emulate their efforts. They present at conferences and get feedback on their work from their colleagues and teachers. As professors, they continue observing other researchers in their field, interact with and learn from them, and continually seek feedback from peers so that they can maintain and improve their skills.

Professional learning needs an infrastructure. Aspiring guitarists have that: guitar teachers, teach-yourself books, videos on YouTube of excellent guitarists, and so on. Researchers, too: graduate school, feedback on grant and paper submissions, specialized workshops and conferences, and department colloquia. But college teachers don't. Unlike guitarists and researchers, college teachers aspiring for excellence can't even readily identify who the existing experts are. Most disciplines lack both rigorous measures of student learning and a systematic practice of trying to evaluate instructor quality. I don't know which of my colleagues are more successful than I am at producing learning among their students over the course of a semester, let alone who is successful at getting students to think better about trolley problems, or to understand the purpose of thought experiments in ethical theorizing. The sparse professional learning resources around instruction are mostly generic: it is not obvious how to apply lessons about pedagogy drawn from physics or mathematics to my own field. I'm a fairly typical professor in that I was enculturated into a specific discipline (philosophy) and mostly teach within my broad field of specialization (ethics, applied ethics, political philosophy). I want to learn how to teach *that* better, to *my students*.

What next? It started with a book. So I read more books about college (and secondary school) teaching and learning in the hopes of finding useful information. I wasn't seeking some master plan that would transform my teaching; I guessed it would be useful to find out what is known about good and not-so-good teaching, generally. No literature provides any precision on how to teach students effectively how thought experiments work, let alone how to teach it to *my* students. But plenty provide useful information about student learning, about the habits of successful college teachers, and, generally, about successful techniques. Shortly after I experienced my discomforting epiphany, my wife became involved in high school improvement, through which I learned that many of the resources produced for high school teachers can also be valuable for college teachers.[4]

It has been well worth devoting a good deal of time to reading about teaching and learning, and I continue to do so avidly. But imagine learning to play the guitar, or tennis, or to bake cakes, or to fix pipes by just reading a book. The next move was to get feedback on my efforts to improve.

The 2007 first-year seminar that forced me to face up to my inadequacies was not a complete disaster. After three weeks or so, I began modifying my instruction considerably and spent a lot of time talking to the students individually and in groups about the class, trying to gauge how

it was going for them, what was working, and what wasn't. I devised in-class exercises to make some sort of discussion happen, and to hold them more accountable for the (too-difficult and too-voluminous) reading. The breakthrough, though, came three years later, when I taught the class for a second time. By then, I knew several of the 2007 students well, and in the summer of 2010, one of them, Emma, asked if there was anything she could do to help with the 2010 version of the class. I knew exactly what I wanted from her.

Roger Federer is, reputedly, the greatest male tennis player of all time. But he still has a coach.[5] He's not an outlier: top athletes and musicians normally employ coaches to help improve their performance. However good, they need someone to observe them, identifying strengths and helping them address weaknesses. Researchers have coaches, too: A good Ph.D. advisor coaches graduate students. Junior professors typically turn to senior colleagues, who read their work, give feedback, suggest tweaks, help them uncover new opportunities, and advise about publication outlets. Experienced researchers have informal coaching networks of colleagues who routinely read their work, helping them formulate problems and suggesting different techniques. I asked Emma to be my instructional coach.

The director of the FIG program coincidentally knew Emma and offered us a $500 budget. Emma's job was to observe me once a week, take notes for a report on what was happening in the classroom, and then debrief for twenty to thirty minutes after class. It was the best use of $500 I've ever made.

The main benefit was the day-to-day criticism. Here are some examples:

- Week 2: "The material you're covering is very challenging for freshmen. It is good you are challenging them, and this is not *too* hard, but it would help them a lot if you would sum up where the lecture and discussion have got to every fifteen minutes."

- Week 3: "Well . . . you didn't do what we said last week." This was, obviously, the point at which I knew it was going to work well, because she proved she would tell me when I was screwing up.

- Week 3: "You've had six sessions with them and you still don't know all their names. You should know all their names by now." I knew eighteen of twenty-two names but kept confusing two in particular, between whom, by the end of the semester, I could not see the slightest resemblance. By the next session, I knew all of their names.

- Week 4: "It is ok to cold call – in fact I wish more teachers would cold call. But you need to *tell them in advance* that you are going to cold call – Marissa was really put on the spot today. And when you do cold call, you have to make it

clear that if they don't have anything to say that is fine." One of the advantages of her being there only one session a week was that I could refer to her advice during the subsequent session without her being there: so I asked whether they agreed, which they all did. I apologized to Marissa and told them that I would feel free to cold call henceforth.

- The course devotes a couple of weeks to the tensions between multiculturalism and feminism. Two of the readings discuss specific practices within the Hmong community as illustrations – and judge them quite negatively. The subsequent year's class, when I employed Emma again, had five Hmong students, and she anticipated my anxiety about teaching those papers. *My* inclination was just to drop those readings. *Hers* was to assign three of the Hmong students to present (everyone had to do a group presentation in class). I followed her advice. The Hmong students had not been vocal participants, but when presenting on these readings, they were the experts in the room. The other students knew even less than I did about Hmong culture and practices; the Hmong students knew a lot. Incidentally all five Hmong students said the readings represented their culture accurately, and that the judgments about the practices in question were fair.

- The 2011 class was 25 percent Hmong, more than 50 percent non-White, and more than 50 percent low income/first generation. The students would sit in a crescent formation that was, after a week, more or less a rainbow, with all but one of the Black students on one end, then Hmong, then Latina, then White (and at the far end one Black man). Most class sessions involved small-group discussions of four or five students. I would assign students randomly to groups so that they would not always be discussing with their friends. But the consequence in this class was that the loquacious White students were taking up nearly all of the discussion time within each racially mixed small group, and then *all* of it in the full class discussion (because they always volunteered as group reporters). Emma was able to think through the problem with me and convinced me that the solution was to create racially homogenous small groups. Indeed, this led to much more talk – and much more connection to the class – from the non-White students. (You might ask why I didn't group the students according to how well they would work with and learn from one another. That's a good question and I have a good answer: I didn't think of it. Nor was I yet skilled enough to have learned which students would work well together.)

Emma provided two things that made a big difference. One was a student-centered perspective: she was only thinking about *their* learning and how *they*

were reacting, so when I was talking with one student, she could be observing the others and *their* responses to what was happening. Lacking the content expertise, she could make judgments about how well they were learning. The other was just a sounding board. I could pilot a new practice – cold-calling, new discussion prompts, even new readings – confident that someone was observing and would actually tell me how well it succeeded or how badly it failed, helping me think about whether to abandon it or modify it, and if so, how.

Before you try this at home, here's some background. Emma majored in nursing, not philosophy: like the students in the class, she was not an expert, she had no interest in dazzling me with her own brilliance, and we both knew that if we fell out it wouldn't affect her professional or academic prospects at all. She was one of the first students I spoke with when the 2007 class was not going well, and in the intervening period, we had discussed her experiences as a learner, both good and bad, in other classes.

But Emma was only an undergraduate student and not herself a great teacher. Surely Roger Federer wouldn't hire a twenty-year-old with limited experience to coach him?

I am not, regrettably, the Roger Federer of college teaching. He is (I'm told) the greatest (male) tennis player ever, whereas I was, at best, mediocre. Of course, if I had the option of getting a professional instructional coach to observe me regularly, I'd jump at it. But I didn't. Emma was not an expert teacher, and had no experience coaching, but – like many of our students – she was well-positioned to deliberate usefully with me about instruction. As a senior, she had taken twenty-four college classes, with different instructors of record, many of them with teaching assistants as well. In those same three years, I had observed just four teachers, in each case for just a single session, rather than several times a week for fifteen weeks; she had seen, and thought about, more teaching in the previous three years than I had in the previous twenty-five. Since then, several other students have coached me and, starting in fall 2015, a coach observed every single class I taught for a year. Their feedback has been invaluable; indeed, so has the built-in requirement to stop and reflect on what has happened.

Ideally, deans would invest in creating a cadre of skilled instructional coaches. Alternatively, training a cadre of students to provide the service throughout the college would help improve instruction, and would be an investment in those students' futures. If you are a dean, consider those two options. If you are an instructor, though, don't wait for the dean to act. Find one or two thoughtful students with whom you have a good relationship and pay them (out of your own pocket, if you are in a position to do so) to do for you what Emma, and others, have done for me.

I regularly get students to observe me now. Someone observed every single class session I taught during the 2015–2016 academic year. Sometimes colleagues say, "It's very courageous of you to ask for feedback." It isn't. I want to improve. They're undergraduates. I have tenure.

I was also influenced by pedagogy scholar Tony Wagner's *The Global Achievement Gap*.[6] In one chapter, he describes a workshop for K–12 teachers. Wagner (or one of his colleagues) led small-group discussions of video-recordings of classes. The aim was for previously unacquainted teachers to develop a common language for discussing instruction, and to come to some sort of interpersonal agreement on standards of practice. Like most teachers (and nearly all professors), his participants had spent very little time observing other teachers and were not practiced in rigorous, detail-oriented discussion of what works and what doesn't. Initially, the reactions to what they were observing were very diverse; there was no agreement about whether what is being done is good or bad teaching. But over the course of the workshop, the participants would develop a common understanding, and a language for expressing it.

Not content with only funding Emma, the director of the FIG program facilitated biweekly discussions of teaching and learning among instructors from the program. Typically, five to ten instructors would discuss a problem of practice such as grading, prompting discussion, or whether to disclose one's opinions about the controversial issues one is teaching. These discussions went well but, inspired by Wagner's book, I wanted to get concrete and discuss actual instruction. If you propose something like this, you must be the first volunteer. A professional videographer recorded part of a lesson. More than twenty colleagues attended the discussion (I also invited two students from the class whom I thought could give context, though mainly I wanted them to experience a faculty discussion about teaching and learning). By this stage, I had gained some confidence: all of the students were engaged in the class, I was able to induce all of them to talk, their presentations and written work were of high quality, and I believed that there was a good deal of discussion in the classroom.

I was wrong. Sure, during a twenty-minute segment, nearly every student spoke (even the one student who, when I asked their permission to be recorded, had said "That's fine, but *I* won't talk"). But, as one colleague cheerfully pointed out, it wasn't a *discussion*. I'd ask a question, someone would answer it (either voluntarily or because they were cold-called), and I'd dialogue with that student. Most of the rest were listening. But the focus was on *me*, not on the ideas, and not on each other. It was like a series of ping pong games, in which each of them was playing with me, but none were playing with each other. And it was easy to see that I was the person preventing discussion from happening. My nonverbal cues encouraged them to focus on me, rather than each

other, and I was too eager to validate what each of them was saying by responding, rather than opening up the discussion to comments from other students.[7]

Again, recognizing a problem is only the first step. I didn't know how to make good, full-classroom discussions happen. If I'd known how to do that, I would have been doing it already!

I was being trapped by the impulse Bok identifies that leads many colleagues to reject class discussion altogether. Professors value rigor and know that the best guarantee of optimal rigor is to use all the airspace themselves. *Our* talk is rigorous, while our *students*' talk is sloppy. But elsewhere in this issue of *Dædalus*, Carl Wieman, echoing former Harvard President Charles W. Eliot, observes:

> The most basic principle that every teacher should know about teaching this sort of thinking is that the brain learns the thinking that it practices, but little else. To have students learn to recognize relevant features and make relevant decisions more like an expert in the field, they must practice doing exactly this. The longer and more intense the practice, the greater the learning.[8]

In STEM, problem sets and labs go some way to facilitating the necessary practice. But in the interpretative social sciences and the humanities, students practice only by writing and by discussing. Reading or listening to someone talk about philosophy, sociology, literary criticism, or psychology is not *practicing*, it is just *observing* an expert practicing. Nor is taking (often inexpertly designed) multiple choice tests. Watching Roger Federer play tennis, and answering multiple choice tests about what he does, would not suffice for becoming even a modestly competent tennis player. You have to practice. And then practice more.

We can make students write outside of class and we can make them (pretend to) read. But professors should know that most students will not discuss the material outside of the classroom because they are not in the habit of doing so, and even if they wanted to, they can't because they don't know their classmates. They might come to know their classmates, of course, but only if professors make that happen *inside* the classroom. Classroom discussion is essential for students to master the content and skills we care about; and for that to happen, the professor must be willing to sacrifice some rigor. My impulse to give rigor undue priority over engagement was preventing discussion from happening.

Fortunately, I was able to observe other teachers who *did* know how to run an actual discussion. The first time was rather fortuitous. I invited then–graduate student Paula McAvoy, who had previously been a high school social studies teacher, to teach my class an issue she had written a paper about. They

were assigned the paper, and Paula trusted them to read it. After making them introduce themselves by naming something they loved, she spent ten minutes reviewing the main argument, and then set the students to a complex small-group discussion assignment that required them to engage with and debate the ideas and arguments in the text. Students reported back to the full group, after which Paula led a discussion engaging all twenty students. From observing her, and other teachers, more often, I've learned a great deal about how to make real discussion happen.

I now give very explicit instructions to students, making clear the expectation that they address *their classmates*, *not me*, even though I will usually be the one setting the agenda and facilitating. Until this is the norm, I frequently stand behind the student who is speaking so they're forced to look at other people as they talk. Discussions usually focus on some problem or prompt that I have devised, which relates to a problem that arises in the reading, or is directly about the reading itself, and which is either on a handout or (if it is short) on a slide. The questions are usually very specific but sufficiently open-ended that reasonable people can disagree (and about which I anticipate disagreement in the class). I use "think, pair, share" and, in smaller classes, cold-calling liberally, to ensure that all students participate. (Emma was right about cold-calling; my students seem fine with it after they have come to trust that it really is okay to say they don't want to speak just now. One student told me at her graduation that after the first class session of freshman year, she called her mother and said "I *hate* Brighouse and I'm going to drop the class because he says he's going to cold-call." But by graduation, she no longer went bright red when talking in class. Another student recently told me that cold-calling was "life-changing" because, having made exactly the same phone call in her own first week, she now contributes confidently to all her classes. Voluntarily.)

I have to curb my tendency to jump in with either interrupting reassurance or some interesting, pedagogically valuable comment. So I've engineered some sort of gestalt switch in my head. When a student speaks, instead of thinking that I am depriving her (of assurance or of some valuable thought) by *not* responding, I think to myself that I am depriving her precisely *by* responding: preventing interaction with her peers, the reasons they can give to her, and the opportunity to surprise and be surprised by them. If the conversation ebbs, or if some particular strand is, in my opinion, played out, I step in to prompt the discussion with further questions, and often with low-pressure cold-calling. My rule of thumb is that, on average, at least four students should speak before I contribute again.

Running a discussion this way – that is, running a *discussion* – is more mentally taxing than engaging in twenty-one separate consecutive conversations.

The instructor is simultaneously trying to read twenty-one minds, keep everything on track, interpret what the students are saying, remember what needs to be highlighted at the end, and be sensitive to the needs of each student (some of whom need drawing out, others reining in). It's especially difficult with first-year students who are, at my institution and others like it, disposed to be deferential and, just because they know less and are inexperienced, have less to say than their older peers.

Since 2016, my department has held monthly "brown bag" meetings on teaching and learning. In the wake of an uptick in reported racist incidents on and around campus, our chancellor called for departments to discuss initiatives around diversity and inclusion. Our response – instituting the meetings about instruction – is not as orthogonal to the call as it may seem. Instructional quality is the most neglected – and perhaps the most serious – equity issue in higher education. Good instruction benefits everyone, but it benefits students who attended lower-quality high schools, whose parents cannot pay for compensatory tutors, who lack the time to use tutors because they have to work, and who are less comfortable seeking help more than it benefits other students. Philosopher Jennifer Morton, also a contributor to this *Dædalus* volume, emphasizes the importance to her first-generation and low-income students at City College of embodied and engaged interaction with the professors and with each other in a well-managed classroom:

> I often require that my students defend a position in front of the classroom. For many, this is the first time they have spoken in front of a crowd of students from differing socioeconomic and ethnic backgrounds. The experience is terrifying, but as one Latina student told me, even though her face still "lights up red" when she speaks, she is now able to raise her hand and contribute to class discussions. By the time that student graduates and walks into her first job interview, she will have learned to manage her fear of speaking her mind. For students from low-income families who manage to overcome the tough odds, college is the first place where they will be asked to defend a position and to engage in vigorous intellectual debate. It is also likely to be the first place where they have to consistently engage with middle-class students and professors and navigate middle-class social norms.[9]

More generally, lower-income, first-generation, and minoritized students are more vulnerable to harm from low-quality instruction because they have fewer academic resources to fall back on.

The idea behind the faculty discussion group and the brown bag is encapsulated by this comment by former University of California, Berkeley, Education Dean Judith Warren Little on K–12 school improvement:

> School improvement is most surely and thoroughly achieved when: Teachers engage in frequent, continuous and increasingly concrete and precise talk about teaching practice (as distinct from teacher characteristics and failings, the social lives of teachers, the foibles and failures of students and their families, and the unfortunate demands of society on the school). By such talk, teachers build up a shared language adequate to the complexity of teaching, capable of distinguishing one practice and its virtue from another.[10]

My department is small: there are about twenty faculty and some thirty active graduate instructors. Most of my colleagues, like most professors, see their department as the home of their professional life on campus; professors are generally skeptical that disciplinary outsiders can provide useful insights about how to teach our content well. And few professions are more status-conscious than academia: if you want systematically to change faculty behavior, you need to operate in the discipline, and colleagues with high status must be involved.[11] In the typical meeting, one or two people (often one faculty member and one graduate instructor) present some ideas about a specific problem of practice (for example, how to make discussions more inclusive, how to incorporate discussion into large lectures, how to reach absentee students, or what sorts of comments are useful when grading papers) and moderate a whole-group discussion. Attendance is voluntary, but the meetings average about fifteen participants, including graduate instructors, junior professors, and tenured professors as well as highly respected researchers. Until the brown bags, my department had, like most departments in research institutions, no formal forum for discussing instruction. Coordinating the meetings is now recognized as committee service. What we have instituted is imperfect, but attendance has not declined over time.

Judith Little continues:

> Teachers and administrators frequently observe each other teaching, and provide one another with useful (if potentially frightening) evaluations of their teaching. Only such observations and feedback can provide shared *referents* for the shared language of teaching, and both demand and provide the precision and concreteness, which makes talk about teaching useful.

We haven't reached *that* point. *Yet*.

I am much more serious about teaching than I used to be. I spend more time talking with students, and have developed strategies for engaging and reaching out to the less-advantaged students who are much less likely to seek my support and help than the students for whom the culture of

academia is a second home. Am I actually a better teacher, though? I think so. But then I would think that, wouldn't I? Whether because the learning we most care about can't be measured, or because (as I suspect) we just haven't bothered figuring out how to measure it, we lack high-quality measures of learning, so I can't go back and compare the learning that was happening in my classes before 2007 with the learning that happens now.

That said, suppose that you were choosing between two plumbers from the remarkable firm I described in the introduction. Here's all that you know about them: Both were trained as terrific bakers, and neither has been trained at all as a plumber. One has simply followed the incentives. The other has read a good deal about plumbing, regularly observes other plumbers, employs a plumbing coach, gets colleagues to observe her, and frequently meets with other smart plumbers who, despite having been hired through a similarly bizarre process, are serious about consciously trying to improve their plumbing skills. If you wanted a really good cake, you might toss a coin. But if you wanted the best chance of getting your pipes fixed, I'm guessing you'd choose the latter.

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AUTHOR'S NOTE

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ENDNOTES

[1] See Willian G. Bowen and Michael S. McPherson, *Lesson Plan: An Agenda for Change in American Higher Education* (Princeton, N.J.: Princeton University Press, 2016); and Robert Zemsky, Gregory R. Wegner, and Willian F. Massy, *Remaking the American University: Market-Smart and Mission-Centered* (New Brunswick, N.J.: Rutgers University Press, 2005).

[2] Derek Bok, *Our Underachieving Colleges: A Candid Look at How Much Students Learn and Why They Should Be Learning More* (Princeton, N.J.: Princeton University Press, 2006), 125.

[3] They did. Maybe they still do.

[4] She has subsequently become an instructional coach, but only after the experiment I go on to describe.

[5] See Atul Gawande, "Personal Best," *The New Yorker*, September 26, 2011.

[6] Tony Wagner, *The Global Achievement Gap: Why Even Our Best Schools Don't Teach the New Survival Skills Our Children Need – And What We Can Do about It* (New York: Basic Books, 2010).

[7] I rewatched it with current students who have recently taken the class and was gratified that they were shocked at how bad it was.

[8] Carl Edwin Wieman, "Expertise in University Teaching & the Implications for Teaching Effectiveness, Evaluation & Training," *Dædalus* 148 (4) (Fall 2019). Charles W. Eliot, in his inaugural address as president of Harvard, explained, "The lecturer pumps laboriously into sieves. The water may be wholesome, but it runs through. A mind must work to grow." Charles W. Eliot quoted in Bok, *Our Underachieving Colleges*, 123.

[9] Jennifer M. Morton, "Unequal Classrooms: What Online Education Cannot Teach," *The Chronicle of Higher Education*, July 29, 2013.

[10] Judith Warren Little, *The Power of Organizational Setting: School Norms and Staff Development* (Washington, D.C.: U.S. Department of Education, 1981), 12–13. Warren is not saying that the talking and the shared language are, themselves, sufficient for continual improvement. They are necessary components, and signs, of continuous improvement.

[11] See Mary Sue Coleman, Tobin L. Smith, and Emily R. Miller, "Catalysts for Achieving Sustained Improvement in the Quality of Undergraduate STEM Education," *Dædalus* 148 (4) (Fall 2019).

Catalysts for Achieving Sustained Improvement in the Quality of Undergraduate STEM Education

Mary Sue Coleman, Tobin L. Smith & Emily R. Miller

Promoting excellence in undergraduate STEM (science, technology, engineering, and mathematics) education at major research universities is necessary to ensure that we have the STEM-literate workforce and general population required to propel the nation forward into the twenty-first century and beyond. This essay provides a brief contextual history of the Association of American Universities' (AAU) effort to improve the effectiveness of undergraduate STEM education at member campuses and delineates the specific goals of this initiative. The essay then illuminates the essential role of the academic department and department chair in achieving long-lasting change and improving the quality of undergraduate education. It also discusses critical strategies and approaches for promoting the most effective methods for undergraduate STEM teaching and learning, with numerous examples from AAU member universities. The essay concludes with an acknowledgment of key challenges and opportunities that continue to face undergraduate education at research universities.

In the late 2000s, Association of American Universities (AAU) staff recognized that its member institutions were vulnerable to criticisms concerning the quality of undergraduate STEM (science, technology, engineering, and mathematics) teaching, learning, and retention, such as those raised in the 1998 Boyer Commission Report on educating undergraduates in the research university.[1] At the same time, the rise of MOOCs (massive open online courses), growing calls for higher education accountability at the state and federal level, and mounting pressures to justify the cost and value of an undergraduate degree at a research university were topics of growing discussion among the AAU membership. Following reports such as *Rising Above the Gathering Storm* by the National Academy of Sciences, a significant degree of national attention was also placed on the need to improve STEM education to

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ensure that an adequate pipeline of domestic STEM talent was being produced to generate the ideas, products, and industries that would drive future U.S. global competitiveness.[2] It was also well documented at the time that over 40 percent of students who entered research universities intending to major in a STEM field did not complete their degrees or ended up earning degrees in non-STEM disciplines.[3]

During this same time period, research on teaching and learning had also led to the development of instructional methods that were more engaging and effective at helping students learn. The positive impact of these improved teaching methods had been extensively documented in STEM fields and was summarized in reports issued in 2010 by both the National Academy of Sciences and the President's Council of Advisors on Science and Technology.[4] A comprehensive meta-analysis of 225 studies revealed that undergraduate students in classes with traditional lectures are 1.5 times more likely to fail than students in classes that use active learning methods.[5] Evidence was also emerging (and now is firmly established) demonstrating that learning gains from using these teaching approaches in highly structured classrooms are particularly good for students from disadvantaged and diverse backgrounds.[6] Active learning also has been shown to confer disproportionate benefits to female students in male-dominated fields.[7]

Reflecting on undergraduate STEM education from 2009 to 2012, the AAU found that most university efforts to support student success in STEM fields occurred outside the classroom, and that a majority of STEM faculty members remained inattentive to scholarship on effective pedagogy. Student-centered, evidence-based teaching practices were not yet the norm in most undergraduate STEM education courses, and the desired magnitude of change in STEM pedagogy had not materialized.[8]

Most scholarship on STEM educational reform has focused on individual faculty members and the students in their classrooms. This literature often centers on microlevel assessments of the classroom, which are crucial to assessing the effect of pedagogy on student learning and informing the broad audience of instructors about what works. Much less evident is research about the larger institutional and external environments, including the costs and political challenges in scaling up reforms.[9] Concern about more macrolevel environments requires a change in assessment from looking solely for benefits and learning outcomes at the course or program level to a more nuanced consideration of factors that facilitate, impede, or influence widespread transformation in undergraduate STEM education.

Education scholar Ann Austin has recommended that sustainable STEM reform requires engaging institutional leaders such as department chairs,

deans, and presidents in rethinking institutional structures and culture.[10] Relying on her well-documented systems approach to change, Austin has also suggested that external stakeholders, such as disciplinary societies, government agencies, and employers, are crucial to long-lasting change.[11] Transforming undergraduate STEM education requires multiple facilitators or "levers" pushing for change that can counterbalance the forces that sustain ineffective instructional practices and that address the systemic obstacles that work against educational innovation and reform.[12]

In 2011, the AAU launched the Undergraduate STEM Education Initiative, which was designed to assist AAU institutions in widely implementing effective teaching practices in STEM education and supporting student learning and persistence in STEM. This ambitious project has sought to increase the importance and value of effective undergraduate STEM teaching in the nation's leading research universities and continues to promote the implementation of a systemic view of educational reform within academia.[13]

Since its launch, the initiative has made significant progress in advancing these goals. At the institutional level, although many of the interventions are still in progress, initial data and analyses point toward their positive impact. Of the eight initial AAU STEM Initiative project sites, all have reported some improvement in student learning outcomes. The magnitude and significance have varied according to the different stages of the reform process across the institutions and departments. Several campuses have experienced dramatic reductions in achievement gaps, especially for women, underrepresented minorities, and first-generation students. Reports of decreased DFW (D grades, F grades, and withdrawals from a course) rates are common, as is increased student persistence and success in subsequent courses as measured by grade performance. AAU project sites also found improved performance on exams designed and sponsored by disciplinary societies to assess knowledge of core disciplinary concepts (that is, concept inventories). Some campuses also have tracked the effects of instructional interventions on more general psychological factors, such as self-efficacy, metacognition, and student attitudes toward science.[14]

However, evidence alone is not enough to change faculty behavior. As AAU principal investigator James Fairweather has explained, "research evidence of instructional effectiveness is a necessary but not sufficient condition" for faculty to change their teaching practices. Fairweather has suggested that the assumption that "the instructional role can be addressed independently from other aspects of the faculty position, particularly research, and from the larger institutional context" is misguided.[15] Given the size and scale of higher education, changing individual faculty members or even isolated departments

will have minimal impact. To achieve long-lasting and broadly disseminated educational reforms, efforts must go well beyond this microlevel focus.

As such, AAU member campuses are implementing specific strategies to catalyze change, partner with academic departments, and support faculty members to improve the effectiveness of undergraduate education. Moreover, two cross-cutting resources – data and funding – are being committed to advancing these strategies. Before describing these approaches, it is important to discuss the academic department and its role in facilitating long-term sustained change. The department is the location where these strategies obtain buy-in and commitment, as well as connect with faculty members in the university.

In 2017, the American Academy of Arts and Sciences' Commission on the Future of Undergraduate Education published a report that examined the current state of American undergraduate education, projected the nation's short-term and long-term educational needs, and offered recommendations for strengthening all aspects of undergraduate education.[16] One of the primary recommendations of the Commission is for institutions to make a systemic commitment to the improvement of undergraduate teaching. According to the Commission, strengthening college teaching will require institutional collaboration with academic departments. In a supplemental report, the Commission recommended that institutions provide sustained support for department chairs to enable them to become more knowledgeable about the research base on effective college teaching and help them create teaching improvements in their home departments.[17]

From its inception over six years ago, the AAU's Undergraduate STEM Education Initiative has recognized that academic departments are the primary loci for cultural change and that academic units and colleges are central to improving the quality of undergraduate education. Institutions rely on individual academic departments to coordinate and manage the academic process.[18] Departments determine course offerings, curricula, and teaching assignments; appoint and promote teaching and administrative staff; and manage essential services for faculty members and students. Moreover, faculty members typically identify more strongly with their departments than with their university as a whole because their identities are most closely tied to their academic disciplines and because academic work is primarily carried out in separate department-based worlds.[19] Thus, the department is the primary unit in which faculty members see themselves as having the greatest influence, and the space in which they can create desired change.[20]

The department chair plays a significant leadership role at a university. In addition to leading their departments, chairs also situate their departments

within institutional context and priorities: they lie at a pivotal junction between the administration and the faculty, maintaining the department as well as meeting the needs of the institution.[21] The chair is a linchpin that connects institutional priorities and faculty work by translating messages from senior institutional leaders, and interpreting questions, issues, and concerns expressed by faculty members.[22] Department chairs have meaningful, ongoing interactions with faculty members, students, and other department chairs. They advocate within the university for the interests of those engaged in their particular fields.[23] Department chairs can help create cultures in their units where teaching excellence is valued and rewarded.[24] Overall, the work of department chairs has an immediate and lasting impact: their actions affect the daily experience of faculty members, staff, and students. Research has shown that department chairs are responsible for 80 percent of administrative decisions on campuses.[25]

Consistent with the importance of department chairs in reforming undergraduate STEM education, the AAU convened teams of department chairs from member campuses in 2015 and 2018. During these workshops, the AAU discussed the evidence of improved learning gains and STEM-major retention in classes using engaged and structured teaching methods. The chairs then discussed topics such as creating inclusive and welcoming classroom environments, using data to inform and assess curricular innovations, introducing practices to evaluate and reward teaching effectiveness, and developing productive partnerships between academic departments and centers for teaching and learning. By engaging STEM department chairs in these critical teaching and learning issues, the AAU has worked to increase the magnitude and speed of change in the quality and effectiveness of undergraduate STEM education at research universities.

The AAU Undergraduate STEM Education Initiative has found that departments taking collective responsibility for improving the effectiveness of their foundational courses are the ones most likely to emphasize evidence-based active-learning strategies. Collective responsibility is related to developing a uniform departmental vision of educational improvement among faculty members and implementing strategies necessary to support a cycle of continuous improvement.

The AAU has observed six key drivers for the continuous improvement of undergraduate STEM teaching and learning.

Embedding discipline-based education and pedagogical expertise in departments to assist in educational improvement. To improve introductory foundational STEM courses, many AAU institutions are investing in faculty members who have

subject matter expertise, a deep understanding of effective pedagogy, and experience in using evidence-based teaching practices. Crucial to the effective use of these personnel is finding ways to incorporate them in departmental decision-making about teaching and curricula.

These education-based faculty appointments vary widely across institutions. Some are discipline-based education researchers hired in tenure-track faculty lines. Others are faculty members in lecture positions aligned with a promotion track, which provides some level of employment security. Some are postdocs who provide expert pedagogical guidance to faculty members. Appointments vary by title, tenure-track status, teaching load, research expectations, performance expectations, and promotional level.[26] The role and responsibility to advance institutional, college-wide, or department-based educational improvement efforts by faculty members in these positions is a function of hiring expectations and the acceptance by departments and institutions of their contributions to improving undergraduate education.

Embedding faculty with disciplinary and educational expertise in departments can assist in department-wide educational improvement, including the design and teaching of foundational courses. When linked with colleagues across departments, these individuals can also assist in achieving broader, institution-wide, systemic STEM teaching reforms. Although many of these faculty members exclusively teach (especially introductory courses), when given the opportunity, they are quite effective as change agents, leading refinements in course curriculum and assessments, helping tenure-track faculty teach these introductory courses more effectively, conducting educational research and assessments, and linking their academic department to other university teaching and learning units. These broader departmental reforms are more difficult to achieve if these newer types of faculty members are not given time to engage in nonteaching activities. Acceptance and support from departmental leadership and tenure-track faculty members of individuals with instructional expertise are essential to make maximum use of their expertise to promote long-lasting reforms in teaching and learning.

A number of AAU institutions are testing an adaptation of an e*xpert-guided course-transformation process*. For example, TRESTLE (Transforming Education, Stimulating Teaching and Learning Excellence) is a multi-institution, National Science Foundation–funded project that studies and implements a model for improving STEM education at public research universities. The embedded pedagogical experts lead their department colleagues through department planning and course transformation using a backward mapping design process consistent with improvement science. This process is complemented by a curriculum-mapping step to promote a sense of shared ownership of

courses and curricula and to generate a common vision. In addition, TRESTLE is building intellectual communities around evidence-based educational improvement, within and across departments and institutions. It is also collecting and making visible evidence of the impact of reforms on teaching and learning.

Creating inclusive and welcoming classroom environments. Unstructured learning environments can lead to unfairness, feelings of exclusion, and collisions of students' cultural backgrounds with the learning environment. In a structured learning environment, the instructor designs classroom interactions with the intention of maximizing student learning.[27] Adding structure to learning environments can mitigate unfairness, promote feelings of inclusion, and foster student success.[28] At some institutions, faculty members are participating in mentee-mentor coteaching teams to implement inclusive, evidence-based teaching methods designed to close achievement gaps in foundational science courses. Inclusive teaching has two main components: putting more structure into a course by giving clear instructions so that all students know what to do before, during, and after class; and facilitating class discussion so that everyone can participate.

Another effective strategy to create inclusive learning environments is to partner with undergraduate students. Undergraduate learning assistants (ULA) are undergraduate students who have done well in the class previously. They help facilitate learning activities during instructional time. Frequently, ULAs support instructors making extensive use of innovative, evidence-based pedagogies in their courses. Depending on the university, recognition for ULAs range from course credit to financial stipends. In addition to the support ULAs offer instructors, studies indicate that learning-assistant programs have several benefits, such as improved learning outcomes and knowledge retention for students who take courses with ULAs compared with students who take parallel courses without ULAs; reduced DFW rates in courses that have ULAs; and, after being a ULA, students have equivalent knowledge to graduate students in the field.[29] Undergraduates can also be employed to facilitate peer-led team learning (PLTL). PLTL groups typically consist of six to eight undergraduate students who work together to solve problems and are facilitated by a peer leader. Peer leaders are undergraduate students who have previously taken and performed well in the course. PLTL is designed to help students become conscious of the problem-solving process. It also helps students develop important collaboration skills, including how to approach problems effectively as a group, how to communicate well, and how to exchange and critique ideas in a collaborative environment. Peer leader training is an important component of the program. Peer leaders often are enrolled in courses

to learn how to be mentors for their groups; they form a collaborative group of their own to help one another address common PLTL challenges.[30]

Employing collaborative active learning techniques in the classroom is an important strategy for achieving student engagement and for enhancing learning. Numerous studies provide significant evidence that engagement is critical to student success. In collaborative and flexible learning spaces, faculty members are using innovative teaching and learning strategies that promote higher-order thinking skills that lead to better understanding and improved ability to transfer knowledge to other applications. These rooms are often an important catalyst for faculty members to redesign courses and are cited by students as providing more inclusive learning environments.[31]

Implementing practices to value, evaluate, and reward teaching effectiveness. College and university efforts to improve undergraduate teaching and learning require the recognition of faculty who use teaching practices shown to support student learning. Despite decades of scholarship to develop rich, multisource systems for evaluating teaching, these methods have not been broadly implemented into or recognized within faculty reward systems.[32] Many departments, colleges, and institutions are now developing innovative efforts to support the implementation of higher-quality approaches to teaching evaluation.

Evidence shows that stated policies about teaching alone do not strongly influence faculty behavior, much less encourage academic culture to more highly value teaching. A richer, more complete assessment of teaching quality and effectiveness for tenure, promotion, and merit is necessary for systemic improvement of undergraduate education.[33]

Several institutions have adopted strategies to create an environment in which the continuous improvement of teaching is valued, assessed, and rewarded at various stages of a faculty member's career, and is aligned across the department, college, and university levels. The AAU has developed a matrix to map the landscape of efforts working to improve policy and practices related to the evaluation of faculty work.[34]

Staff at some centers for teaching and learning are developing frameworks and rubrics to provide a more comprehensive view of faculty teaching. These tools are often designed to structure departmental evaluation of faculty members' teaching with defined expectations and dimensions of effective teaching practice. At other institutions, in partnership with centers for teaching and learning, departments are using a variety of tools (such as the Classroom Observation Protocol for Undergraduate STEM and the Decibel Analysis for Research in Teaching) to help conduct more effective observations of faculty teaching.[35] In some instances, a radical revision of teaching observations

is underway. As an example, some faculty members observe classes taught by others with evidence-based instruction. Instead of evaluating that instructor's performance, they write a self-reflection on their own teaching to include in annual reviews. Faculty senates are also leading efforts to reconsider the institutional process for the evaluation of teaching.

Developing productive partnerships between academic departments and units dedicated to educational effectiveness. Across the AAU, a variety of institutional structures exist to support faculty members in improving the quality and effectiveness of teaching and learning. The AAU has recognized that when academic departments develop productive working partnerships with units dedicated to educational effectiveness, it results in change at scale.

This reflects a core principle that the ultimate responsibility for teaching quality lies with the department, especially the department chair. This effect occurs through three main mechanisms: determining the curriculum (typically developed by a faculty committee and enforced by the chair), making teaching assignments, and evaluating faculty teaching. Many institutions have recognized the interdependence of support units and departments in improving teaching and learning. They are elevating and reorganizing the traditional teaching center into a full division or more closely aligning it with university leadership, oftentimes an associate provost responsible for teaching innovation or excellence with a direct reporting line to the provost. By expanding and more centrally locating these teaching responsibilities at higher levels within the university, the institution can make its expectations for teaching more explicit to academic units. More centralized leadership provides the necessary scaffolding for individual faculty members who wish to incorporate evidence-based teaching approaches into their course or department-level projects that promote student learning, create inclusive classrooms, and retain highly qualified students. Individual faculty members are also provided assistance to design and conduct assessments to evaluate curricular innovations as well as determine the impact of pedagogical changes on student learning. In this new light, centers for teaching and learning can bridge instructional teams (faculty, graduate students, undergraduates, and postdocs) and experts in assessment, technology, pedagogy, and student support. Increasingly, these support units provide department chairs with a suite of necessary information to generate appropriate conversations and reflection on teaching and teaching quality.

Finally, these more visible and institution-wide units are better positioned to compete for extramural grant funds to facilitate course transformation, teaching development efforts, and cultural change across the institution around teaching. In some instances, more visible centers for teaching

and learning have helped departments to submit proposals and receive grant funding from the institution to encourage and facilitate high-impact learning practices, technology-enhanced learning, and a culture of educational excellence at the department and college levels.

Using data to inform and assess curricular innovations. Research universities can facilitate STEM education improvement by supporting the development and use of institution-wide data and analytical tools on student instruction and learning outcomes. It is critical that data collected by the institution are compiled and shared with departments in ways that help them and their faculty members to enhance continually the quality of their STEM instruction. Central to the successful use of data analytics is to distinguish between the types of data useful for individual faculty members designing and assessing their courses and the types of data that can be used to inform departmental decision-making. For example, information about incoming student backgrounds, demographics, and past performance (such as SAT scores); pre- and post-tests to assess student understanding of core concepts; data from various course observation protocols; and data provided by student evaluations and assessments can be helpful to individual faculty members. Data regarding student performance in subsequent courses, DFW rates over multiple semesters, and data that enable comparisons across various sections of a class can be useful to the department. The ease and efficiency of the use of data are also important factors in broad acceptance of teaching-related metrics. Last and most important, data must be seen as part of the policy- and decision-making process. Among the more important lessons learned on the use of data in educational reform are that actionable and supported strategies based on data analytics must be developed within academic units.

Several AAU institutions are developing analytical tools to examine student demographics, student preparation, student performance, student choice, curricular complexity, instructional resources, and student learning. The aim is to foster a cycle of progress in which faculty members and administrators move from awareness and understanding to a continuous cycle of action and reflection.

Creating new business models. Systemic improvement of undergraduate STEM education at research universities should not be done from one grant to the next. Although this is an acceptable approach for supporting research, it is not appropriate for the institutional instructional mission. Symbolically and practically, establishing and maintaining lasting business models and organizational structures that support STEM educational reform are required elements for eventual institutionalization. Systemic changes in undergraduate STEM education require long-term administrative financial support.

Institutionalization of reform efforts will frequently require funds for personnel, infrastructure, and space. In the past, institutions have not fully taken advantage of the fundraising potential that exists around efforts to improve the quality of their STEM teaching. However, more and more institutions are finding that donors are inspired by these new teaching practices and learning environments and will provide funds to support these efforts.

Likewise, new funds are needed to support embedding high-level, teaching-oriented faculty with deep disciplinary expertise within departments. Universities have for many years sought funds to endow research chairs within departments. These chairs often have been funded by industry or industrial leaders. Endowed chairs can provide more space and recognition for faculty wanting to devote time to helping their departments improve the quality of their teaching. Institutions and departments would be wise to capitalize on this growing interest by endowing education-oriented chairs within their departments and providing these faculty with the resources needed to enhance and improve teaching in their departments. At the same time, industry would be wise to seek to support such endowed chairs to help ensure a well-trained STEM workforce in disciplines critical to their continued success.

While the AAU is working to help universities advance these critical catalysts necessary for systemic change in undergraduate STEM education and to leverage the influence of peer institutions, challenges remain.

First, institutions and departments need to find ways to better value the contributions of individuals (such as teaching professionals and teaching faculty) working to achieve the university's educational mission. The AAU has observed at research universities a significant challenge in recognizing the academic unit as a team of faculty members all making contributions to undergraduate education. In addition, the value of activities to improve undergraduate education, particularly the more invisible elements of teaching (such as course or curriculum redesign and assessment), is weighted differently across and within institutions. And as faculty members work to demonstrate effectiveness in research, teaching, and service as part of the promotion and tenure process, it is often unclear where to discuss this work. The AAU has found differing opinions by deans and department chairs within universities on this topic. Some consider efforts such as collaborating with faculty colleagues on a curriculum design as a service role or as part of committee work. Others consider this task a core element of teaching. This ambiguity can make it difficult to reward faculty for making key contributions to the full range of departmental educational objectives.

For faculty members hired to provide pedagogical, discipline-based expertise with long-term contracts and the opportunity for professional advancement, there is considerable debate about teaching loads, research expectations, how contributions to improving courses or mentoring faculty members in evidence-based pedagogy are counted in annual review, as well as policies about their rights to participate in department governance and service committees. The AAU has observed that departments are relying on these faculty members to make significant educational improvements to foundational introductory courses but have not figured out how to provide these faculty members voice in departmental governance or how to give faculty members credit for their teaching and educational leadership contributions. This growing tension must be addressed.

Second, for sustainable undergraduate STEM education reform, departments will need to create environments to support the interactions necessary to build trust and respect among the whole team of faculty members and address some of the critical barriers to undergraduate education improvement. A recent study by higher education scholar Adrianna Kezar examined the role of the AAU in scaling improvements in undergraduate STEM education.[36] The study found that through in-person convenings of faculty members and campus leaders, the AAU has facilitated a community of change leaders by creating an environment in which they can share challenges, learn from peers in similar institutional contexts, and provide multiple dimensions of support to one other. Moreover, the AAU has found that the in-person component of networking is important. Even in our technological age, physical proximity matters for collaboration: productive collaborations are driven by face-to-face interactions in shared spaces.[37] Networks are central to facilitating and scaling change since they provide the emotional support and sense of community necessary for participants to feel that they can safely take risks and experiment together.

Third, there is the challenge of expanding beyond STEM. Effective teaching and learning and creating inclusive and welcoming classroom environments are critical not just in STEM but for all disciplines. The AAU is pleased that member institutions are expanding their efforts to include the full range of disciplines represented on their campuses. The AAU has found such efforts in the social and behavioral science courses that enroll a large number of students as well as in foundational or general education curriculums. In these spaces and in the humanities, there is growing recognition that these courses are also important for student learning and for departmental budgets; they account for a significant amount of credit hours and tuition every term. Such courses are also very difficult to teach, enrolling students from a wide variety

of backgrounds, interests, and goals, as well as endeavoring to prepare them for subsequent study across a range of fields.

Finally, institutions must commit to a cycle of continuous improvement. At the national policy level, we have begun to see a more coordinated effort to improve undergraduate education across relevant organizations and actors.[38] We have observed a shift away from isolated directives within individual disciplines and nationally funded efforts that do not require long-lasting reforms within academic institutions. Today, many funders are designing solicitations with expectations for projects to build and sustain institutional change.[39] At the institutional level, universities are designing institutional structures and committing to leadership roles necessary to support the diverse, complex pathways students take to earn degrees, as well as ensure effective teaching for the growing diversity of learners.[40] Universities are also engaging in a reflective practice of assessing institutional improvement efforts in teaching and learning and then adjusting practice at multiple levels of the university. Ultimately, effective undergraduate education will require a sustained institutional commitment to a continuous cycle of improvement. The AAU will continue to work to promote the use of evidence-based teaching practices and drive systemic change to improve the quality of undergraduate education at research universities.

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Expertise in University Teaching & the Implications for Teaching Effectiveness, Evaluation & Training

Carl Edwin Wieman

Universities face the challenge of how to teach students more complex thinking and problem-solving skills than were widely needed in the past, and how to teach these to a much larger and more diverse student body. Research advances in learning and teaching over the past few decades provide a way to meet these challenges. These advances have established expertise in university teaching: a set of skills and knowledge that consistently achieve better learning outcomes than the traditional and still predominant teaching methods practiced by most faculty. Widespread recognition and adoption of these expert practices will profoundly change the nature of university teaching and have a large beneficial impact on higher education.

University teaching is in the early stages of a historic transition, changing from an individual folk art to a field with established expertise, much as medicine did 150 years ago. What is bringing about this transition and what can we expect of it? To answer, I start with the nature of expertise and how it applies to the context of academic disciplines. In particular, I discuss how such expertise defines disciplines and how research and other scholarly work plays an essential role in establishing disciplinary expertise. Then I show how recent research has established expertise in university teaching: a set of instructional practices that achieve better student outcomes than traditional teaching methods. These advances also illustrate the essential role that disciplinary expertise has in effective university teaching and provide perhaps the best justification for the research university as an educational institution. However, while disciplinary expertise is a necessary part of good university teaching, it is far from sufficient: there are many other elements of teaching expertise. I conclude by arguing that the widespread recognition of expertise in university teaching will improve both the effectiveness and efficiency of teaching by making it a more

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collective and coherent endeavor with better-defined standards for evaluation and training.

There is a general process by which expertise is established in any human endeavor; this applies to both academic disciplines and university teaching. In many areas of human activity, including music, sports, and medicine, the concept of "expertise" is well known. In these areas, there are individuals who can consistently achieve measurably better results than most people. Much of the research and discussion on expertise has focused on what it is about uniquely high-performing individuals that sets them apart. But what is the nature of expertise more generally? What are the requirements for associating expertise with an area of activity? And how does this concept of expertise apply to academic disciplines and university teaching?

There is a large literature on expertise, both what it is and how it is acquired. I will use the definition given by cognitive psychologist Anders Ericsson, slightly paraphrased: *expertise is a specific set of skills and knowledge that are not widely shared and can be seen to consistently produce measurably better results when applied to relevant tasks*.[1] Thus, for an activity to involve expertise, there must be readily identifiable tasks, and there must be measurable outcomes. The research shows that a person's level of expertise or, equivalently, "competence level" steadily increases with the amount of time spent in appropriate learning activities. For mature disciplines, reaching the highest levels (becoming an "expert") requires thousands of hours of practice.[2] When I refer to an "expert" here, I mean a recognized successful practitioner in the discipline; for example, the equivalent of a typical university faculty member.

From the studies of expertise across multiple fields, including my own research looking at different academic disciplines, I argue that, in the context of academic disciplines, expertise is primarily defined in terms of a set of decisions. It is *applying the skills and knowledge of the discipline to make decisions with limited information in relevant novel contexts*. The quality of those limited-information decisions – be they which scholarly question or problem to pursue, which information is relevant and which irrelevant, choosing methods of analyses, how to structure an argument, choosing standards of evidence, or justification of conclusions – all rely on the standards of the discipline. An activity can only exist as a recognized discipline if there are consensus standards that are used to evaluate the quality of scholarly work (such as the quality of the decisions embodied in that work) and, correspondingly, the quality of scholars in a field (for example, in academic hiring and promotion decisions). A requirement for the establishment of such standards is a foundation of "research"/scholarly work that has demonstrated that, among the possible alternative

decisions that a person might make, there are particular choices and processes for making such decisions that consistently achieve better results.

In some activities, particularly sports, there are clear quantitative measures of overall performance, and so the "research" proceeds rapidly, establishing which practices and training methods lead to improvements in outcomes. In a new video game, for example, the establishment of expertise in game performance happens very rapidly. In academic disciplines, the outcomes, and the connections between performance elements (like decisions) and outcomes, are more complex. Then the research process proceeds more slowly, as extensive research is needed to establish what factors do and do not impact outcomes, and over what range of contexts and performers.

To establish levels of competence and guide improvement, it is also essential to resolve expertise in a field into the set of subskills or practices required in the ultimate performance. For example, rather than simply having standards as to what constitutes well-played violin music, there are accepted standards as to what is good fingering technique, bowing technique, and so on that the "research" by music teachers has shown are important for achieving the ultimate goal of good music. Thus, there are standards that guide the learner in practicing and mastering that subskill, even while they are doing other things wrong and good music is not being produced. In academics, such standards for subskills would apply to the outcome of the decisions listed above, such as choice of question or sources of evidence. Making such decisions in an expert way involves both having the relevant knowledge and having the reasoning skills to guide when and how that knowledge is used. In total, these standards for subskills, encompassing appropriate knowledge and its use to make decisions, largely define expertise in a discipline. With sufficient practice, some of these decisions become automatic, carried out with little conscious thought, thereby increasing the speed of the process.

The role of research in establishing expertise is illustrated by the field of medicine. In the 1400s, the definition of what it meant to be a good doctor was quite arbitrary and varied according to individual idiosyncrasies. Anyone and everyone could believe, and announce to the world, that they were a good doctor, even though different doctors employed a wide variety of practices. A similar situation exists today with regard to education; almost everyone who has been to school, let alone taught a class, believes that they are an expert, in that their opinion has equal or greater weight as that of anyone else.

Over the subsequent centuries, medical research led to the establishment of knowledge, principles, and methods that produced consistently better results. A practitioner who knew and applied these produced better outcomes (healthier, more long-lived patients) than those who did not, making

it possible to set objective standards for who was a competent doctor. This included standards about the components of expert practice such as washing hands between patients, knowing which diagnostic tests to use, and prescribing the most effective treatments. The transformation of medicine illustrates how fields change as a research base is established, leading to the recognition of expertise in the field. This establishment of research-based medical expertise led to changes in the training and conduct of medicine, with resulting improvements in both outcomes and the rate of further progress. The transition of alchemy into the modern discipline of chemistry is another example illustrating how an academic discipline with expertise develops following the creation of an adequate research base.

Teaching has traditionally not been an area for which well-defined expertise exists; it is more often characterized as an "art" wherein each individual is encouraged to choose their preferred style. While there has been a generally accepted goal – learning – what that means and how it can be measured has been ill-defined and variable. It is striking to read the many recent OECD (Organisation for Economic Co-operation and Development) reports on improving the quality of university teaching and see that none of them actually define teaching quality or how it could be measured. "Good" teachers are often described in terms of personal characteristics like "enthusiasm," "concern with students," and "interest in their subject." Judgments of teaching quality have traditionally depended largely on individual preferences, much like the judgment as to whether a painting is attractive or not, or whether a person is likeable. At the level of the institution or academic department, efforts to "improve teaching" often focus on the curriculum: what topics are covered in what order. Research on learning, however, implies that such curricular choices play at best a secondary role in determining meaningful student learning outcomes, particularly learning to think more like an expert in the discipline. The lack of agreed-upon standards for teaching quality allows everyone to consider themselves to be a good teacher by some standard, and most do.

Research during the past few decades has changed this situation for university teaching, although this change has yet to be widely recognized. These advances in research now make it possible to define expertise in university-level teaching and, correspondingly, define teaching quality in an objective expertise-based manner. The research comes from a combination of studies in cognitive psychology and the science of learning, studies in university science and engineering courses, and, most recently, from brain research. This includes hundreds of laboratory and classroom studies involving controlled comparisons of different teaching methods, primarily, but not exclusively, measuring student learning.

Much of the classroom research is the result of the relatively new field of "discipline-based education research" (DBER), which has developed over the past few decades.[3] This research focuses primarily on undergraduate learning of the science, technology, engineering, and mathematics (STEM) disciplines at research universities, and is carried out by faculty in the respective disciplines (physics, biology, computer science, so on).[4] This is distinct from the educational research that is carried out in schools of education, which is largely confined to the K–12 level.

The standards of DBER have rapidly evolved, and different disciplines are still at different stages of progress in this evolution. Not long ago, such university education "research" consisted of instructors trying some change in their teaching of a course and measuring the impact in some idiosyncratic way, primarily how much the students liked it. Now, quality DBER, which is what I am discussing here, is similar to medical research. It requires controlled comparisons of different ways to teach particular material, and the impacts are measured using validated, often published, and widely used tests that probe learning. Research protocols are similar to those for other human-subjects research and have the same institutional review.

DBER has led to new types of assessments of learning, new teaching methods, and comparisons of learning achieved with different methods of instruction. The research has explored the importance of many different factors for student learning, course completion, and, occasionally, student retention in a major. The teaching methods that have been found to be the most effective are well aligned with cognitive psychology research on learning, sometimes by intention and other times not.[5] This alignment is particularly evident in the research on teaching expert thinking, which has illustrated the need for explicit practice of the mode of thinking to be learned along with guiding feedback.

The assessments of learning in DBER that have been the most sensitive and impactful are "concept inventories." Such inventories are carefully developed to probe the extent to which students can apply relevant disciplinary concepts like an expert in the field to novel situations appropriate to the course content. Their primary use is to measure the effectiveness of the teaching in the class as a whole, rather than the learning of the individual students per se. Such inventories now exist for material covered in a number of standard introductory science and math courses and a few upper-level science courses. These provide researchers with good instructor-independent measures of learning that can be widely used, and hence allow widespread, carefully controlled comparisons of different teaching methods. These assessments are based on the unique disciplinary frameworks for making decisions that experts use, rather

than based on remembering pieces of knowledge or a memorized procedure. As such, learning to do well on these assessments of "expert thinking" is more sensitive to instructional practices than typical exam questions and less sensitive to "teaching to the test." These kinds of assessments have become a uniquely valuable tool for research on the relative effectiveness of different types of university teaching, but for practical reasons, they only measure a subset of the relevant expert thinking. There are other aspects that must be measured in different ways, including things like deciding on choices of possible solutions or designs, recognizing the range of real-world situations in which the discipline can be useful to understand and predict important phenomena, and the learner deciding they can master and enjoy working in the discipline.

Researchers also look at more conventional outcomes, such as failure rates and course and exam grades, but those are more sensitive to the characteristics of the incoming students and the idiosyncrasies of individual instructors, and thus are less reliable measures. Nevertheless, they still have reasonable validity if there are consistent standards and the instructor is careful in the exam construction, because of the degree of standardization of the undergraduate STEM curriculum, textbooks, and instructional goals across universities. Unfortunately, this is not true for many STEM exams that, often unintentionally, primarily test the student's memory of basic terminology, facts, and procedures.

DBER in university STEM courses is a relatively young field and is not widely known. It has primarily been carried out in the United States and funded by the National Science Foundation. It tends to be published in specialized journals (*Physical Review Physics Education Research*, *CBE – Life Sciences Education*, *Chemistry Education*, and *Journal of Engineering Education*, among others), with an occasional article published in *Science* or *Proceedings of the National Academy of Sciences*. There is limited awareness of DBER within the broader university faculty and administration, with the level of knowledge varying significantly by discipline. With a few exceptions, DBER is also little-known outside of North America. Some recent reports and reviews have attempted to synthesize and disseminate the findings of DBER and its implications for improving university teaching.[6]

DBER has established that there are particular principles and practices that consistently achieve better student outcomes than the traditional didactic lecture and high-stakes exam. This has typically been shown through experiments involving controlled comparisons. These effects are sufficiently large that, when one takes incoming student preparation into account by measuring learning gains rather than just outputs, the choice of teaching practices

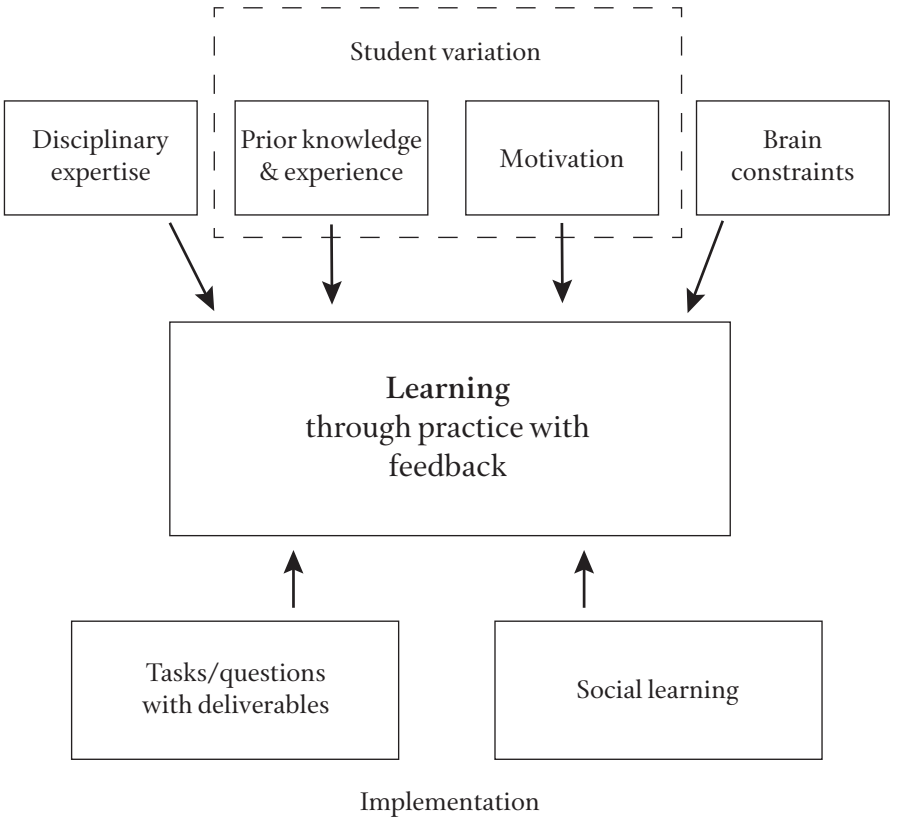
results in larger differences than any other identified variables associated with the teacher (for instance, rated quality as a lecturer) or the students. The results have been replicated within and across instructors, institutions, courses, and disciplines.[7]

Such results have been shown in all the disciplines in which extensive classroom studies have been carried out, including all science and engineering disciplines at the university level and, to a lesser extent, mathematics. There have been some studies in other types of higher education institutions and a few recent, small studies in the social sciences.

It would be worthwhile to carry out similar controlled comparisons of learning in a broader range of disciplines such as history and classics. There are theoretical reasons to think that the same teaching methods would likely also work well in such fields, if properly adapted. The methods that have been consistently effective reflect fundamental mechanisms for learning from cognitive psychology (see Figure 1), particularly for learning to think like an expert in the discipline, as mapped onto the particular course and student population.[8] The DBER that has produced the biggest gains in learning has involved looking at the decisions that students make in solving problems after receiving traditional instruction and how they differ from those of scientists, and then designing educational activities that involve the students explicitly practicing making such decisions with feedback. Sam Wineburg has identified some key elements of historian expertise, including how historians determine the credibility of historical artifacts and what conclusions they decide they can draw from them, and how their thinking in this regard differs from college students who have taken a history course. It seems like these aspects of historian thinking could be directly incorporated into the corresponding research-based methods developed in STEM, likely with corresponding improvements in learning.

In this discussion, I have been careful to distinguish university teaching from teaching at the K–12 level. In *The Cambridge Handbook of Expertise and Expert Performance*, psychologist James Stigler and education scholar Kevin Miller present an excellent discussion of the challenges faced in establishing and defining K–12 teaching expertise in the United States.[9] As they have discussed, there are a number of confounding variables outside the control of the K–12 teacher, most notably the local context, that make K–12 teaching harder to characterize and harder to study. It is useful to contrast the K–12 context they describe with teaching in research universities where most DBER has been carried out. Variables such as classroom behavior, the subject matter mastery of the teacher, the scheduling of teaching and assessment activities, and the extent of variability in the student backgrounds are all major

Figure 1
Principles and Practices of Effective Teaching



Note: This figure represents the full span of research on the principles and practices involved in learning to make good decisions in a specific disciplinary context. At the center are the essential components of learning. This represents the intense practice of the specific elements of thinking to be learned, ideally the decision-making skills that experts in the subject use in relevant situations, combined with feedback that guides improvement in that thinking. The top row of boxes represents factors that enable and facilitate this learning process. Much of the apparent variation across the student population comes in through the motivation and prior knowledge boxes, both of which depend heavily on the learners' prior experiences. The two boxes in the bottom row represent consistent elements in the implementation of highly effective teaching practices.

issues in K–12, but these are much smaller factors at the university level (even though nearly all university teachers complain about the level and uniformity of the preparation of their students). The U.S. K–12 context is also highly variable across schools, districts, and states, and these differences play a large role in the educational practices and assessment. In contrast, the context of university teaching is far less variable: relative to K–12, there is a high degree of standardization of the curriculum, the textbooks, the student populations and behavior, the instructional settings, the subject mastery of the instructors, and the desired learning outcomes. This makes the classroom research at the university level far simpler and cleaner, and it provides more definitive results than research in K–12 teaching. In the future, greater K–12 standardization through vehicles such as the Common Core State Standards Initiative and Advanced Placement courses might provide more K–12 uniformity. Stigler and Miller do propose three "teaching opportunities" that they believe would be the characteristics of expert teachers, if sufficiently clean research results could be obtained; these overlap with what I present below.

When expertise is first being established in a field, the distinctions as to different levels of competence are relatively crude. One can become an "expert," a top performer, merely by recognizing basic decisions that need to be made and, in those decisions, accounting for the basic factors that have been shown to be most relevant. As university teaching is a new area of expertise, one can achieve relatively high levels of mastery merely by using the basic principles and practices that have demonstrated improved learning. The description of expertise here is limited to this relatively coarse level. As any discipline matures, more complexity and nuance are seen to result in higher quality decisions, and thus more subtle factors become recognized as elements of expertise. This will eventually happen in teaching.

Before I can talk about what constitutes expert teaching, I need to define the intended learning goals that such expert teaching will reliably achieve. Often, the stated goals (or "objectives") of courses are expressed in terms of "understanding" or "appreciating" various topics. From extensive discussions with faculty members as to what they mean by such vague statements, I claim that the goals of the great majority of university STEM courses can be summarized as: teaching students to think about and use the subject like a practitioner in the discipline, consistent with the student's background and level. In practice, this means making relevant decisions and interpretations using the reasoning and knowledge that define expertise in the discipline. Of course, the level of sophistication with which the students might learn to do

that and the complexity and range of the contexts in which they are capable of making such decisions will vary widely according to the course. For the dedicated fourth-year chemistry major, that decision might be how best to synthesize a molecule in an industrial setting, while for a major from another discipline taking their one required chemistry course, it might be deciding not to pour hydrochloric acid down the drain or deciding not to invest in a company that claims it has a process for turning seawater into gold. But "thinking like a chemist" is needed for all these decisions. Thus, I am taking the basic goal of most university courses as having students learn to think more like an expert in their respective discipline.[10]

The most basic principle that every teacher should know about teaching this sort of thinking is that the brain learns the thinking it practices, but little else. To have students learn to recognize relevant features and make relevant decisions more like an expert in the field, they must practice doing exactly this. The longer and more intense the practice, the greater the learning. There is a biological origin to this requirement, as such intense mental practice modifies and strengthens particular neuron connections, and the new thinking capabilities of the learner reside in this "rewired" set of neurons. There is much research on how the brain changes the way it organizes and accesses relevant information as it learns, and on the connection between the functional and structural changes that occur in the brain during extended learning of expertise.[11]

The basic principle that people learn from practice with appropriate feedback is placed at the center of Figure 1. To my knowledge, practice and feedback are part of all research-based instruction that shows significantly better learning outcomes than the traditional lecture. These are also the two most basic elements of "deliberate practice," which has independently been found to be essential for the acquisition of expertise.[12] The first element in this context means having the learners actively and intently practicing the thinking to be learned. One particularly important and often overlooked feature in teaching is that thinking like an expert is primarily about making particular decisions. So, the learning task must involve the learners *actually making relevant decisions*. Too often, instruction only involves the teacher modeling a solution process by telling students the decisions that the expert has made. The differences in learning between a student being told the desired outcome of a decision versus having the student make the decision, even if incorrect, and then reflect upon the outcome of their decisions while supported by instructor guidance are profound.[13] These differences are easy to appreciate if you think about learning to find your way through a strange city. If you go between two locations by simply following the directions for each turn provided by a

person or mapping program, you will be incapable of telling another person how to do it or reproduce it on your own. If you had to form a mental map of the city and explicitly decide on the turns, you will have learned far more. In this case, you practiced making decisions and strengthened neuron connections in the necessary way to learn, and it does not matter if some of those turns were wrong, and you had to revise your route: you still learned better the correct decisions. This also carries over to your learning better how to transfer your knowledge to a new context, such as going between new locations or dealing with road closures. The same principles apply to learning problem-solving decisions in a discipline.

Effective teaching is about first designing learning activities that have the student carrying out tasks that require them to make decisions using the specific reasoning processes, including the associated requisite knowledge, to be learned. The second element is good feedback, which means feedback that is timely, specific, nonthreatening, and actionable.[14] To be able to provide such feedback requires that the instructor monitor the learner's thinking in some way, and then use that information to provide feedback to guide the improvement in that learner's thinking (often labeled as "formative assessment"). Under this broad general principle of practice with feedback, there is a detailed set of factors that have been shown to play an important role in supporting this learning process.[15] These are illustrated in Figure 1. Each of the boxes in the upper row represents a well-studied principle involving established mechanisms of learning. Good instructional design incorporates these principles into the design of the practice tasks and the types of feedback provided. The two boxes in the bottom row represent research on how best to implement these in instructional settings. If and how the instruction incorporates the best practices represented in all of these boxes is a measure of teaching expertise.

Disciplinary expertise. Embedding expertise in the subject into the instructional activities is a fundamental requirement. This expertise includes recognizing what decisions need to be made in relevant contexts, along with the tools, reasoning, and knowledge of the discipline to make good decisions.[16] In this regard, good instructional tasks should directly reflect the standards that define expertise in the discipline discussed above, as mapped onto the context of the specific course being taught. This involves many different decisions, but an example of the most general and basic is, when confronted with an authentic problem/question and context, deciding what the key features and information are, and what information is irrelevant to solving the problem. Artificially constrained "textbook type" problems remove practice in this critical decision skill.

Motivation. Serious learning is inherently hard work that involves prolonged strenuous mental effort. The motivation to engage in that effort plays a large part in the learning outcomes. Motivation is obviously enhanced by making a subject interesting and relevant to the learner, which often means framing the material in terms of a meaningful (to the learner!) context and problem that can be solved.

A less obvious element in motivation is having a "growth mindset," the learners' belief that they can master the subject and a sense of how to attain that mastery, a belief that can be powerfully affected by both prior experiences and teacher behaviors.[17] Too often teachers fail to recognize the impact of the various messages they convey through what they say or how they grade. For example, an exam that measures all of what students should have learned and only that, compared with the more typical exam that focuses on the most challenging material that will provide the best differentiation between students, send very different signals to students. The first shows them all of what they are learning and is motivating, while the second leaves many students, for example those who only get a 50 percent score after intensive study, with a demotivating sense of failure and frustration, even if that is the class average.

Prior knowledge and experience. To be effective, instructional activities must match with and build upon what the student already knows and believes about the subject and how to learn it. Research has shown that it is important for effective instruction to recognize and address even very specific aspects of the learners' thinking about particular topics, such as whether a student believes that heavier objects fall more rapidly than lighter objects when teaching introductory physics.

Both prior knowledge and what does and does not motivate students are highly dependent on their prior experiences. Hence, these are the areas where most of the observed variations in the student populations are apparent. The expert teacher will recognize it is inadequate to ask students what they know or come to conclusions based on the syllabi of prior courses the students have taken. Instead they will measure what the students know and can do, initially and ongoing through the course. They will then optimize learning by adjusting their instruction to match best the characteristics of their student population.

Brain constraints. The next box, constraints of the brain, refers to 1) the limited capacity of the short-term working memory of the brain (five to seven new items, far less than introduced in a typical class session) and its well-studied impacts on learning; and 2) the processes that hinder and help long-term retention of information. The limited capacity of working memory means that anything peripheral to the desired learning that attracts the learner's

attention will reduce the desired learning. This includes new jargon, attractive images, or even amusing stories or jokes. The biggest problem with long-term retention is not in remembering material in the first place; rather, it is correctly retrieving it later after additional material has been learned. That new material interferes with the retrieval process. To avoid this interference, as new material is learned, it needs to be intermingled with the recall and application of old material. This is not the usual practice in STEM courses wherein novice teachers cover the topics in a strict chronological order.

The two boxes at the bottom of Figure 1 represent key elements for the implementation of research-based teaching:

Tasks/questions with deliverables. To ensure that students are practicing the desired thinking, they need to be given tasks or questions that explicitly require that thinking. Explicit deliverables achieve engagement in the task and provide essential information to the teacher for giving effective feedback. For example, in a genetics class, students would consider the blind fish in Mexican caves. They would be asked to consider what they could decide about the number of genes containing the blindness mutation from the distribution of blindness in the offspring of true-breeding lines of fish bred from lines in two different caves. In a large class (two hundred to three hundred students), the instructor would have the students answer using a personal response system (PRS), followed by small-group discussion (that the instructor and TAs monitor) and a second vote. In a smaller class, students would have to write out their prediction with the reasoning, to be turned in for participation credit, possibly in addition to the PRS questions. In a physics class, they would be given a problem to solve for a particular physical situation, such as predicting how much electricity could be produced from a hydroelectric plant: the first step would be to write out which physics concepts are most relevant to solving the problem and why, to be turned in later and minimally graded; the instructor and TAs would circulate and read students' responses during class. In a large class, this could be followed with a PRS question testing them on their choices. In all of these cases, there should be follow-up homework questions, and it should be explicit that there will be quite similar questions on future exams.

Social learning. Interacting with peers during the learning process is a valuable and commonly used facilitator of learning.[18] It supports learning in multiple ways. Students get timely knowledge and feedback from their peers, they learn the standards of discourse and argument of the discipline, and they develop metacognitive skills through their critique of others' reasoning and hearing others question their own. Finally, there are unique cognitive processes that are triggered by social interactions that produce learning. Even anticipating that one will teach a peer about a topic has shown to improve learning

over just studying the topic. And, of course, such group activities provide opportunities for the students to learn collaborative skills. Important elements of teaching expertise are to know how to avoid the potential pitfalls of group work, how to set and monitor norms of behavior, and how to structure the group activities to achieve all of the potential benefits.

The set of factors and practices represented in Figure 1 largely determine learning outcomes at the university level for the disciplines and institution types in which they have been tested. There are many examples where very experienced faculty have changed their teaching practices to incorporate these principles and practices, usually moving from lecture to research-based instruction, and achieved substantial improvements in student learning outcomes. Research is ongoing as to how best to take these factors into account in the design and implementation of the learning process across the full range of disciplines, topics, and students. However, the relevance and benefits can be understood in terms of established general mechanisms of learning, and thus it is likely that they will apply across nearly all higher education settings and academic disciplines.[19]

If a teacher is applying these practices in a discipline in which they have not been studied, the respective disciplinary standards of expertise and associated decisions must provide the foundation of the educational practice tasks that learners carry out, as well as the feedback they receive. This emphasizes the need for every good university teacher to have a high level of disciplinary expertise.

In summary, the experimental study of how learning takes place and how best to facilitate it in university teaching has provided a rich body of evidence establishing the basis of expertise in teaching. Research consistently shows better student outcomes compared with lectures when students are fully engaged in challenging tasks that embody expert thinking and they receive guiding feedback: the principles represented in Figure 1. This success is the basis for my claim that expertise in university teaching exists. An expert teacher will be aware of these principles and use suitable research-tested practices to incorporate all of them into their instruction.

In one respect, it is somewhat surprising that the research results are so consistent.[20] As in every discipline, there are countless ways for a novice to do such complex tasks poorly, even if trying to follow best practices. These research-based teaching practices are regularly being adopted by faculty with little teaching expertise, usually, though certainly not always, to good effect. I believe that a likely reason for this consistency is that research-based teaching is, to a substantial extent, self-correcting. In nearly all forms, it provides opportunities for the instructor to know what the students are thinking and

struggling with – far better opportunities than instructors get when lecturing. When instructors are first adopting these methods in even modestly informed ways, they almost always comment on how much better they now understand student thinking and difficulties compared with when they were teaching by lecturing, and how this new understanding of student thinking is changing their teaching. These new insights allow them to recognize and correct weaknesses in their instruction, thereby improving learning.

Although university teaching expertise can now be defined, it is not widely known and practiced. Again, the situation with university teaching is like medicine in the mid-1800s. Although research had established a basis for science-based medical practice, many "doctors" were unaware of that science. Their practice was based primarily on tradition and individual superstitions with no accepted standards. That changed during the late 1800s and early 1900s. There is reason to hope for a similar transition in university teaching.

The establishment of expertise in teaching has implications for the training, evaluation, and cultural norms for how teaching is carried out. In every discipline, the relevant standards of expertise play a large part in the practice and training in the discipline. Once there are well-defined and generally accepted standards of expertise, these provide standards on which to base both evaluation and training. This includes standards for being certified as competent, either formally as in medical or legal licensure, or informally as in the process of review of scholarly work for publication or judging the qualifications of faculty job applicants. In the case of university teaching, a teacher now can, and should be, evaluated on their level of teaching expertise: how familiar they are with the principles and practices represented in Figure 1 and to what extent they use these in teaching. Training needs to provide them with this expertise.

Evaluation of teaching quality at the university level has long been problematic. Currently, the dominant method is student course/instructor evaluation surveys. There are obvious problems with such evaluations, as well as some particularly compelling recent studies showing substantial gender bias.[21] As I have written elsewhere, the basic requirements for any good evaluation system are:

- *Validity.* Results correlate with the achievement of the desired student outcomes and allow meaningful comparisons of quality across different instructors and departments.
- *Fairness.* Only depends on factors under the instructor's control.
- *Guides Improvement.* Provides clear guidance as to what should be done to improve.[22]

Student course evaluations fail badly at meeting any of these criteria. Most important for this discussion, they have been clearly shown to fail at both reflecting the extent of expert teaching practices being used and reflecting improvements in learning.

However, it is now possible to evaluate teaching based on standards of expertise. One example of this is the Teaching Practices Inventory (TPI) developed by Sarah Gilbert and me (see Appendix I).[23] It is a survey that can be completed quickly (about ten minutes per course) and reflects nearly all the decisions that an instructor makes in designing and teaching a course. It provides a detailed objective characterization of most of the instructional practices used in a course and, correspondingly, the extent of use of research-based effective practices. It is not perfect; it does not show the effectiveness with which these practices are being used. It is analogous to measuring if doctors are washing their hands between patients, but not how well they are washing. We and others have seen that this level of measurement is sufficient to easily distinguish between the different levels of teaching expertise present in a typical sample of university science faculty. The TPI shows a high degree of discrimination across a typical sample of university faculty, with the highest scoring faculty also having very high measures of student learning outcomes. TPI results allow meaningful comparisons to be made across faculty, departments, and institutions.

The use of such expertise-based evaluation of teaching would make it more like the evaluation of research, allowing institutions to include teaching both in their evaluation and incentive systems in a far more meaningful and intentional way than is currently possible. It would also make it straightforward to set clear criteria for the level of teaching competence expected for new faculty hires and for promotion and tenure decisions.

Effective training of teachers, similar to good training in any area of expertise, involves practicing the relevant thinking and actions in authentic contexts, along with feedback to guide improvement. As in academic disciplines, the most important part of training in teaching is to practice the relevant decision processes, recognizing what information is most important to guide those decisions and using it accordingly. This will require training that is both more extensive and more targeted than most existing university teacher training programs.

The list of elements that needs to be covered in training university teachers reflects all aspects of teaching a course and all the principles represented in Figure 1. This may seem overwhelming compared with what is now typical, but it is small compared with the training faculty received to become

experts in their disciplines. I have seen that faculty can reach a respectable level of teaching expertise in something in the range of fifty hours of training; less time than is required to complete most university courses.[24] That is sufficient to allow faculty members to switch from teaching by traditional lecture and exams to research-based methods and achieve good results. Of course, this small amount of time (fifty hours) required to be reasonably competent in teaching, compared with the thousands of hours required for high competence in a mature discipline, is a reflection of the immaturity of the field and the current level of expertise. As the level of teaching expertise increases, the standards of competence and corresponding expectations of training and quality will likely also increase.

I should emphasize that it does not require any additional time to teach using these new research-based methods instead of traditional teaching; it only requires time to learn how. But in my experience, nearly all faculty that successfully adopt these methods find that it makes teaching a far more enjoyable and rewarding activity. Consequently, many of them voluntarily choose to spend more time on teaching than they had previously.[25]

The typical university teacher training program is too unfocused, as it is usually designed to serve faculty from all disciplines at the same time. As with the specificity needed for training of any type of expertise, effective development of teaching expertise will require training programs that focus on the teaching of the particular discipline and student population that the faculty member will encounter. While the principles are general, it is a very large step from them to knowing how to apply them to teaching a specific discipline and level.

One training option is to have an individual "coach," an approach successfully used in many areas of expertise. Such a coach for university teaching would have expertise both in the relevant discipline and in teaching in that discipline, and would be well informed about the student population and the other important contextual constraints. The coach would individually review the trainee's instructional activity designs, observe their implementation in class, and provide feedback to guide improvement. A vital skill is also knowing the way things can fail, and help the trainee anticipate and avoid such failures. The use of such disciplinary teaching coaches has been shown to be an effective model in the Science Education Initiative (SEI; see Appendix II). The SEI provided funding to departments to hire disciplinary experts, typically new Ph.D.s, with a strong interest in teaching, who were then trained in the research on teaching and learning and implementation methods, and on how to work with faculty to support and coach them in transforming their teaching. "Master-apprentice" training involving a novice teacher team-teaching a

course with an experienced expert teacher faculty member captures most of the same elements and has also been shown to be effective.[26]

There is a fundamental change in the social culture of a discipline when it develops widespread recognition of expertise, a change that we can expect in university teaching in the coming years. The establishment of recognized expertise in a discipline enables increased collaboration/collective work and building upon prior work. When a field is recognized as an area of expertise, like physics, chemistry, or history, that means there is a commonly accepted set of standards and principles, along with accompanying common language, for discussion. This commonality makes it both possible and desirable to share ideas and methods and pursue collaborative projects, as well as have disciplinary conferences and journals. In contrast, teaching at the university level is now widely seen as an isolated activity, with faculty in a department almost never coming to view each other's classes and seldom discussing or collaborating on teaching activities or methods. This contrast in culture is directly related to differences in the level of recognized expertise.

It can be understood by considering the hypothetical situation of a physicist whose office is in a building otherwise occupied exclusively by ancient poetry scholars. There would be little value in the physicist going and talking with those faculty to discuss ideas about physics, or to find new ideas for experimental designs (and vice versa, if it were a poetry scholar exiled to the physics building). Assuming no Internet, the physicist would sit at a desk trying to invent everything in isolation. But that same physicist, if located in a building full of physicists, would be engaged in peer discussions about scientific ideas and methods, gaining new information and insights and making far more progress as a result. These physicists would be pursuing their own specific goals, but within a commonly accepted framework of principles, knowledge, and standards: the core of physics expertise that facilitates discussion and sharing for mutual benefit. This framework supports interaction and sharing of ideas while still allowing room for identifiable individual contribution, essential components of every academic discipline.

Teaching is currently seen as a matter of individual taste and style. Each time faculty members teach a new course, they usually design it largely from scratch, at best taking small elements from previous offerings of the course at their institution and nothing from other institutions. This perception of teaching as a solitary activity is encouraged by the institutional policies for how teaching is allocated and evaluated. Each individual course is typically assigned to an individual faculty member who then has full responsibility for all aspects of that course, with very little oversight or expectations as to what will be taught and how.

The recognition of expertise in university teaching will go hand-in-hand with it becoming a more collective enterprise within departments and institutions, much as is the case for scholarly work in the disciplines. I observed this in the UBC Science Education Initiative.[27] There were far more frequent and substantial discussions about teaching among the faculty in a department after a number of the faculty became moderately expert. This socialization of teaching will in turn make teaching more efficient and effective. In scholarly research, by building on past work, an individual can accomplish far more than if they had to invent everything on their own. As practices established through DBER have spread, there have been early examples of this happening for teaching in some disciplines. While many elements of expert teaching are the same across disciplines, it is likely that socialization of teaching will still be largely confined to the existing disciplinary boundaries. That is because of the large role that the disciplinary expertise plays, including student knowledge and beliefs about the discipline, in the design and implementation of educational activities.

The lecture method that dominates university teaching has remained much the same for hundreds of years. The concept of education through an expert relaying information to a room full of novices predated the printing press, but to a large extent remains the norm today. The treatment of teaching as an individual art form has shaped its practice and evaluation. This is in striking contrast to the nature of the academic disciplines, which have changed and advanced enormously. These medieval methods of teaching are now confronting the challenges posed by the increased complexity of thinking that it is desirable for students to learn, and the greatly increased numbers and diversity of students that need a good university education. The acquisition of basic information is now of limited value, while complex reasoning and decision-making skills that can be broadly applied have high value in many aspects of modern society.

The establishment and recognition of teaching expertise has far-reaching implications. Much as happened in medicine as it moved from its medieval roots to modern, research-based methods, the expertise established by these research advances in teaching provide a standard for the quality of practice, hiring, evaluation, and training. The adoption of such standards will result in immediate and ongoing improvements in educational effectiveness. The establishment of such consistent standards also enables the conduct of teaching in a more collective way, using and building on previous work. This promises to improve both the effectiveness and efficiency of instruction. While higher education is facing many challenges, the rise of teaching expertise offers a

path to a dramatic improvement in how it pursues its educational mission. This would be a historic change, and while such changes never come easily, it would provide broad societal benefits. As well as enhancing the educational value provided by universities, it would more clearly demonstrate their unique educational contribution.

Many examples of teaching activities that incorporate these principles in various disciplines are given in Appendix III, accessible at http://www.amacad.org/daedalus/teachingexpertise.

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ENDNOTES

[1] Anders Ericsson and Robert Poole, *Peak: Secrets from the New Science of Expertise* (New York: Eamon Dolan/Houghton Mifflin Harcourt, 2016); and K. Anders Ericsson, Ralf Th. Krampe, and Clemens Tesch-Römer, "The Role of Deliberate Practice in the Acquisition of Expert Performance," *Psychological Review* 100 (3) (1993): 363–406.

[2] Ibid.

[3] Susan R. Singer, Natalie R. Nielsen, and Heidi A. Schweingruber, eds., *Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering* (Washington, D.C.: National Academies Press, 2012).

[4] In what follows, I use the label "university" to refer to research universities: those large institutions with substantial numbers of undergraduate and graduate degrees, conventional academic departments, substantial programs of scholarly work, and so on.

[5] Daniel L. Schwartz, Jessica M. Tsang, and Kristen P. Blair, *The ABCs of How We Learn* (New York: W. W. Norton & Company, 2016).

[6] Singer et al., *Discipline-Based Education Research*; President's Council of Advisors on Science and Technology, *Engage to Excel: Producing One Million Additional College Graduates With Degrees in Science, Technology, Engineering, and Mathematics* (Washington, D.C.: Executive Office of the President, 2012); and Scott Freeman, Sarah L. Eddy, Miles McDonough, et al., "Active Learning Increases Student Performance in Science, Engineering, and Mathematics," *Proceedings of the National Academy of Sciences* 111 (23) (2014): 8410–8415.

[7] Freeman et al., "Active Learning Increases Student Performance in Science, Engineering, and Mathematics."

[8] See also Schwartz et al., *The ABCs of How We Learn*.

[9] K. Anders Ericsson, Neil Charness, Robert R. Hoffman, and Paul J. Feltovich, eds., *The Cambridge Handbook of Expertise and Expert Performance*, 2nd ed. (Cambridge: Cambridge University Press, 2018).

[10] A notable exception is the typical service course for nonmath majors taught by mathematics faculty.

[11] Ericsson et al., *The Cambridge Handbook of Expertise and Expert Performance*.

[12] Ericsson and Poole, *Peak*; and Ericsson et al., "The Role of Deliberate Practice in the Acquisition of Expert Performance."

[13] Ibid.; and Singer et al., *Discipline-Based Education Research*.

[14] Schwartz et al., *The ABCs of How We Learn*.

[15] Here we are considering the brain of the typical university student, neglecting any "clinical" anomalies present in special cases.

[16] There are many calls for university students to learn "critical thinking." As this is usually defined, it is equivalent to making better decisions in realistic situations. But a closer examination of what this means to any particular advocate of teaching critical thinking is usually that the students should learn to use the skills and knowledge of their discipline in making decisions of the sort valued by their discipline, with the assumption that this represents a generic skill that all students should have. There is an extensive body of research indicating that there is no such generic skill: any authentic decisions will necessarily involve discipline-specific knowledge and reasoning, and hence any measure of "critical thinking," including those currently used with claims they are generic, such as the Collegiate Learning Assessment, are in fact not generic. If the context and nature of the decisions involved changed, so would a student's performance.

[17] Schwartz et al., *The ABCs of How We Learn*.

[18] Ibid.

[19] This is different from the all-too-common example of a novice teacher applying some technique without understanding the principles on which it is based or the benefits it might provide, and thereby achieving little apparent benefit. An example (a real one) is introducing the use of clicker questions and peer discussion in a political science course with little understanding of suitable questions or goals of

discussion, and then judging the effectiveness of this teaching method according to the changes (or not) observed in the quality of the writing of the students' term papers.

[20] Freeman et al., "Active Learning Increases Student Performance in Science, Engineering, and Mathematics."

[21] Carl Wieman, "A Better Way to Evaluate Undergraduate Teaching," *Change: The Magazine of Higher Learning* 47 (1) (2015): 6–15; Lillian MacNell, Adam Driscoll, and Andrea N. Hunt, "What's in a Name: Exposing Gender Bias in Student Ratings of Teaching," *Innovative Higher Education* 40 (4) (2015): 291–303; and Amy L. Graves, Estuko Hoshino-Browne, and Kristine P. H. Lui, "Swimming against the Tide: Gender Bias in the Physics Classroom," *Journal of Women and Minorities in Science and Engineering* 23 (1) (2017).

[22] Wieman, "A Better Way to Evaluate Undergraduate Teaching."

[23] Originally developed for characterizing teaching in sciences, with some very small wording changes, it is now being used on at least a limited basis for all academic disciplines. Carl Wieman and Sarah Gilbert, "The Teaching Practices Inventory: A New Tool for Characterizing College and University Teaching in Mathematics and Science," *CBE – Life Sciences Education* 13 (3) (2014): 552–569; and Carl Wieman Science Education Initiative at the University of British Columbia, "CWSEI Teaching Practices Inventory," October 3, 2014, http://www.cwsei.ubc.ca/Files/CWSEI_TeachingPracticesInventory_Oct2014.pdf.

[24] Carl Wieman, *Improving How Universities Teach Science: Lessons from the Science Education Initiative* (Cambridge, Mass.: Harvard University Press, 2017).

[25] Ibid.

[26] Ibid.

[27] Ibid.

Appendix I
CWSEI Teaching Practices Inventory:
For Use in the Natural and Social Sciences

To create the inventory we devised a list of the various types of teaching practices that are commonly mentioned in the literature. We recognize that these practices are not applicable to every course, and any particular course would likely use only a subset of these practices.

We have added places that you can make additions and comments and we welcome your feedback.

It should take only about 10 minutes to fill out this inventory.

Please fill out the inventory for the current or just completed Term, lecture sections only.

Course number:
Section #(s) or Instructor name:
Total number of students in your class or section (approximate):

I. Course information provided to students via hard copy or course webpage

Check all that occurred in your course:

- ☐ List of topics to be covered
- ☐ List of topic-specific competencies (skills, expertise, . . .) students should achieve (what students should be able to *do*)
- ☐ List of competencies that are not topic related (critical thinking, problem solving, . . .)
- ☐ Affective goals – changing students' attitudes and beliefs (interest, motivation, relevance, beliefs about their competencies, how to master the material)
- ☐ Other (please specify)

If you selected other, please specify:

II. Supporting materials provided to students

Check all that occurred in your course:

- ☐ Student wikis or discussion boards with little or no contribution from you
- ☐ Student wikis or discussion boards with significant contribution from you or TA
- ☐ Solutions to homework assignments
- ☐ Worked examples (text, pencast, or other format)
- ☐ Practice or previous year's exams
- ☐ Animations, video clips, or simulations related to course material
- ☐ Lecture notes or course PowerPoint presentations (partial/skeletal or complete)
- ☐ Other instructor selected notes or supporting materials, pencasts, etc.
- ☐ Articles from related academic literature
- ☐ Examples of exemplary papers or projects
- ☐ Grading rubrics for papers or large projects
- ☐ Other (please specify)

If you selected other, please specify:

III. In-class features and activities

A. Various

Give approximate average number:

Average number of times per class: pause to ask for questions:
Average number of times per class: have small group discussions or problem solving:
Average number of times per class: show demonstrations, simulations, or video clips:
Average number of times per class: show demonstrations, simulations, or video where students first record predictions (write down, etc.) and then afterwards explicitly compare observations with predictions:
Average number of discussions *per term* on why material useful and/or interesting from students' perspective:
Comments on above (if any):

Check all that occurred in your course:

- ☐ Students asked to read/view material on upcoming class session
- ☐ Students read/view material on upcoming class session *and* complete assignments or quizzes on it shortly before class or at beginning of class
- ☐ Reflective activity at end of class, e.g. "one-minute paper" or similar (students briefly answering questions, reflecting on lecture and/or their learning, etc.)
- ☐ Student presentations (verbal or poster)

Fraction of typical class period you spend lecturing/talking to whole class (presenting content, deriving mathematical results, presenting a problem solution, . . .):

- ☐ 0 – 20%
- ☐ 20 – 40%
- ☐ 40 – 60%
- ☐ 60 – 80%
- ☐ 80 – 100%

Considering the time spent on the major topics, approximately what fraction was spent on the *process* by which the theory/model/concept was developed, including the experimental methods and results that support specific theories?

- ☐ 0 – 10%
- ☐ 11 – 25%
- ☐ more than 25%

B. Individual Student Responses (ISR)

If a student response method is used to collect responses from all students *in real time in class*, what method is used?

Check all that occurred in your course:

- ☐ Raising hands
- ☐ Raising colored cards
- ☐ Electronic (e.g. "clickers") with student identifier

- ☐ Electronic anonymous
- ☐ Written student responses that are collected and reviewed in real time
- ☐ Other (please specify)

If you selected other, please specify:

Number of ISR questions posed followed by student-student discussion per class:
Number of times ISR used as quiz (counts for marks and no student discussion) per class:

IV. Assignments

Check all that occurred in your course:

- ☐ Homework/problem sets assigned or suggested but did not contribute to course grade
- ☐ Homework/problem sets assigned and contributed to course grade at intervals of 2 weeks or less
- ☐ Paper or project (an assignment taking longer than two weeks and involving some degree of student control in choice of topic or design)
- ☐ Encouragement and facilitation for students to work collaboratively on their assignments
- ☐ Explicit group assignments
- ☐ Other (please specify)

If you selected other, please specify:

V. Feedback and testing; including grading policies

A. Feedback from students to instructor during the term

Check all that occurred in your course:

- ☐ Midterm course evaluation
- ☐ Repeated online or paper feedback or via some other collection means such as clickers
- ☐ Other (please specify)

If you selected other, please specify:

B. Feedback to students

(check all that occurred in your course)

- ☐ Assignments with feedback from instructor, teaching assistant, or peer before grading or with opportunity to redo work to improve grade
- ☐ Students see graded assignments
- ☐ Students see assignment answer key and/or grading rubric
- ☐ Students see graded midterm exam(s)/quizzes
- ☐ Students see midterm exam(s)/quizzes answer key(s)
- ☐ Students explicitly encouraged to meet individually with you
- ☐ Other (please specify)

If you selected other, please specify:

C. Testing and grading

Number of tests during term that reflect course expectations (e.g. mid-term exams, but not final exams):

Approximate fraction of test scores from questions that required students to explain reasoning:

Approximate breakdown of course grade (% in each of the following categories):

Final exam:
Midterm/other exam(s):
Homework assignments:
Paper(s) or project(s):
In-class activities:
In-class quizzes:
Online quizzes:
Participation:
Lab component:
Other:

If you selected other, please specify:

VI. Other

Check all that occurred in your course:

- ☐ Assessment given at beginning of course to assess background knowledge
- ☐ Use of instructor-independent pre-post test (e.g. as concept inventory) to measure learning
- ☐ Use of a consistent measure of learning that is repeated in multiple offerings of the course to compare learning
- ☐ Use of pre-post survey of student interest and/or perceptions about the subject
- ☐ Opportunities for students' self-evaluation of learning
- ☐ Students provided with opportunities to have some control over their learning, such as choice of topics for course, paper, or project, choice of assessment methods, etc.
- ☐ New teaching methods or materials were tried along with measurements to determine their impact on student learning

VII. Training and guidance of Teaching Assistants

Check all that occurred in your course:

- ☐ No TAs for course
- ☐ TAs must satisfy English language skills criteria
- ☐ TAs receive 1/2 day or more of training in teaching
- ☐ There are Instructor-TA meetings every two weeks or more frequently where student learning and difficulties and the teaching of upcoming material are discussed
- ☐ TAs are undergraduates
- ☐ TAs are graduate students
- ☐ Other (please specify)

If you selected other, please specify:

VIII. Collaboration or sharing in teaching

- ☐ Used or adapted materials provided by colleague(s)
- ☐ Used "Departmental" course materials that all instructors of this course are expected to use

Discussed how to teach the course with colleague(s):

- ☐ 1 Never
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 Very Frequently

Read literature about teaching and learning relevant to this course:

- ☐ 1 Never
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 Very Frequently

Sat in on colleague's class (any class) to get/share ideas for teaching:

- ☐ 1 Never
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 Very Frequently

IX. General

Open-ended comments:

Please write any other comments here. If this inventory has not captured an important aspect of your teaching of this course, or you feel you need to explain any of your above answers, please describe it here:

Approximately how long did it take you to fill out this inventory?

We thank you for taking the time to fill out this inventory.

Source: Adapted from Carl Wieman and Sarah Gilbert, "Teaching Practices Inventory," *CBE – Life Sciences Education* 13 (3) (2014): 552–569.

Appendix II
Background of the CWSEI

The Carl Wieman Science Education Initiative (CWSEI) at the University of British Columbia and its smaller partner at the University of Colorado Boulder were large-scale finite-duration experiments (approximately $10 million and $5 million, respectively) in institutional change. They showed that it is possible for large research-intensive university science departments to make major changes in their teaching, and they revealed the processes that help and hinder such change. An extensive discussion of this experiment is given in Carl Wieman, *Improving How Universities Teach Science* (2017).

At the University of British Columbia, the Initiative changed the teaching of about 170 science faculty members and courses, with the fraction of transformed faculty and credit hours reaching 90 percent in some departments. These faculty are finding teaching to be more rewarding, and their students are far more engaged and learning more. Teaching became much more of a collaborative intellectual activity in these departments, with faculty sharing methods and results and seeking out ideas from others. The transformed teaching is characterized by: detailed learning goals for the course that express what students should learn to do in operational terms; in-class active-learning activities such as peer instruction, think-pair-share, and worksheets that have students practicing expert thinking by answering questions in small groups monitored by the instructor and TAs and interspersed with regular instructor feedback and guidance; different forms of assessment aligned with course goals, such as graded homework, more-frequent lower-stakes exams, and two-stage exams that students complete individually and then as a group; reflective exercises such as two-minute papers at the end of a class; and brief preclass preparations such as targeted readings.

Such results were not easy nor shared across all departments. The three most important elements were: supporting department-level change, incentives, and maximizing faculty buy-in.

Supporting department-level change. At universities, each department decides what and how to teach, and so the department is the unit of educational change. The CWSEI used a competitive grant program by which departments competed for up to $1.8 million over six years to transform teaching. Potential grants of this scale produced discussions of undergraduate teaching needs and opportunities that had never happened before. The success of the funded departments was strongly influenced by disciplinary culture and the quality of the departmental leadership and administration, which varied greatly. New

structures and people, such as a teaching initiatives committee with responsibility and resources, were required, as the traditional departmental structures, when left unchanged, were never effective at supporting innovation.

A key component in every successful department were science education specialists (SESs) with deep expertise in the respective discipline combined with expertise in teaching and learning in the discipline. The SESs were hired by the department and worked collaboratively with a sequence of faculty to transform courses and, in the process, the teaching of the faculty. The SESs act as nonthreatening coaches, providing expert guidance and support to faculty members as they try new things in their courses. With SES guidance, a faculty member was likely to implement research-based teaching methods in an effective manner from the beginning, and hence have a positive teaching experience. The SESs also provide expert and time-saving assistance in developing new course materials and assessments. It was usually easy to find good SES candidates with the necessary disciplinary knowledge and interest in education, typically new Ph.D.s, but it was necessary to set up an extensive training program for them in the relevant research and best research-based teaching methods.

Incentives. Incentives need to be provided for both the departments and the individual faculty members to take the time to learn new teaching methods. The formal incentive system is a powerful disincentive to improving teaching. At all universities, the evaluation system does not recognize that research has shown there are fundamental differences in the effectiveness of different teaching methods, and hence the system penalizes any time away from research to learn better methods. The CWSEI showed that it does not cost more money or time to teach using these more effective methods, but it does cost money to bring about change. One incentive is having the dean and department chair clearly convey that better teaching is an important institutional goal, but most other incentives involve money in one form or another, largely to minimize and compensate for the time required to learn.

Maximizing faculty buy-in. Instead of starting with specific courses to transform, it was more effective to start with any willing faculty members and accommodate them according to what courses and process of change work best for them. Some faculty were happy to carry out a total course transformation all at once, but for many others, an incremental approach worked better, from both psychological and logistical perspectives. Even modest changes usually showed positive results. Almost immediately the use of active learning methods gave faculty a better understanding of their students' thinking, and hence how to make their teaching more effective. There are many fears associated with making change. The most effective ways to address these fears were not

by providing data, but rather by having faculty talk to their colleagues who had transformed their teaching and watch the teaching of a good transformed course in their department. For many faculty members, it can take one or two years of hearing about these ideas and discussing them with their colleagues before they decide to change, with no obvious large differences between young and older faculty members.

The CWSEI has published a large body of resources on its website. These include peer-reviewed research papers on various aspects of teaching and learning and extensive guidance for instructors. The following links also feature a variety of guides on details of design and implementation of research-based instruction and videos showing demonstrations.

- For a collection of documents offering detailed advice for departments and faculty members on how to redesign courses, see "Course Transformation Resources," http://www.cwsei.ubc.ca/resources/course_transformation.htm.
- For a collection of short guides for instructors (on assessment, clicker use, student engagement, and so on) that illustrates in concrete terms the pedagogical philosophy (active engagement of students) underlying these initiatives, see "Instructor Guide," http://www.cwsei.ubc.ca/resources/instructor_guidance.htm. The advice is highly practical.
- For a collection of videos that show, among other things, what active learning looks like, see "Science Education Initiative (SEI) Videos," http://www.cwsei.ubc.ca/resources/SEI_video.html.
- For an annotated bibliography of papers on the research behind many aspects of active learning, see "Recommended Papers," http://www.cwsei.ubc.ca/resources/papers.htm.

Together *and* Alone? The Challenge of Talking about Racism on Campus

Beverly Daniel Tatum

Higher education institutions are among the few places where people of different racial, cultural, and socioeconomic backgrounds can engage with each other in more than just a superficial way, providing students a unique opportunity to develop the skills needed to function effectively in a diverse, increasingly global world. Whether students develop this capacity will depend in large part on whether the institution they attend has provided structures for those critical learning experiences to take place. But what form should such learning experiences take? This essay argues that positive cross-racial engagement may require both structured intergroup dialogue and intragroup dialogue opportunities to support the learning needs of both White students and students of color in the context of predominantly White institutions.

In 1954, the year of the landmark Supreme Court case on school segregation *Brown v. Board of Education*, the U.S. population was 90 percent White.[1] Today, the majority of elementary and secondary school children are children of color: Black, Latinx, Asian, or American Indian.[2] Yet despite the changing demographics of the nation, most children in the United States attend elementary and secondary schools that do not reflect that diversity. Old patterns of segregation persist, most notably in schools and neighborhoods. More than sixty years after *Brown*, our public schools are more segregated today than they were in 1980.[3] Nationwide, nearly 75 percent of Black students today attend so-called majority-minority schools, and 38 percent attend schools with student bodies that are 10 percent or less White. Similarly, approximately 80 percent of Latinx youth attend schools where students of color are in the majority, and more than 40 percent attend schools where the White population is less than 10 percent of the student body. Both Black and Latinx students are much more likely than White students to attend a school where 60 percent or more of their classmates are living in poverty.[4]

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Neighborhoods once again determine public school assignment, and to the extent that neighborhoods are segregated, the schools remain so.

Given this pattern of segregation, it is perhaps no surprise that, according to a 2013 American Values Survey conducted by the Public Religion Research Institute (PRRI), 75 percent of Whites have entirely White social networks, without any minority presence. This degree of social network racial isolation is significantly higher than among Black Americans (65 percent) or Hispanic Americans (46 percent). Robert P. Jones, the CEO of PRRI, has pointed out that "the chief obstacle to having an intelligent, or even intelligible, conversation across the racial divide is that on average White Americans . . . talk mostly to other White people." The result is that most Whites are not "socially positioned" to understand the experiences of people of color.[5] The now centuries-long persistence of residential and school segregation in the United States goes a long way toward explaining such social network homogeneity.

And what difference does it make? In his 1968 book *Where Do We Go From Here: Chaos or Community?* Rev. Dr. Martin Luther King observes that the social change needed for a healthy multiracial society would not occur without meaningful cross-group contact. "A vigorous enforcement of civil rights will bring an end to segregated public facilities, but it cannot bring an end to fears, prejudice, pride and irrationality, which are the barriers to a truly integrated society." King continues, "Racial understanding is not something that we find but something that we must create.... The ability of [racial groups] to work together, to understand each other will not be found ready-made; it must be created by the fact of contact." *Empathic* contact must be created. It is not enough to be in the same neighborhood, or even in the same room. It is necessary to create contact that allows for genuine empathy across lines of difference if we are to reduce the barriers that King describes.

Higher education offers us the possibility of creating such empathic contact. More young people than ever are making the choice to pursue higher education. The increasing diversity of our nation can be seen in higher ed institutions of all kinds. The incoming class of 2022 is more diverse than ever, reflecting the changing demographics of the nation. Even a highly selective institution like Harvard University reported in the fall of 2017 that the entering class was the most diverse in its history, with students of color for the first time making up more than 50 percent of the cohort.[6] Colleges and universities are among the few places where people of different racial, cultural, and socioeconomic backgrounds can engage with each other in more than just a superficial way. For many students, regardless of racial background, the college environment is likely the most diverse learning environment they have experienced in their lives. In that context, students have a unique opportunity to

engage with people whose life experiences and viewpoints are different than their own *and* to develop the leadership capacity needed to function effectively in a diverse, increasingly global world. Learning to engage with others whose viewpoints are different from one's own is a citizenship skill fundamental to maintaining a healthy democracy.

Whether college students develop this citizenship skill, however, will depend in large part on whether the institution they attend has provided structure for those critical learning experiences to take place. It is natural for students of all backgrounds to gravitate to the comfort of the familiar, seeking out those places where they experience a deep sense of belonging. Sometimes that sense of belonging comes from spending time with same-experience peers (such as those who may be of the same racial background, or share the same religious beliefs, or speak the same home-language), and there is nothing wrong with that. But the development of these citizenship skills requires stepping out of one's comfort zone and engaging with difference. Without encouragement, students often avoid doing so.

For example, in the fall of 2016, I visited Franklin and Marshall College, a small liberal arts college in Lancaster, Pennsylvania, that is increasingly known for its commitment to expanding access for student talent from all racial, ethnic, and socioeconomic backgrounds. The president had invited me to join him in a conversation about the importance of dialogue as the kick-off event for "A Day of Dialogue" on campus. After the college had spent the previous school year "participating in a national conversation about inclusiveness and discrimination, about identity and community, about who we are and who we hope to become," the faculty suggested that classes be canceled for a day to allow time for the community to "center ourselves . . . and listen to one another, where we set a goal to be able to go forward as a community in diversity – not have *one* day of dialogue but *catalyze* deeper inquiry together as a part of who we are, our very core."[7]

The schedule for the day was full, and students were engaged in facilitated conversations on various topics. Every session room I saw was full, and students were listening to each other intently. At lunchtime, students were randomly assigned to eat lunch together in student spaces that they might not otherwise enter. I joined a group of students having lunch in one of the fraternity houses. Many of the students had never been in it before, and the young White man who served as one of the hosts acknowledged that he, too, had avoided spaces on campus that felt unfamiliar to him. For example, he had never entered the Black Cultural Center, though he had been invited to programs there, or attended a Hillel event, though he had several Jewish friends, or made the time to attend the weekly International Student

Coffee Hour. Student enthusiasm for the opportunity to enter unfamiliar territory and make new connections that day seemed genuine. The unanswered question was whether they could build on the day's momentum for *sustained* engagement.

How might such meaningful engagement be created? I would argue that positive cross-group engagement can be achieved through the power of structured dialogue. Institutions that are intentional in stimulating such intellectual growth by providing formative experiences of dialogue across lines of difference (ideological as well as sociological) can help students develop the skills they need to be effective citizens in an increasingly complex world and, perhaps, help each other find common ground.

The University of Michigan has pioneered this strategy for sustained engagement through a residential learning community known as the Michigan Community Scholars Program (MCSP). Established in 1999, the MCSP has an inspiring mission statement:

> The Michigan Community Scholars Program is a residential learning community emphasizing deep learning, engaged community, meaningful civic engagement/community service learning, and intercultural understanding and dialogue. Students, faculty, community partners, and staff think critically about issues of community, seek to model a just, diverse, and democratic community, and wish to make a difference throughout their lives as participants and leaders involved in local, national, and global communities.[8]

The learning community is made up of 120 first-year students and their resident advisers, as well as ten to fifteen faculty members linked to the program. An intentionally diverse community, the MCSP interrupts the experience of segregated residential communities from which the students typically come. The MCSP uniquely brings together service-learning, diversity, and dialogue in a powerful way. Unlike the typical residence hall experience in which students from different backgrounds might pass each other in the hallway without really engaging one another, at the core of the MCSP experience is the opportunity, indeed the requirement, for intergroup dialogue. As part of the residential experience, the students take a seminar together and participate in various structured dialogues in the residence hall.

While visiting the University of Michigan in the fall of 2016, just a month before the U.S. presidential election, I facilitated a focus group of MCSP students and heard all speak eloquently about how much they had gained from the program. They also shared how different their experiences were from their classmates' who were not participating in such a program. In the midst

of a campaign season characterized by rancorous debate and divisive rhetoric, these students were deeply engaged with each other, across lines of difference, and were learning how to talk *with* one another about hard topics rather than talking *past* one another or avoiding interaction altogether.

The value of these cross-group connections was made more salient by racist acts that took place on campus during that semester. White supremacist posters with explicitly anti-Black content were posted around the Michigan campus, creating a hostile environment for Black students who felt under attack. One young African-American woman, still in her first year, explained, "It's hard to focus [on your schoolwork] when there's so much hateful stuff. . . . It's hard to know who to trust. . . . It takes energy to reach out to Whites without knowing if they are 'safe.' MCSP helps with that." A White woman in her cohort was quick to second that sentiment, even though as a White student she was not the target of hateful rhetoric. She added, "MCSP is the only place where I've constantly felt supported, listened to, and understood."

In a qualitative study of the impact of the MCSP on students' growth relative to social justice outcomes, Rebecca Christensen, Michigan's director of engaged learning, found that nineteen out of twenty-two participants exhibited greater cognitive, affective, and behavioral empathy toward others, and were actively engaged in educating others and "speaking out" against injustice. They had heightened motivation to "create small-scale change in their everyday lives" and to "incorporate social justice into their future careers." Of the various curricular, cocurricular, and informal MCSP-affiliated activities that facilitated their growth, students identified the dialogues both in and outside of the classroom as the most influential.[9]

Though only a small number of students (relative to the thousands who attend the University of Michigan) have the opportunity to participate in the residential MCSP, it serves as an excellent model that could be expanded at Michigan and certainly replicated on other campuses. Alternatively, Michigan students also have the option to register for one of the dialogue courses offered by the Program on Intergroup Relations (IGR). The first program of its kind in the nation, founded in 1988, the IGR precedes the MCSP by a decade. Described as a social justice education program, the IGR blends theory and experiential learning to facilitate students' learning about social group identity, social inequality, and intergroup relations. It is intentional in its effort to prepare students to live and work in a diverse world and educate them in making choices that advance equity, justice, and peace.[10]

What exactly are the dialogues? Defined by Ximena Zúñiga, one of the original architects of the Michigan IGR program, and her colleagues, an intergroup dialogue is a facilitated, face-to-face encounter that seeks to foster

meaningful engagement between members of two or more social identity groups that have a history of conflict (for example, Whites and people of color or Arabs and Jews).[11] The identity groups (defined by race, ethnicity, religion, socioeconomic class, gender, sexual orientation, ability status, or national origin) are balanced in size, with five to seven participants from each group, and carefully designed to address issues of social group identity, conflict, community, and social justice. Emphasizing both process and content, the credit-bearing courses use a four-stage model that provides a developmental sequence for the dialogue: 1) creating a shared meaning of dialogue; 2) identity, social relations, and conflict; 3) issues of social justice; and 4) alliances and empowerment. At the heart of the methodology is cultivating the capacity to listen, a skill that is central to the practice of dialogue.

Does dialogue lead to social action? The research evidence suggests the answer is yes! Both White students and students of color who participate in dialogue demonstrate attitudinal and behavioral changes, including: increased self-awareness about issues of power and privilege, greater awareness of the institutionalization of race and racism in the United States, better cross-racial interactions, less fear of race-related conflict, and greater participation in social change actions during and after college.[12] A multiuniversity study of intergroup dialogue programs found that participants increase their capacity for intergroup empathy and their motivation to connect with people different from themselves. This is especially significant since longitudinal research shows that these changes endure beyond the time of participation in the dialogues.[13]

Increasingly recognized as a high-impact educational practice, dialogue programs are spreading to other campuses. Zúñiga now teaches at the University of Massachusetts in the social justice education program, where she is training graduate students who want to become expert in dialogue facilitation and related research. As at Michigan, UMass offers intergroup dialogue courses. I had the opportunity to sit in on two group dialogue sessions in November 2016, just ten days after the presidential election. It was powerful to hear students talking about how they had been able to use their dialogic skills outside of class to have difficult conversations with peers about the election at a time when so many of their elders were struggling to have such conversations themselves.

The ripple effects of the Michigan and UMass models can be seen at Skidmore College, where sociologist Kristie Ford is now the director of the Skidmore intergroup relations program, which has adapted the Michigan model to suit Skidmore's small campus. In 2012, Skidmore became the first college or university in the United States to offer a minor in intergroup relations.

(Even though it is the leader in intergroup dialogue, the University of Michigan did not establish its intergroup relations minor until 2015.) Unlike UMass or the University of Michigan, Skidmore is a liberal arts college and does not have a ready supply of graduate students to serve as dialogue facilitators. Instead, Skidmore focuses on developing peer facilitators to lead the dialogue groups. Facilitators are selected based on their academic performance, developmental maturity, leadership potential, and demonstrated facilitation ability. They take at least three courses over a three-semester period as preparation, and they are provided ongoing support and supervision from a faculty member during their peer-facilitation experience. In her book *Facilitating Change through Intergroup Dialogue: Social Justice Advocacy in Practice,* Ford documents the postgraduate effects on those undergraduates who learned to be facilitators. Their commitment to social justice is evidenced in their career choices and their continued growth as White allies and as empowered people of color.[14]

The IGR model has recently been adapted for use in high schools. In one study, trained college students, serving as near-peer facilitators, led eight weekly dialogues with students in a racially diverse high school, designed to engage the younger students in exploring identity, building cross-group relationships, and learning how to intervene in intergroup conflict. As with the college examples, the dialogues with younger adolescents were impactful. Students "deepened their ability to think critically about racial issues and listen actively to others' opinions," proving the dialogues to be "an effective intervention model for promoting civil discourse on race in this hyperpartisan age."[15]

While it is clear that intergroup dialogue can be an effective tool for building bridges and perhaps reducing what Dr. King referred to as the "fears, prejudice, pride and irrationality, which are the barriers to a truly integrated society," there are those who are understandably hesitant to participate. Among them are students of color who fear that the dialogue process will place the heavy burden of educating their White peers on their shoulders. In his essay on the challenges of being a Black professor whose scholarship is on race, George Yancy writes not only of his experience with racism in the academy, but also about the frustration students of color express about the futility of talking to White people about racism.

> Some of my students of color have asked me, "Why talk about race with white people when at the end of the day everything remains the same – that is, their racism continues?" "Why teach courses on race and whiteness?" "Do you really think that such courses will make a difference?"[16]

I hear similar questions from students of color on the predominantly White campuses I regularly visit. They wonder if it is worth the emotional energy required to try to explain what it is like to be the target of someone's malice or the object of someone's indifference. Is it their obligation, they ask, to educate fellow students about history that should have already been learned, or experiences with racism that are painful to recall and exhausting to explain? Some people of color have concluded it is not worth the emotional cost.

Though journalist Reni Eddo-Lodge lives in Great Britain, her 2014 blog post on why she does not want to engage with most White people in conversations about race has resonated with many people of color in the United States. She expanded on her post in a longer article for *The Guardian*:

> On 22 February 2014, I published a post on my blog. I titled it "Why I'm No Longer Talking to White People about Race." It read: "I'm no longer engaging with white people on the topic of race. Not all white people, just the vast majority who refuse to accept the existence of structural racism and its symptoms. I can no longer engage with the gulf of an emotional disconnect that white people display when a person of colour articulates their experience. You can see their eyes shut down and harden. It's like treacle is poured into their ears, blocking up their ear canals. It's like they can no longer hear us."[17]

The frustration of feeling unheard again and again can be a significant source of stress for an already vulnerable population. According to a national survey conducted in 2018, students of color report higher rates of emotional distress in their freshman year than White students and are more likely to keep their difficulties to themselves. They are half as likely as their White peers to seek out counseling, yet they need support.[18] That support is often found through affinity groups and in designated cultural spaces on campus.

Some faculty and administrators question the value of such spaces, sometimes referred to as "safe spaces." Such places might be more accurately described as "refueling spaces," where students feeling depleted from the ongoing effort to navigate unfamiliar or hostile social environments can relax and recharge their energy with other students who share and therefore understand their experiences. Alumni of color often acknowledge the importance of this kind of emotional support for their success in an otherwise alienating environment. In a recent conversation with a Native woman who graduated from a highly selective university, she acknowledged that she "never would have made it through without the Native American Cultural Center," where she spent much of her free time. In an essay about her undergraduate experience at the University of Missouri from 1997 to 2001, historian Marcia Chatelain describes the racial harassment she and other student activists were

subjected to in the form of threatening letters, strange phone calls, and frightening emails, delivering messages about "who needed to shut up and die."

> Conjuring up those memories makes my stomach churn. . . . Pranks or promises? You never knew. . . . You sink into a hypervigilance that some read as paranoia. But the humiliation and fear become a part of you. Every cell of your 19-year old body holds the anxiety of the moments when you are put in your place because you dared to come into someone else's home and thought you could make it yours too. . . . When critics mock students for wanting safe spaces, they often argue that political correctness is undermining education and that students today are "too sensitive." Rarely do I ever hear any curiosity about what students are seeking shelter from; when my friends and I peered around the corners of our sprawling campus, dissenting opinions were the least of our worries.[19]

Twenty years later, with hate crimes on the rise since the 2016 presidential election of Donald Trump, the fear she describes is part of another generation's college experience.[20] The Southern Poverty Law Center, which tracks hate-motivated incidents, reports that schools, both K–12 and higher ed institutions, have been the most common venues for hate incidents.[21] Add to that the "you don't belong here" message conveyed by frequent social media documentation of White people calling the police to report "suspicious" Black people doing ordinary, quite lawful things like sitting in Starbucks waiting for someone or taking a nap in the common room of one's own residence hall; or the "stop speaking Spanish" demands directed at Latinx shoppers in a store; or the casual "Where are you REALLY from?" questions asked of Asian-American citizens, too often viewed as "foreigners" in the country of their birth. It is easy to understand why students of color will tell you they are "tired" and why they might want to refuel in the welcoming company of each other.

In her 2018 book *Race on Campus: Debunking Myths with Data*, higher ed scholar Julie Park summarizes research demonstrating that the involvement of students of color, particularly Black and Latinx students, with ethnic student organizations is linked with a deeper sense of campus belonging and greater cross-racial campus engagement.

> Ethnic student organizations play a vital role in not just helping retain students of color: they also contribute to the broader campus racial climate by promoting interracial interaction, giving students of color space to recharge their batteries and navigate a diverse and at times racially charged environment.[22]

Though it may seem counterintuitive that affinity group opportunities would promote higher rates of overall interracial contact, if we understand that people are more willing to take risks when they are operating from an

internal sense of strength, it makes sense that the experience of affirmation and belonging found in affinity groups could serve as a launching pad for greater cross-campus engagement and eventual participation in the challenging work of intergroup dialogue.

As noted earlier, White adults represent the demographic group with the lowest rates of casual interracial contact and interracial friendship. The same is true of young White students.[23] Consequently, Whites have their own anxieties about engaging in intergroup dialogue. During my years of teaching a course on the psychology of racism at predominantly White institutions, my White students often expressed fear that because of their limited knowledge and experience interacting with people of color, they might ask a naive question or make an offensive remark. This student's comment was typical: "The fear of speaking is overwhelming. I do not feel, for me, that it is fear of rejection from people of my race, but anger and disdain from people of color." Another acknowledged, "Fear requires us to be honest with not only others, but with ourselves. Often this much honesty is difficult for many of us, for it would permit our insecurities and ignorance to surface. . . . Rather than publicly admit our weaknesses, we remain silent."[24]

The retreat into silence is just one of several strategies commonly used by White students when they experience discomfort in conversations about race. Multicultural education scholar Robin DiAngelo has coined the term "white fragility" to describe the emotional response to such discomfort: "A state in which even a minimum amount of racial stress becomes intolerable, triggering a range of defensive moves. These moves include the outward display of emotions such as anger, fear, and guilt, and behaviors such as argumentation, silence, and leaving the stress-inducing situation."[25]

Framing White fragility as a lack of stamina in the face of racial discomfort, DiAngelo explains that it results in part from racial isolation and the deeply ingrained expectation of racial comfort that comes from the daily experience of "racial belonging" that White people typically share in a White-dominated society. She writes, "In virtually every situation or context deemed normal, neutral or prestigious in society, [White people] belong racially. This belonging is a deep and ever-present feeling. . . . It is rare to experience a sense of not belonging racially, and these are usually very temporary, easily avoidable situations." DiAngelo further enumerates a common set of racial patterns that are "the foundation of white fragility," including: a demonstrated preference for racial segregation, a lack of understanding about the systemic nature of racism (focusing instead on acts of mean-spirited individuals), seeing themselves as individuals who are "exempt from the forces of racial socialization," a reluctance to acknowledge the significance of history, an inclination

to make assumptions about the universality of their experience, an unwillingness to listen closely to the racial experiences of others, a tendency to dismiss what is not understood, a desire to jump over the hard, personal work of self-examination and get to "solutions," a need to maintain solidarity with other Whites (such as by not confronting them when they say or do something racially offensive), feeling paralyzed by guilt, taking a defensive stance toward any suggestions that they are connected to racism, and maintaining a focus on intentions rather than impact.[26] White fragility serves to maintain a sense of equilibrium in the face of racial discomfort.

> White equilibrium is a cocoon of racial comfort, centrality, superiority, entitlement, racial apathy, and obliviousness, all rooted in an identity of being good people free of racism. Challenging this cocoon throws off our racial balance. Because being racially off balance is so rare, we have not had to build the capacity to sustain the discomfort. Thus, whites find these challenges unbearable and want them to stop.[27]

Such framing helps us understand why exposure to stamina-building activities like dialogue can be an appropriate intervention. That said, some prework may be needed before White students can be effective dialogue partners. An Asian-American woman in one of my classes explained,

> The process of talking about [racism] is not easy. We people of color can't always make it easier for White people to talk about race relations because sometimes they need to break away from that familiar and safe ground of being neutral or silent. . . . I understand that [some are] trying but sometimes they need to take bigger steps and more risks. As an Asian in America, I am always taking risks when I share my experiences of racism, however the dominant culture expects it of me. . . . Even though I am embarrassed and sometimes get too emotional about these issues, I talk about them because I want to be honest about how I feel.[28]

She is ready to break the silence, but too often her White peers are not. They need more practice.

So what are campus leaders to do? I return to the example of the University of Michigan. Not only do they have intergroup dialogues but they have intragroup dialogues: opportunities for students with shared identities to have facilitated conversations among themselves; students of color in dialogue with each other, as well as White students exploring with other White students why talking about racism is so hard for them and how to become better allies to those who do not experience the same kind of racial belonging on campus that they do. In this context, intergroup dialogue is important, but intragroup dialogue has value, too.

It is certain that without understanding the context of intragroup dialogue, some people see such homogeneous offerings as the institutional sanctioning of segregated gatherings (perhaps even a throwback to our Jim Crow history), and consequently respond very negatively to the idea. For example, when the University of Maryland Counseling Center posted signs advertising a group called "White Awake: A group for White students to talk about race," described as a "safe space for White students to explore their experiences, questions, reactions, and feelings," the social media response was rapid and largely negative. One student of color posted, "Why do they need to attend therapy sessions on how to be a decent human being in society? Why do they need to have these sessions to learn how to coexist?"[29] A White *National Review* commentator wrote,

> It should seem clear to anyone with a brain that the best way to learn about issues related to other races is to interact with people of other races. Creating a forum to discuss such issues that intentionally *excludes* non-white people is doing everyone a disservice. The best way to learn about any kind of experience is to learn from someone who has actually gone through it, and this group will have no opportunities for that.[30]

Implied in this last comment are the assumptions that White students live outside of the structures of racism, and that students of color should be their teachers, exactly the kind of assumptions many students of color find so problematic.

In response to the critiques, the university changed the name of the group to "Anti-Racism and Ally Building Group," clarifying its intended purpose. A statement issued by the counseling center staff explained: "The aim of this group is to help White students become more culturally competent, so they can better participate in creating a more inclusive environment at the University of Maryland."[31] Seen through the conceptual lens of White fragility, the counseling center initiative could be understood as an effort to build White students' stamina for racial dialogue and relieve students of color of some of the burden of educating their White peers.

If we are clear that the purpose of affinity groups for students of color and ally-building groups for White students is in fact to increase or strengthen the capacity of students to engage meaningfully with each other, the wisdom of providing intragroup dialogues as a campus resource is apparent. The long history of segregated communities in our society has left us with a population of students who arrive at our campus with little previous experience of the kind of empathic contact that Martin Luther King described as necessary for meaningful social change. They should leave better prepared than they

arrived. Building that capacity requires a multifaceted approach. In the case of intergroup or intragroup dialogue, it is not an either-or choice, but rather a both-and strategy.

Some people believe that talking about race only makes race relations in our society worse. Silencing the conversation, however, is just another way to maintain the status quo. You cannot solve a problem without talking about it. Learning how to have this dialogue is a necessary part of moving forward as a healthy society. It is of particular importance that White people who want to see social change learn how to have the conversation, not just with people of color, but with their White peers as well. As social justice educator Lee Anne Bell has written, "Refusing to talk about powerful social realities does not make them go away but rather allows racial illiteracy, confusion and misinformation to persist unchallenged."[32]

Rather than avoiding hard conversations, through dialogue together and sometimes in same-race groups alone, students can help each other see the past more clearly and understand and communicate with others more fully in the present. With some help, they can find ways to work together in coalition for the betterment of our communities tomorrow and for the health of our democracy.

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"Now Is the Time": Civic Learning for a Strong Democracy

Sylvia Hurtado

Cultivating citizens for American democracy has historically been a key purpose of higher education, yet today's college students are in contact with more divergent worldviews, increasing demographic diversity sometimes accompanied by fear of "the other," and resulting conflict in policies amid rising inequality. Now is the time to recenter civic learning within and across all institutions and disciplines, as well as undertake more critical approaches to this work in terms of pedagogy that prepares students for a diverse and unequal society. Colleges' collective efforts have already resulted in critical community engagement, curricula reform, and better ways of articulating and assessing civic learning practices. Extending civic learning to reflect how we teach will result in more engaged citizens capable of understanding differences, conflict as an opportunity to learn, and community-building processes characteristic of a strong democracy.

During a time of great civil unrest over racial injustice, Dr. Martin Luther King Jr. stated, "Now is the time to make real the promises of our democracy." Today's changing demographics, globalization, media, and technology place young adults in regular contact with diverse cultures, social movements, and conflicting worldviews that raise important questions about our democracy and challenge their own perspectives. Now is the time to foster civic learning to prepare all students for engaging in a democracy embedded in an "increasingly contentious and fractured world, where diversity is crucial."[1] The contemporary era is divided over key policy issues and rising inequality, and yet it represents a critical opportunity for the education and engagement of young adults. The 2018 midterm elections reflected a surge in voting among the high school senior and college-age population, with 31 percent exercising their right to vote and significant increases in youth political activism since the 2016 presidential election.[2] Increased voter turnout was attributed, in part, to one of the most contentious presidential candidates in U.S. history, who had no record of public service. Rather than abandoning

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ideals out of cynicism and growing dismay about democratic processes, youth surveys suggest a diverse, college-age population with a collective approach toward positive change. However, voting and activism are not the only behaviors to monitor. Engaged citizenship requires development of college students' capacities and habits of mind that include knowledge, skills, and values to counter misinformation, negotiate conflict, and identify threats to a pluralistic democracy. Further, although 87 percent performed some type of volunteer work during high school, only 19 percent of freshmen entering four-year colleges score high on civic engagement behaviors.[3] That is, civic learning involves more than engaging in charitable service, and many students have yet to discover what democratic practices feel like in the classroom. How and what we teach the next generation is critical to building a hopeful vision of an American society that is more equitable, sustainable, and economically stable, and is governed by a strong democracy.

The purpose of this essay is to illuminate how inclusive college teaching based on civic learning goals can model community and democratic principles to enhance students' civic skills and dispositions for a diverse and changing world. To begin, I provide a brief overview of the civic learning landscape in higher education. I call attention to integrative approaches to civic learning goals to bring coherence to campus efforts, even as the diversity and civic engagement movements have evolved separately and oftentimes exist in separate units on campus.[4] Key democratic concepts and pedagogy typically associated with service learning and intergroup dialogue can be integrated into many courses and classrooms. The aim is to encourage faculty to take responsibility to engage diverse classrooms and develop a new generation of citizens willing to enact innovative solutions to the problems of the twenty-first century.

While primary and secondary education are intended to provide all students with education in civics – defined as the rights and duties of citizens and an understanding of how government works – higher education has historically played a special role in educating citizens for leadership in society. Cultivating citizenship has been embedded in the purposes of higher education from the days of the earliest colleges to the contemporary movements of civic engagement. It is a key component of a quality education. For example, accreditation agencies include civic engagement and civic discourse in a diverse and multicultural society as a core element in evaluating the quality of education that many campuses promote in institutional mission statements. Civic learning is also one of the five identified areas in the "Degree Qualifications Profile" established to promote the quality of associate's to master's degrees, fostering students' capacity to "engage with, respond to, and reflect

on political, social, environmental and economic challenges at local, national and global levels."[5] Still, there is the common notion that civic learning is optional and that we are reaching only students who arrive with open hearts and minds about their personal and social responsibilities and choose specific college courses. We need to extend the reach and occasions for civic learning in college.

Much activity has taken place across the American higher education landscape in the last thirty years to recenter the role of colleges and universities in advancing civic learning. Many institutions have created new roles, initiatives, and centers supporting civic learning as well as increased their involvement in a broad social movement reflecting an array of academic groups and campus consortia concerned with civic learning and student development, including the initiatives and resources in such organizations as Campus Compact, Bringing Theory to Practice, and Imagining America.[6] In 2012, the American Association of Colleges & Universities' (AAC&U) National Task Force on Civic Learning and Democratic Engagement released the comprehensive report *A Crucible Moment: College Learning & Democracy's Future*. It was a national call to action for civic learning to acquire equal footing and integration with educational career and degree-completion goals. The report helped jump-start and coordinate higher education efforts in an attempt to reverse a "civic recession" in the country, evidenced by the relative declines in National Assessment of Educational Progress (NAEP) civic learning measures for twelfth graders from 1998 – 2010, and relatively low voter-participation rates among young adults.[7] The report identified the many ways that higher education institutions have laid pathways to democratic engagement and provided a template that raised the bar for developing the civic-minded campus, including a focus on the college curriculum as well as the development of powerful community partnerships. Momentum surrounding the report renewed conversation about higher education's role in cultivating citizenship and reinvigorated collective campus commitments to developing programs, serving communities, and reforming curricula.

The U.S. Department of Education funded and supported the work, but deferred to the National Task Force on Civic Learning and Democratic Engagement to arrive independently at its recommendations for higher education. The Department released its own report intended to be priority-setting for a national agenda of educational goals for civic learning.[8] Although momentum has evaporated at the federal level with the change in staff and administration, collective campus activity has not waned and, in several cases, efforts have been consolidated. The expansion of the reach of civic learning

and a commitment to diversity and democracy is evident in AAC&U's activities, the American Association of State Colleges and Universities' American Democracy Project, and The Democracy Commitment (TDC), which recently emerged to foster community-college engagement. Campus Compact has over one thousand campus members, has merged efforts with TDC, and continues to encourage campuses to commit to developing civic action plans.[9] The ALL IN Campus Democracy Challenge, a consortia of college campuses that emerged at the time of the *Crucible Moment* report, focuses on activities to increase youth involvement during and between elections and joined efforts with the nonprofit Civic Nation in 2016 to increase democratic engagement in the electoral process. ALL IN activities may have played a role in increasing midterm election turnout of the college-age population, as campuses devised plans and competed for awards to raise the voter participation rates of their student bodies. These higher education consortia continue to provide portals, events, and meetings where change agents share practices and resources to integrate the educational and civic missions of their institutions.

Institution-wide commitment is important, but how does such a commitment reach more students than those already inclined to seek civic learning activities in college? Educator and activist Parker Palmer has stated that "students learn not only from *what* is taught: they also learn from *how* it is taught."[10]

> If students are to be well served and are to serve a democracy well, we need to invite them into a lived engagement with democracy's core concepts and values. There are at least two ways to do this: by engaging students in democratic processes within the classroom and the school and by involving them in the political dynamics of the larger community.[11]

Civic learning requires students to be active participants, as "democracy is not a spectator sport in which citizens can watch the pros at work."[12] Our teaching methods can include aspects of civic learning to give students an opportunity to learn and practice democratic concepts, engage in dialogue across difference, and develop projects working alongside diverse communities. Even in this era of "digital connectedness," Palmer believes we can engage in teaching to develop students' 1) understanding that we are all in this together; 2) appreciation for the value of "otherness"; 3) ability to hold tension or conflict in life-giving ways; 4) sense of personal voice and agency; and 5) capacity to create community. Civic learning can encompass each of these "five habits of the heart" and takes place in all types of venues, classrooms, and fields of study.

While a national standards framework exists for K–12 education to guide teaching and desired outcomes in civics education, no comparable standards for civic learning outcomes exist across all types of higher education institutions.[13] Campuses establish their own faculty-driven standards that are adopted in consensual agreement. However, a civic engagement working group of educators and nonprofit staff, coordinated by the AAC&U, developed an integrated framework called the Civic Learning Spiral that captures multiple dimensions of civic learning in college. The framework was introduced as a way to consolidate the three contemporary reform movements of diversity, global learning, and civic engagement in higher education; identify multiple, interrelated dimensions of students' capacity for engaged citizenship; and give guidance on achieving personal and social responsibility as one of the AAC&U's Essential Learning Outcomes adopted by many institutions and campus systems.[14] The framework identifies multiple areas of civic learning that can be incorporated more broadly in college courses, general education requirements, and campus programs.

At the Spiral's core lies the notion of interwoven learning across six dimensions or "braids": self, communities and cultures, knowledge, skills, values, and public action. Classroom and cocurricular activities can be directed toward outcomes in each of these dimensions. Increasing an understanding of *self* in civic learning involves developing one's own identity, voice, reflective practice, and sense of purpose. *Communities and cultures* outcomes include the development of empathy and appreciation for diverse individuals and communities, the capacity to transcend one's own embedded worldviews, and the recognition of inequalities that impact underserved communities. *Knowledge* outcomes involve understanding knowledge as socially constructed; information literacy in this era of "alternative facts" and misinformation, including the capacity to understand scientific evidence and critically evaluate sources of authority; and deep knowledge of key democratic principles, processes, and debates that inform one's major or area of study. *Skills* include conflict resolution, deliberation, and community-building, as well as the ability to work collaboratively and communicate with diverse groups. *Values* outcomes include ethical and moral reasoning and democratic aspirations such as equality, liberty, justice, and interest in sustaining the arts and sciences for the public good. Lastly, *public action* outcomes include students' participation in democratic processes and structures, multiple forms of action and risk-taking to promote social progress, and ally behaviors such as working alongside communities in need to solve important problems.

These dimensions of development are resonant with Palmer's notions of habits of the heart for democracy and are interdependent, but not organized

in a stage-like developmental sequence. For example, a greater understanding of self is often achieved in contact with people from different social identity communities and cultures, skills in deliberation and community-building are key to leading democratic governance structures in diverse communities, and self-confidence in one's voice is critical to participating in various forms of public action to effect change. Thus, each turn of the spiral represents the synthesis and integration of inextricably linked facets of civic learning. Repetition of learning across these braids promotes a "routine of integration that can lead to a lifelong disposition of open inquiry, dialogue across differences, and practice in public activism."[15] The spiral depicts a framework for civic learning that is fluid and continuous and that can be applied to assess curricular and cocurricular program goals throughout a student's career. Mapping survey measures across these different civic learning dimensions for college students, we have observed strong associations between diversity experiences, habits of mind for lifelong learning, and civic learning outcomes in longitudinal assessments.[16] Thus, institutions can articulate civic learning outcomes, invest in intentional practices, and begin to assess elements of each of these dimensions using student portfolios, course rubrics, surveys, and evaluation of programs or initiatives.

Intentional, engaging pedagogy for coursework and campus programming is the primary way to develop the different dimensions of civic learning in college students. Research syntheses have identified at least three pedagogies that promote civic learning through meaningful engagement: intergroup dialogue, service learning, and collective civic problem-solving.[17] Students often describe service learning and intergroup dialogue as their most "eye-opening" experiences during college, as they begin to see the world differently with greater involvement and develop empathy for others in communities that may be quite different than their own. Students from underserved communities are attracted to these pedagogies because they offer a sense of purpose and an academic pathway to maintain a connection with and advance their own communities. Collective civic problem-solving permits students to learn by working on authentic problem-based projects along with peers, faculty, and community partners; in focusing on the purpose and process, "students learn about democracy by acting democratically."[18]

These pedagogies share several features. First, the experiential learning process encourages students to test their assumptions, revise their thinking, and begin to feel personally and socially responsible. Paolo Freire, an advocate of critical pedagogy, has stated that as students "are increasingly posed with problems relating to themselves in the world and with the world, [they]

will feel increasingly challenged and obliged to respond to that challenge."[19] New challenges evoke new understandings and "gradually the students come to regard themselves as committed."[20] A second pedagogical feature is that learning is enhanced by guided self-reflection. Most college students have little time to reflect on their experiences, whereas service learning and intergroup dialogue require student journals that ask students to reflect on their learning and individual transformation throughout the course experience. Both Freire and educational theorist David Kolb agree on the importance of self-reflection: for Freire, it is vital for the development of a critical consciousness, and for Kolb, it is essential for abstract conceptualization in developing new knowledge.[21] Moments of disequilibrium are recorded in student journals as learning instances in which their experiences contradict previous knowledge, bias, or beliefs. Instructors follow student reflections to provide additional content or process activities to help them achieve new understandings. A third common feature is that these pedagogies provide students with supported pathways to cross boundaries and step outside of their "comfort zone" to engage with "others" that differ by social identity, culture, power/social status, education, and worldview. For example, California State University, Monterey Bay, requires all students to take two service-learning courses that teach "critical civic literacy," one in the lower division to build awareness and another in their major. Both courses emphasize the effects of power relations and social group identities on opportunities and participation in public life and stress the examination of root causes of systemic social problems in diverse communities. They define civic literacy as the "knowledge, skills, and attitudes that students need to work effectively in a diverse society to create more just and equitable workplaces, communities, and social institutions."[22] While not all service-learning courses take a critical civic literacy approach, Monterey Bay is integrating service learning in ways that address inequality as part of civic learning and using many of the principles of identity-based education.

Intergroup dialogue is unique in that it extends beyond raising awareness about social identity groups in the context of inequality by addressing key conflicts and building alliances. Its techniques and principles can be applied to many other types of courses and it is attentive to group dynamics, improving students' skills for a deliberative democracy. The intergroup dialogue model, developed as an initiative between academic and student affairs units at the University of Michigan, has been replicated on many campuses and rigorously assessed.[23] There are several important premises that support the design of a sustained dialogue lasting from ten to fourteen weeks, or a course term. First, most of the social identity groups that enroll in dialogue have a long

history of conflict, and the pedagogy operates on the premise that emergent conflict "should not be avoided, denied, or excessively managed."[24] When facilitated well, conflict is an opportunity to learn. Second, groups or course sections are intentionally structured to create equal status in terms of representation, oftentimes bringing together specific groups in which dialogue is needed to increase understanding. Using trained peer facilitators, the implementation of this model at the University of California, Los Angeles, has brought together men and women from different race/ethnicities, documented and undocumented students, students from different social class groups, LGBTQ and heterosexual students, as well as different religious groups for dialogue on key issues that shape their experiences. Third, much like a "flipped classroom," students are provided foundational content for shared understanding that they read outside of class, and most class time is devoted instead to active learning exercises designed to facilitate dialogue and illustrate key concepts. The sustained dialogue includes four stages that focus on building 1) relationships and community, using inclusive group dynamic techniques; 2) students' awareness about multiple social identities and group-based inequality, including systemic forms of privilege and oppression; 3) students' capacity to discuss controversial topics and anticipate conflict; and 4) alliances and agency to engage in action with others in one's community.[25] It is important to note that "hot topics" are not discussed until the group has gone through the initial stages of dialogue together, built some familiarity and community, and adopted a constructive process for dialogue. The last stage involves an action project or plan to carry out together on campus or in their community. Students gain confidence in intergroup relations skills and feel empowered to play a role in resolving intergroup problems in their campus or communities. In some cases, service-learning courses have also integrated intergroup dialogue pedagogy to improve students' capacities to address tensions associated with understanding others' social identities and power dynamics that affect diverse communities where students are engaged in service.

Service learning and collective civic problem-solving also have the unique pedagogical feature of not only teaching students' civic responsibility, but also seeking to strengthen communities through engagement and development of powerful partnerships. Relationships established with community organizations or partners require trust, reciprocity in the relationship, mutually beneficial goals, and responsibilities that are often articulated in a memorandum of understanding with campus participants.[26] Many programs have moved from a deficit view or charitable approach to their practice in favor of advancing interdependence for the welfare and shared future of their community.

That is, rather than reinforce privilege, they are working toward helping students see that the problems communities face are "not just their problems" and create the sense that "we are all in it together." Education scholar Robert Rhoads proposed that participation in this form of critical community service "provides a means to foster a sense of connectedness and offers an opportunity for students to understand themselves and to develop caring selves. . . . Caring selves are critical to the process of democracy and the struggle to build a more just and equitable society."[27] Thus, in higher education, critical community service "should be seen as a key educational vehicle for fostering an ethic of care and a commitment to democratic citizenship."[28] Consistent effort to sustain community relationships is also central to this pedagogy and, in many cases, instructors are assisted with public service or partnership units on campus who help to seed and maintain these relationships over time.

It is important to note that these pedagogies are not limited to the social sciences or humanities. There is value in having young scientists anticipate and learn to develop public trust, to engage with and understand diverse communities who can benefit from responsive innovations in science. Several campuses have developed signature STEM initiatives that train aspiring scientists to develop these sensitivities and solve real-world problems in local communities and across the globe. For example, University of Alaska-Fairbanks adopted a One Health initiative that focuses on advancing research on the interrelationship between the health of humans, the environment, and animals that is consistent with indigenous worldviews and suited for the many rural communities that have a close relationship with the natural environment in the state. Faculty and students are engaged in culturally responsive relationships with rural communities to study and solve health problems, which not only required the development of community relations and understanding of local needs, but also an integrated approach to science training and the development of an interdisciplinary curriculum. Students are engaged in experiential learning and reflection in critical research projects that are vital to the health of communities that rely on a subsistence lifestyle. Community partners also participate in data collection and practical uses of research that empower them to improve their quality of life. On a global level, students at Worcester Polytechnic Institute (WPI) participate in a series of interactive projects as part of their general education curriculum, to solve real-world science problems in communities locally and around the world. Beginning with the class of 2022, all first-year students will receive a scholarship to complete a project at one of WPI's fifty-plus project centers located in thirty-one countries. As WPI states on its website, "the best way for students to understand and appreciate societal issues is to experience them firsthand."

Faculty and instructors have been central to the development and introduction of these pedagogies in the college curriculum. Faculty have approved campus-wide general education requirements that include courses addressing service learning and intergroup dialogue. As a result, some institutions are reporting record numbers of courses that integrate classroom learning with community partnerships that address social and environmental issues. Faculty have also expanded the scholarship of teaching and application to better assess civic learning and evaluate their own impact on students and communities, respectively. Many departments have approved capstone courses that integrate service projects with local communities to meet major requirements. Dialogue training has also been integrated into required courses for preparing resident assistants and graduate programs in student affairs. Even with these multiple opportunities on campus, not all students have had occasion to participate in these courses. Civic learning is still optional on many campuses.

What can faculty do in classrooms to promote civic learning? Faculty can provide students with several tools or strategies that are useful in any kind of classroom or democratic workspace. Taking a page from the pedagogies described earlier, students should learn and practice active listening; ask different types of questions to prevent prejudgment; create an awareness about power dynamics and co-construct inclusive ground rules for engagement that empowers others to use their voice; separate positions from interests when encountering opposing views; and explore commonalities and differences as they deliberate issues or engage in problem-solving. Faculty-designed exercises and activities have been implemented to address each of these deliberative skill areas. These faculty practices and student behaviors are what doing democracy looks like in the classroom.

The paradigm shift that is required in faculty mindsets involves inviting students to serve as cofacilitators of learning, empowering them to use their voice and creativity to reflect their social concerns, and working with difference in the classroom instead of ignoring it. By far the most difficult strategy is to value conflict as an opportunity to learn or, as Palmer has put it, learning to hold tension creatively to produce citizens "who know how to hold conflict inwardly in a manner that converts it into creativity, allowing it to pull them open to new ideas, new courses of action, and each other."[29] Some students, just like faculty, are averse to any kind of conflict. When anticipating conflict one day in my class, a Latino student set others at ease by telling them they cannot plan for conflict or its resolution; in this course, "you learn to trust the process." I could not have said it better, and it probably had even more weight coming from a peer who was a participant in the process. He was talking about the brave community and the process for open dialogue and respect we built

together that would ensure we would arrive at a deeper level of understanding by the end of our session. We learned to use strategies such as active listening, breaking down the conflict to determine the level and type (as not all conflict is a crisis), separating positions from interests, asking questions that go a long way in clarifying or affirming, employing empathy by recognizing multiple social identities, and acknowledging the privilege and oppression associated with these identities. According to political theorist Benjamin Barber, a "strong democracy *transforms conflict*. It turns dissensus into an occasion for mutualism and private interest into an epistemological tool of public thinking."[30] As the students provided hope in our capacity to work through conflict, we were modeling a strong democracy in a pluralistic society.

This is not to say that all faculty now have the pedagogical knowledge and skills to make this shift in teaching, but many have the mindset and values that support the integration of civic learning activities in the classroom. For example, while only about 17 percent of undergraduate teaching faculty at baccalaureate-granting institutions report that they have taught a service-learning course in the past two years, 93.4 percent agree with the statement that "colleges have a responsibility to work with their surrounding communities to address local issues." Over 84 percent agree that their role is to enhance students' knowledge of and appreciation for other racial/ethnic groups, but over half think that "faculty are not prepared to deal with conflict over diversity issues in the classroom."[31] This suggests that many more faculty may appreciate opportunities to learn how to engage students in critical community service, employ dialogue techniques, and turn classroom conflict into productive mutual learning environments. With clear key values, articulation of civic learning outcomes, and faculty leadership, we have a much better chance at helping faculty implement more engaging pedagogies to achieve the goal of extending the reach of civic learning.

I have described a collective impetus to recenter civic learning within and across all institutions and disciplines, as well as more critical approaches to this work in terms of pedagogy that prepares students for a diverse and unequal society. I have described these civic learning developments in higher education optimistically, yet each day, I sense our democracy becoming more fragile. Political theorists have suggested dire consequences if we do not develop a strong democracy that is highly inclusive and also extensively open to public contestation, in which conflict is resolved through deliberation and respect for differences. A competitive political system that is exclusive in participation but also open to public contestation is unable to handle particular forms of conflict that arise.

> Any dispute in which a large section of the population of the country feels that its way of life or its highest values are severely menaced by another segment of the population creates a crisis in a competitive [political] system. . . . The historical record argues that the system is very likely to dissolve into civil war or to be displaced by [an exclusive] hegemony or both.[32]

Although this thesis is based on the history of political systems throughout the world, it seems to be hauntingly relevant in America today. If the democratic purpose of higher education is to protect against the threat of tyranny, now is the time for institutions to advance civic learning and safeguard our democracy.[33] The levers appear to be increasing participation of diverse groups and opportunities for public contestation, with deliberative processes in place and individuals capable of productively handling tension in such a democracy. Facilitated by civic learning pedagogies that include diverse communities on- and off-campus, today's students and their change-agent inclinations are our best hope in making real the promises of our democracy.

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The Future of Undergraduate Education: Will Differences across Sectors Exacerbate Inequality?

Daniel I. Greenstein

This essay looks at how different sectors of U.S. higher education are funded, the students they serve, and the outcomes they deliver for those students. It raises serious policy questions about whether the distribution of public funds across this highly segmented industry both reflects and contributes to growing inequality in this country. It also asks whether recent trends in educational innovation and the impact of technology innovation in higher education will exacerbate or ameliorate that inequality. While the evidence is disturbing, the essay concludes optimistically. The past, it suggests, need not be prologue in higher education. The path forward for our industry, while highly constrained, can as yet be shaped through thoughtful, conscious, and analytically driven choices at individual, institutional, and state and federal policy levels.

The U.S. postsecondary education system, which serves an increasingly diverse student population, is sharply segmented. Public research, comprehensive, and two-year institutions have very different missions, resource levels, student bodies, and outcomes. Adding the private nonprofit and for-profit sectors creates an even more complicated picture. Students come to the door with very different levels of preparation, goals, expectations, and conflicting responsibilities such as family and work; the same programs and institutions are unlikely to serve all of them well. However, the current stratification patterns reinforce and may amplify the inequalities with which students come to higher education. Although we know quite a bit about how to improve outcomes for students, there is a real danger that well-resourced institutions, which generally enroll relatively privileged student bodies, will outpace underresourced institutions, which generally enroll relatively disadvantaged student bodies, in implementing promising innovations. This possibility reinforces the need for thoughtful and constructive changes in our systems of financing and managing colleges and universities.

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After a brief review of the importance of a conversation about the future of undergraduate education in the context of these sectoral differences, this essay reviews key structural characteristics of the higher education industry. It focuses on the different needs of the student groups that flow through the sectors, based on age, race and ethnicity, family income, and other characteristics. It raises questions about how, whether, and to what extent there is a single future for undergraduate education, or if we are looking instead at a variety of futures for institutions offering very different educational "products" to many different "consumer" or student groups.

Focusing on how different sectors are funded, the students they serve, and the outcomes they deliver for those students, this essay also raises serious policy questions about whether the distribution of public funds across this highly segmented industry both reflects and contributes to growing inequality in this country. A second section looks at recent trends in educational innovation : in particular, those growing out of the student completion movement that took shape beginning in the 1980s. To date, these efforts have reached only a fraction of today's students. It is too soon to know their impacts on the industry going forward. It is not too soon, however, to wonder whether they will be adopted by institutions in all segments and used with all student groups or will instead amplify the distinctions that already exist across sectors, exacerbating inequalities rather than ameliorating them. A third section asks a similar question with reference to the impacts of technology innovation, particularly online learning, and results in a similarly tentative and disturbing prognosis. This essay concludes by reflecting on the extent to which our past is prologue in higher education, and suggests that the path forward for our industry, while highly constrained, can as yet be shaped through thoughtful, conscious, and analytically driven choices.

College enrollment has increased dramatically over time among all demographic groups. As both young people and older adults have realized that it is difficult to find jobs that will support a middle-class lifestyle without some college education, students who would not have continued their education beyond high school a generation ago now pursue a range of postsecondary paths. The available paths have expanded, and half of all undergraduate credentials are now short-term certificates or associate's degrees, as opposed to bachelor's degrees. New institutions and programs are serving a student body that is more diverse in terms of socioeconomic background, race and ethnicity, and age than the college population fifty years ago.

With the expansion of higher education, the differences across sectors have been amplified. Public research universities are more selective, spend more per

student, and have higher completion rates than public comprehensive universities and community colleges. Private nonprofit colleges and universities enroll a very different population from for-profit institutions – and have very different student outcomes. The inequality across institutions exacerbates inequality among the students who enroll in those institutions. The challenge that lies ahead is providing the range of opportunities and supports that best serves the needs and goals of a diverse student body, while narrowing the gaps in both resources and outcomes across the sectors of postsecondary education.

Earnings are highly correlated with educational attainment. In 2017, median earnings for thirty-five-to-forty-four-year-olds whose highest degree was a bachelor's degree were 71 percent higher than the median for high school graduates. The annual earnings premium for an associate's degree was 17 percent, or about $6,000.[1] But perhaps as important as wages are the changing demands made by U.S. employers with respect to the educational attainment of the people they hire. A study by the Georgetown Center for Education and the Workforce showed that of the 11.6 million jobs added between January 2010 and January 2016 (during the recovery from the Great Recession), 11.5 million required some college education, which might range from short courses in welding and advanced manufacture to bachelor's degrees in physics, economics, or English literature.[2] And if labor economists are to be believed, demand among employers for some higher education will continue to grow, and will require workers to return to school to boost skills and capabilities throughout the course of their careers.[3]

College was not always the primary bridge to opportunity. When I graduated from a large public high school in Rochester, New York, in 1978, I was part of the minority of all graduates that enrolled in college. In those days, it was entirely reasonable for a high school graduate to assume he could cross the stage, receive his diploma, and secure a job with reasonable long-term opportunities with a local manufacturer such as Kodak. Those jobs are not gone for today's graduates – Pennsylvania, for example, predicts that as many as 46 percent of all jobs in 2026 will not require any form of postsecondary credential owing to continuing strength in manufacturing and agriculture – but the number of these jobs is declining dramatically and, once gone, they are not likely to return.[4]

Unemployment rates are about twice as high for high school graduates as for those with a bachelor's degree or higher. In April 2018, 4.3 percent of high school graduates ages twenty-five and older and 2.1 percent of those with a bachelor's degree or higher were unemployed, down from 7.5 percent and 3.9 percent, respectively, five years earlier.[5] Of course, going to college is not just about improving one's employability and financial security. Education levels are associated with a range of desirable lifetime outcomes including relatively

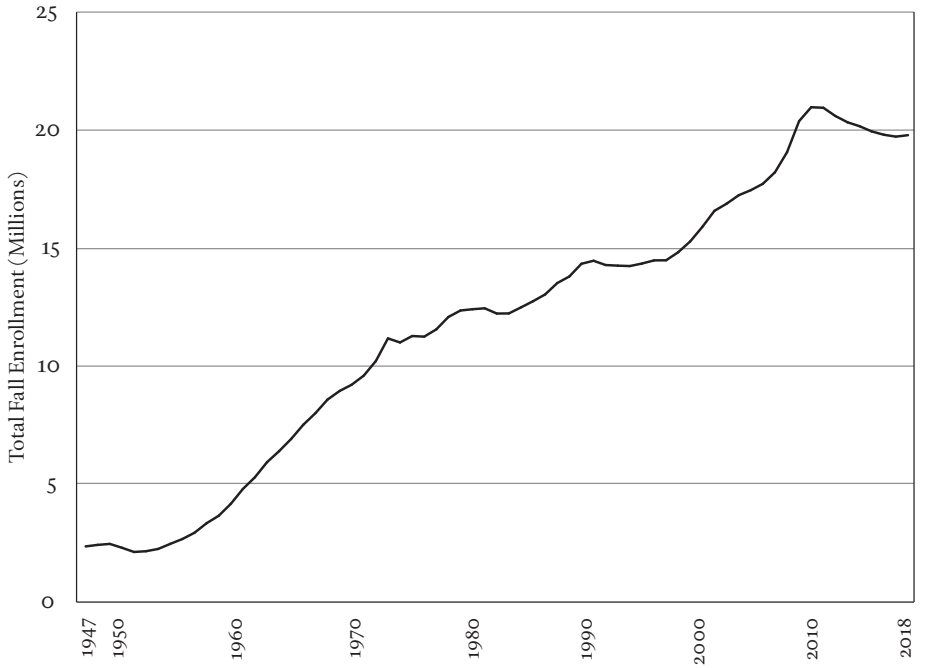
low rates of divorce, obesity, and smoking, and higher levels of voting.[6] It is in part for this reason that in survey after survey, the vast majority of parents from all backgrounds want a college education for their children.

The opportunity to attend college is greater now than at any time in our past, thanks in large part to sustained public investments since the late 1940s. Public investments have provided funding both directly to students and to institutions, increasing the number of students able to enroll as well as the capacity of public higher education. The GI Bill of 1944 allowed returning service men and women to attend college; the Higher Education Acts of 1965 and 1972 created federal grants (now Pell Grants) and low-interest loans to remove financial barriers for low-income students. The mobilization of public funding that grew out of the Truman Commission underscored the importance of low-cost on-ramps to a college degree and stimulated massive growth in two-year (once "junior," now "community") colleges. And states make major investments in individual students through financial aid programs such as Cal Grants in California and Pennsylvania Higher Education Assistance grants, as well as in the form of appropriations to public two- and four-year colleges.[7]

The net result has been transformational. The nation expanded its higher education infrastructure, growing the number of degree-granting institutions from 1,851 in 1949–1950 to 3,152 in 1979–1980 and to 4,360 in 2016–2017.[8] The number of postsecondary students grew from 2.4 million to 11.6 million to 19.8 million over these years, respectively.[9] The share of high school graduates enrolling immediately in college rose from 45 percent in 1960 to 58 percent in 1985 and to 70 percent in 2016.[10] The trend line for enrollment growth was particularly steep in the 1950s and 1960s as the nation expanded its higher education capacity to accommodate the baby boomers and their children (so-called Tidal Waves 1 and 2).

The dramatic expansion in higher education did not just swell overall student numbers, it democratized the face of the student body. Once largely the preserve of the sons and later daughters of White and relatively affluent families who attended residential colleges directly after completing high school, higher education became accessible to low-income students, students of color, and adult students entering college from the workplace. The Civil Rights Act of 1964 and the resurgence of feminism in the early 1960s (coupled with slower overall wage growth, which fueled women's growing participation in the labor market) contributed to the diversification of the student body. Diversification happened in other ways as well, with increases in the proportion of students attending part time, working while attending college, or who are parents raising children of their own. The democratization of U.S. higher education proceeded so far that today the typical student as conceived of in the popular imagination

Figure 1
Total Fall Enrollment in Degree-Granting Postsecondary Institutions, 1947 to 2018



Source: National Center for Education Statistics, "Table 303.10. Total Fall Enrollment in Degree-Granting Postsecondary Institutions, by Attendance Status, Sex of Student, and Control of Institution: Selected Years, 1947 through 2023," https://nces.ed.gov/programs/digest/d13/tables/dt13_303.10.asp.

(relatively affluent high school graduate attending a residential college full-time for a few years after high school) represents at best perhaps one-quarter of the student body. Students once labeled as nontraditional are now in the majority (and will henceforth be referred to as new-majority students).

The enrollment growth in the postwar years had a dramatic impact on the landscape of institutions offering education after high school and amplified the institutional diversity (industry segmentation) that was already apparent in the first half of the twentieth century. The greatest growth occurred among public two-year colleges. Initially established as on-ramps to four-year colleges, the two-year sector evolved from the 1930s to take on a career

orientation and, from the 1970s, various types of adult education.[11] The boom years (from the 1950s to the 1980s) swelled enrollments in public two-year colleges from 585,240 in 1958 to 4,826,000 in the fall of 1980, and saw the introduction of state support for two-year colleges that had hitherto relied on a combination of local funding and very modest student tuition and fees. The share of all postsecondary students enrolled in public two-year colleges rose from 26 percent in 1970 to 38 percent in 1991, but between 2002 and 2016, declined from 38 percent to 29 – 37 percent of all undergraduate enrollments.[12]

Both public research universities, which teach to the doctoral level and offer professional degrees, and public comprehensive universities, which teach to the master's level and in which typically half or more of all students major in areas such as education, business, and health sciences that track directly with specific careers, have also grown over time. Public research universities grew out of the Morrill Land Grant Acts of 1862 and 1890, intended "to teach such branches of learning as are related to agriculture and the mechanic arts" and, in effect, to fuel directly the nation's economic development. After World War II, they prospered from public investments in students as well as in research, the latter driven by federal agencies like the National Science Foundation and the National Institutes of Health. The comprehensive universities had diverse origins: technically focused land grant institutions established under one of the Morrill Land Grant Acts; teachers' colleges established to meet demand for a rapidly growing public education sector; and sectarian and other community-specific institutions (such as historically Black colleges and universities) that evolved with an emphasis on education tracking directly to specific occupations. They, too, prospered from public funding and provided robust pathways into high demand occupations required in Main Street America and in education, social services, and health care.[13]

Private nonprofit colleges and universities enrolled 21 percent of all postsecondary students in fall 2016, a share that has remained fairly steady over time.[14] The institutions in this sector are diverse, with 18 percent enrolling fewer than two hundred students and 11 percent enrolling five thousand or more.[15] Tuition prices also vary over a wide range: 10 percent of full-time students in the sector are enrolled in institutions charging less than $15,000 per academic year and 20 percent are at institutions charging $51,000 or more per academic year.[16] One-quarter of all private nonprofit four-year institutions accept 90 percent or more of the students who apply; 5 percent accept less than one-quarter of applicants.[17] They also vary in the kind of education offered and the types of students served, including the most selective research universities (such as the University of Pennsylvania) and liberal arts colleges (such as Williams College), small sectarian schools, and niche-oriented institutions

(such as women's colleges like Mills College and historically Black universities like Johnson C. Smith University). And this sector is the home of the 240 or so independent "classical liberal arts colleges" that typically teach to the bachelor's level and promote an education that, while enabling students to concentrate in a specific major area, emphasizes a general education curriculum with exposure across broad discipline areas, including the humanities, social sciences, and hard and life sciences.[18]

Private for-profit institutions initially focused on career and technical education for people seeking middle-skill workforce roles. Their numbers (measured both in terms of institutions and enrollments) swelled to a high-watermark in 2010 when they enrolled 10 percent of all students.[19] Growth resulted from a number of factors including easily available student financial aid (including loans), tuition assistance for in-service military personnel, and education funding for veterans – a very large and continuously self-replenishing group of potential students – and growing demand for an educated workforce, which outstripped the supply of students who went to college directly after high school. For-profit institutions also proved more nimble than their not-for-profit counterparts, leveraging available capital and relatively weak shared governance structures to integrate instructional approaches catering to their "nontraditional" adult students who were typically integrating education into lives that were already crowded with obligations to work, family, and/or military service. These multiple factors account for the sector's tremendous growth, largely through online distance learning, which began in the 1990s.

All sectors experienced the tidal waves of new students and new dollars in the postwar years, but they did so differently, emerging with distinguishing characteristics measurable by the kinds of students they served (see Table 1). In 2015 – 2016, when 39 percent of undergraduate students enrolled in public two-year colleges, 46 percent of independent students (those who are older, are parents, are veterans, or have other characteristics that eliminate their parents from affecting their financial aid eligibility), and 46 percent of Hispanic students were enrolled in this sector. The share of students enrolling in public four-year institutions increased with family income and among those students, those from more affluent families were most likely to enroll in doctoral institutions, which are the most selective and have the most funding. Notably, 15 percent of Black undergraduates – compared with 8 percent overall – attended for-profit institutions. In other words, students from different backgrounds attend different types of institutions.

These sectors of higher education vary in a number of visible ways. For example, in 2015 – 2016, public doctoral universities devoted $19,270 per student to education and related expenditures, compared with $14,530 at public

Table 1
Sectors of Postsecondary Enrollment by Dependency Status, Family Income, and Race and Ethnicity, 2015 to 2016

	Public Two-Year	Public Four-Year	Private Nonprofit Four-Year	For-Profit	Other
All	39%	35%	15%	8%	3%
Dependent	33%	45%	18%	3%	2%
Independent	46%	24%	12%	13%	4%
Dependent Students' Parent Income					
Less than $27,900	40%	38%	13%	6%	3%
$27,900 – $62,999	37%	43%	15%	4%	2%
$63,000 – $113,499	33%	47%	17%	2%	1%
$113,500 or more	20%	51%	27%	1%	1%
Race/Ethnicity					
White	37%	37%	17%	6%	2%
Black or African American	38%	30%	13%	15%	4%
Hispanic or Latino	46%	31%	11%	9%	4%
Asian	41%	39%	14%	5%	1%
Other	41%	36%	12%	8%	2%

Source: National Center for Education Statistics, National Postsecondary Student Aid Study 2016, https://nces.ed.gov/datalab/index.aspx.

master's universities and $10,080 at public two-year colleges.[20] Graduation rates also vary dramatically across sectors. The segments' characteristics shaped the overall educational experience available to students within them.

Additionally, faculty teaching loads and composition are different across sectors in a variety of ways that affect the experiences of the students they educate. Typically, faculty in two-year, four-year comprehensive, and for-profit institutions have higher teaching loads than those in independent colleges and research universities.[21] And while the use of adjunct faculty – faculty who

neither have nor are on a track to gain tenure – is at an all-time high (about 70 percent industry-wide), it is distributed differentially across sectors. Yes, tenured faculty with high course loads are typically found in institutions where they are not expected to do research, explaining some of the variance in workload. And yes, it is difficult if not impossible to compare teaching quality of adjunct and tenured (and tenure-track) faculty. Still, it is impossible to ignore the impacts that teaching load and employment status have on faculty-student engagement and thus on student outcomes.[22]

The point here is not to advocate for one or another educational experience, to engage in a conversation about how public funding is distributed across various sectors, or even to address issues having to do with faculty support and composition (however important these subjects are to the future of undergraduate education). It is simply to illustrate how the undergraduate experience will be – must be – very different in different sectors in ways that reflect the characteristics of the student body, the level of financial support that is available, and the composition, workload, and support of the faculty.

Democratization did more than amplify differences between segments of U.S. higher education. It also reduced the substantial educational access gaps that had existed between rich and poor, White and non-White. In 1970, high school graduates from families in the top income quartile were nearly three times as likely as high school graduates from families in the lowest quartile (78 percent compared with 28 percent) to enroll directly in college. In 2016, they were 1.5 times as likely (78 percent versus 46 percent, respectively), and the gap between high- and middle-income high school leavers has also narrowed. Access gaps by race and ethnicity have shrunk as well, as evident in the college participation rates of recent high school graduates in 1976 and 2016 shown in Table 2. There is evidence as well that attainment gaps by race and ethnicity have been reduced somewhat, as shown in Table 3.

Still, there is a great deal of room for improvement in narrowing college completion gaps. On average, White and Asian students who first entered college in 2010 earned a college-level credential at a rate about 20 percentage points higher than Hispanic and Black students.[23] And significant gaps in college completion remain by income. While the gap between students in the wealthiest two quartiles has closed between 1970 and 2016 (from 25 to 17 percentage points), that between the top two quartiles and the bottom two quartiles has widened.

There is enormous variation in the characteristic of the students enrolled in different higher education sectors. Bluntly, new-majority students – low-income, adult students, and students of color – attend in great disproportion those colleges that have the lowest average per-student investment in

Table 2
Percent of Recent High School Graduates Enrolling in College, by Race/Ethnicity, 1976 and 2016

	1976	2016
White	41	66
Black/African American	33	51
Hispanic/Latino	34	59

Source: The Pell Institute for the Study of Opportunity in Higher Education, "Equity Indicator 1c(i): Cohort College Participation Rates of Recent High School Leavers by Race/Ethnicity: 1976 to 2016," in *Indicators of Higher Education Equity in the United States: 2018 Historical Trend Report* (Washington, D.C.: The Pell Institute for the Study of Opportunity in Higher Education, 2018).

Table 3
Percent of Population with Some Postsecondary Education, by Race/Ethnicity, 1992 and 2016

	1992	2016
White	58	74
Black/African American	45	66
Hispanic/Latino	35	45

Source: Anthony P. Carnevale and Megan L. Fasules, *Latino Education and Economic Progress: Running Faster but Still Behind* (Washington, D.C.: The Georgetown University Center on Education and the Workforce, 2017), Figure 4.1, https://1gyhoq479ufd3yna29x7ubjn-wpengine.netdna-ssl.com/wp-content/uploads/Latinos-FR.pdf.

instruction and student support, the largest (most unfavorable) student-faculty ratios, and the lowest graduation rates for first-time full-time students.

Research by economists Caroline Hoxby and Sarah Turner has shown that students in more-challenging academic environments are likely to succeed at higher rates than similar students in less-challenging environments. The so-called undermatching phenomenon – in which academically high-achieving students enroll in colleges with a majority of lower-achieving students – is particularly acute for low-income and first-generation students and students of color.[24]

Additionally, no one institutional structure, pedagogical approach, or set of support services delivers the same level of success for all students. Intuitively,

this makes sense. A first-generation high school graduate who enters college needing two levels of remediation in math and/or English requires a very different kind of pedagogy and a more intrusive approach to advising than say a high-achieving, fourth-generation high school graduate entering into an honors program at a selective college. Arguably, the adult student enrolling in an online degree program while working full-time in order to complete a bachelor's degree that they began but did not complete ten or fifteen years ago is likely to require something different yet again from these other two groups in the way of instructional approach and student supports. For undergraduate education, context matters: the kind of college, the level of support available, the kinds of students that are present. So, the research suggests, do students' backgrounds, needs, and preparedness. This forces us to think hard about the future of undergraduate education: to adopt an approach that ensures higher education is relevant to the needs of the very different student groups that we serve and to ensure the approaches that are adopted are both effective in terms of student outcomes and financially viable in what are very different industry segments.

Finally, it is worth noting that the increasing differentiation of the higher education landscape and the distribution of different student groups across it has implications that extend far beyond how we think about delivering a student's educational experience. These are represented most starkly in work by economist Raj Chetty and colleagues at the Equality of Opportunity Project. A working paper published in 2017 showed that at the highly selective Ivy-Plus colleges (colleges that typically accept fewer than 10 percent of all undergraduate applicants, comprising the eight Ivy Leagues – Brown, Columbia, Cornell, Dartmouth, Harvard, Penn, Princeton, and Yale – plus the University of Chicago, Stanford, MIT, and Duke), more students come from families in the top 1 percent of the income distribution than the bottom half of the income distribution. Indeed, they find that children with parents in the top 1 percent are seventy-seven times more likely to attend an Ivy-Plus college than children with parents in the bottom 20 percent.[25] Table 1 makes the point more generally, showing the degree of stratification that exists across the industry.[26]

The relative segregation of new-majority students matters in at least two ways. First, it deprives all students of exposure to multicultural experiences – critical in reversing disturbing tendencies apparent in our civil and political society toward growing isolation of and intolerance across social groups defined at the intersections of race, class, and gender. Second, it matters because higher education sectors perform very differently with respect to student outcomes. Again, according to Chetty and his colleagues, graduates from highly selective colleges do not just graduate at much higher rates, they also significantly out-earn graduates of less selective institutions. According to journalist

Thomas Edsall, "instead of serving as a springboard to social mobility as it did for the first decades after World War II, college education today is reinforcing class stratification." In an opinion piece published in *The New York Times* in 2012, Edsall argued that this is not meritocracy at work. The trends cannot be explained by test scores alone. "When high-scoring students from low-income families are compared to similarly high-scoring students from upper-income families," he wrote, "80 percent of those in the top quarter of the income distribution go on to get college degrees, compared to just 44 percent of those in the bottom quarter."[27] Even if Edsall is confusing cause and effect – the distribution of students across higher education sectors may reflect existing social inequalities – there is little doubt that the distribution of students across the industry coupled with public policy choices that are reflected in levels of funding made available to those sectors reinforce and amplify those inequalities.

Despite their reputation for being stubborn, legacy-centric, and slothful with respect to change, colleges and universities in all sectors have been remarkably agile in evolving educational approaches in response to the changing demands of their students, funders, and employers, and in reflection of their constantly changing financial circumstances. This is particularly evident in the college completion movement that has emerged since the 1980s in response to probing questions about the growing cost and perceived value of higher education. While the movement has registered some gains in terms of student outcomes, it also raises questions about whether it will only reify the inequalities that result from and reflect the industry's segmentation.

The birth of the completion movement reflected the phenomenal success of public policies that dramatically expanded participation in higher education, placing enormous pressure on scarce public funds and raising natural questions about what taxpayers were getting for their money. One thinks of:

- *A Nation at Risk* (1983), which concluded that "the educational foundations of our society are presently being eroded by a rising tide of mediocrity that threatens our very future as a Nation and a people";[28]
- the 2006 report of the Commission on the Future of Higher Education, convened by then–Secretary of Education Margaret Spellings, which urged a higher level of accountability with respect to student outcomes in return for public investments;[29] and
- state-level initiatives that tie state funding to institutional performance.[30]

Employers, too, added voice in questioning the value of higher education. That voice rises and falls in waves and has reached almost deafening levels

today in concerns being expressed about graduates not having the skills they need to participate effectively in the twenty-first-century economy.[31]

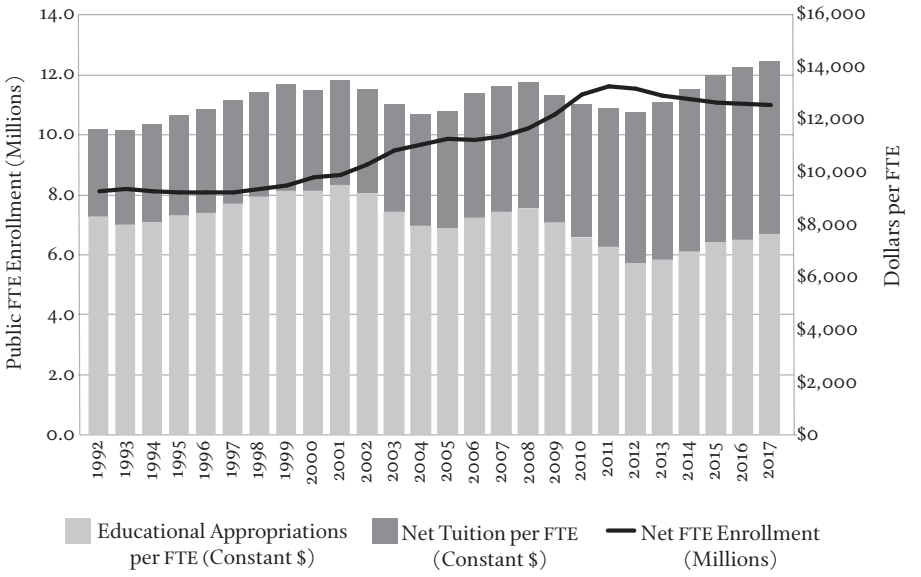
Another force driving educators to think hard about improving student outcomes is of more recent origin. It is driven by the growing need that colleges feel to demonstrate the value of their increasingly high-priced product; to demonstrate the price is worth paying and will pay off by opening access to sustaining careers.

The need to measure outcomes was not always felt so acutely. One factor feeding this need is Baumol's cost disease, which describes the challenges certain "professional services" face when controlling costs because they rely on high-priced labor (such as faculty in the higher education sector), which is not easily replaced or augmented with automation. In higher education, the impacts show up in tuition increases that routinely surpass the overall rate of inflation.[32] The trend is compounded by the long-range decline in public funding represented by the secular decline in state appropriations per student in public higher education.[33] Demographic trends are also a factor as demonstrated by economist Nathan Grawe, who looks at changes in the size of high school leaving populations and their impacts now and, very soberingly, into the future, where populations are projected to flatten or decline in most states from around 2025.[34] In states or regions where that contraction is already apparent – Pennsylvania, Connecticut, Massachusetts, rural parts of Georgia and Texas – there are already signs of the cutthroat competition that is yet to come for most higher education institutions in this country. In Pennsylvania, which is experiencing the competition acutely, institutions are struggling to generate necessary revenues, balancing the declining pool of students with tuition price sensitivity. According to Grawe's analysis, the viability of institutions in all sectors that are outside the top 150 (ranked in terms of selectivity at admissions) is seriously at risk.

The completion movement took shape in the last two decades of the twentieth century, growing out of concerns arising from the public cost of growing enrollments and uneven student outcomes, and gained force in the early twenty-first century in response to both student and employer concerns about the value and price of higher education. The movement is less a coordinated campaign and more a series of loosely connected skirmishes, several of which are worth touching on because they demonstrate the tools that are currently available to practitioners as they think about the future of undergraduate education, as well as the limits to scaling those tools effectively.

Concern with students' learning outcomes emerged forcefully in response to a 1989 federal regulation that directed accreditors (responsible among other things for evaluating colleges and universities with respect to their fitness

Figure 2
Public Full-Time Equivalent (FTE) Enrollment and Educational Appropriations per FTE, United States, FY 1992 to FY 2017



Source: State Higher Education Executive Officers Association, *State Higher Education Finance: FY 2017* (Boulder, Colo.: State Higher Education Executive Officers, 2017).

to receive Title IV student financial aid funding) to examine them. The regulation itself reflected growing concern with the nation's economic competitiveness and the cost and value of higher education. According to Peter Ewell, president emeritus of the National Center for Higher Education Management Systems, it also reflected a newly activist regulatory stance within the Department of Education.[35] Notable within the cottage industry that sprung up in response are the American Association of Colleges and Universities' LEAP program (Liberal Education and America's Promise) and the College Learning Assessment. The former, launched in 2005, identified workforce-aligned learning outcomes, providing practitioners with guidelines for integrating them into liberal arts course rubrics for assessing student mastery of these outcomes. The latter was one of several instruments designed to look beyond graduation rates and salary outcomes to determine what students actually learn in college.

Shining a light on learning outcomes revealed some disturbing patterns about student workload (low) and learning (low) in higher education, and raised questions about whether and to what extent colleges really add value to a student's human capital through learning.[36] The patterns that emerged were similar across higher education sectors and student groups, but with the graduation rate and earnings problems concentrated in sectors that disproportionately serve new-majority students. The findings at once stimulated and reinforced debate and discussion about the role higher education plays in reifying and potentially expanding class and racial inequalities. In particular, it fueled debate about whether the higher salary outcomes apparent for students from selective schools were primarily a reflection of socioeconomic background, a consequence of the networking effects they experienced in college, and the signaling effect that degrees from selective colleges had in the marketplace, or whether these students actually learned more in college than others.[37] Ethnographic research fueled the discussion, focusing on the challenges new-majority students face succeeding in selective institutions where the student culture and academic pathways are created for the predominantly White and more affluent plurality.[38] The literature speaks to imposter syndrome – the feeling that one is not worthy to belong in the academic community – and cultural isolation, both of which can lead directly to students stopping out. In *Paying for the Party*, sociologists Elizabeth Armstrong and Laura Hamilton also demonstrate how low-income women students, lacking the social capital and the network of their higher-income peers, cannot risk achieving a middling academic performance, and thus are put at greater risk by engaging fully in the social life of the institution. Still, it appears that the new-majority students who are able to navigate the environmental and cultural challenges they face in more selective and better-resourced institutions will have better outcomes.[39]

The completion movement has also generated interest in innovations in teaching practices and institutional structures that promise to improve student outcomes. There is growing evidence about the effectiveness of active learning to replace the lecture model, new approaches to developmental education, and curriculum redesign that adds structure to students' degree pathways: so-called guided pathways that steer and support students through their college careers. These strategies are particularly important for at-risk and new-majority students, but implementing them requires institutional resources. There is a real danger that the colleges at which most low-income students enroll will be unable to match the improvements adopted by better-resourced institutions.

With respect to teaching practices, an evidence base is growing under "high-impact practices" that appear to generate better student outcomes as measured in performance on course exams and in course completion rates.

A meta-analysis conducted by biologist Scott Freeman and others showed the positive impact of a single high-impact practice: the use of active learning techniques that enable students to construct their own understanding of a subject as opposed to sitting passively and listening to lectures.[40] And biologists David Haak, Sarah Eddy, and Kelly Hogan have demonstrated that active learning had disproportionately large positive effects on students from educationally or economically disadvantaged backgrounds, reducing educational attainment gaps.[41] While the evidence base is still thin, it is nonetheless promising and shows that high-impact practices – others of which are referenced throughout this issue of *Dædalus* – may be a very effective means of addressing persistent educational attainment gaps. The question is whether sectors in which historically underserved students are concentrated are able, given their limited funding and high teaching loads, to support faculty in learning and reproducing those practices faithfully and at a sufficient scale across the institution to have significant overall effect on student outcomes. One wonders, in other words, whether innovation that promises improved student learning outcomes is equally accessible across sectors.

A similar concern emerges for practices that are proving themselves effective in improving outcomes for students who begin their college careers in developmental education. Developmental education – efforts to prepare students to enter and succeed in college – dates back at least into the 1600s.[42] In the United States, waves of interest in improving and reforming developmental education have typically been associated with surges in the size of the college-going population, such as after the Morrill Land Grant Acts in the nineteenth century or with the introduction of federal student aid funding in the twentieth. Such efforts intensified in the 2000s as the accountability movement gained steam and shined a harsh light on the appalling low rates at which students beginning in remedial education were completing their degrees, and the disproportionate impacts on low-income students and students of color.[43]

From around that date, research conducted by the Community College Research Center (CCRC), Complete College America, and others demonstrated the efficacy of a multifaceted, whole-student approach that includes better student advising; multiple math pathways (the removal of Algebra 2 as the only pathway through which one could demonstrate competency for college); corequisite instructional models whereby students were able to meet remedial requirements while taking credit-bearing college courses; and the use of multiple measures including high school GPA as well as placement testing in order to evaluate remedial need.[44] Recent research, however, questions whether the approach can be adopted by institutions housing the students that need it most. Implementing a corequisite instructional model reduces

the footprint of developmental education departments on campus without eliminating the need for supplemental instruction: that is, for supporting students' remedial needs while they are enrolled in credit-bearing courses. The economic impacts are doubly difficult. Developmental education departments are revenue-generating cost centers and while the marginal costs of instructing a remedial student are actually higher than those for a student in credit-bearing courses, it is not clear that the difference is enough to sustain the additional cost of supplemental instruction. In a nutshell, significant reduction of a developmental education department results in a potentially very significant hit on a college's revenues – a hit that may or may not be wholly recoverable in a way that results from improved student retention.[45]

Similar concerns arise from recent enthusiasm gathering around guided pathways: a wholesale approach to the construction of narrowly focused, closely advised course sequences that result in a degree. Here, energy is found initially in the elite four-year sectors in which reform warrior and University of Pennsylvania professor Robert Zemsky has advocated for curricula carefully designed to expose students in a structured and sequenced way to the competencies they need in pursuit of a particular degree or major.[46] For him, the common "cafeteria"-style approach in which students constructed majors from course catalogs that included a random assembly of courses that individual faculty cared to teach was not only ineffective with respect to learning outcomes, it was also costly. Researchers from the CCRC reached similar conclusions for two-year colleges where they found that the cafeteria-style approach contributed to relatively higher stop-out rates of historically underserved students: notably, first-generation, low-income students, and students of color.[47] For them, the antidote was the guided pathway. Initially observed by CCRC researchers in the nine community colleges affiliated with Completion by Design, the approach integrates three practices areas:[48]

- helping students choose and enter a well-defined pathway to a credential that meets their end goals;
- keeping students on their chosen path by integrating intrusive advising and high-impact instructional practices; and
- ensuring that students are learning along the path, again with reference to high-impact practices and continuous assessments with feedback loops.

Canonized by economist and CCRC founder Thomas Bailey and colleagues in 2015, guided pathways took off in a flash across the two-year sector initially through an institute launched by the American Association of Community Colleges (AACC) in 2016 and then amplified through multiple copycat

initiatives.[49] Downward enrollment pressures resulting from a strong economy may have had a role as colleges turned to retention as a means of maintaining student numbers. And the pathways movement offered college leaders a means to integrate a distracting array of piece-part reforms, all of them promising improved student success, but each of them advocated and implemented separately.

Early evidence suggests that a pathways approach can improve students' success and contain costs.[50] But here, too, one wonders about the potential for widespread adoption. Organizing curricula, instructional practices, and advising around a student's journey requires nothing less than a fundamental overhaul to the educational and business models that are baked into the culture, practice, and business systems of most colleges and universities. It requires significant support for professional development of both faculty and staff who engage directly with students. And it relies upon significant change leadership and change management capabilities, two characteristics that are typically weak in universities and colleges.[51] Some third-party supports are available from professional (such as the AACC) and membership (such as Achieving the Dream) associations and from the commercial marketplace, notably through consultants and institutes. But these are weak levers. Seeking to reach the broadest number of institutions at the lowest possible per institution price, professional associations and membership organizations are not able to provide the hands-on supports and capability development required. Consultants can go deeper, but at a cost that may be prohibitive for many institutions. As a result, one wonders how and to what extent the capability to implement proven completion-oriented reforms will track closely with an institution's resources and financial flexibility. If it does, it will advantage the very large enrollment institutions (because they benefit in all things from economies of scale) and the elite private and public not-for-profits. In this regard, the fruits of the completion movement could very well exacerbate divides that already exist across the higher education industry.

Heralded frequently as a great leveler of educational access and attainment, the history of technology integration through online learning also raises questions about whether innovations will reduce or reinforce inequalities.[52]

Online learning has its origins in correspondence courses mounted to reach working adults, in-service military personnel, and professionals in practices requiring continuing education. Initially conducted on paper and through the mail, it evolved with successive generations of technology. The United Kingdom's Open University is perhaps the most famous instantiation.

Popularized by the film *Educating Rita* (1983), the Open University at one time combined television lectures, occasional meetings between students and their local tutors, and in some cases, short-duration in-residence instruction that used sparsely populated university facilities out of term time (such as during summer). From the 1990s, course delivery in distance education moved from the airwaves to the Internet, eventually, as we have seen, propelling growth in the for-profit sector. Capitalizing on virtually unregulated access to federal student aid, rising demand from working adults and other student groups who were underserved by nonprofits that concentrate on recent high school graduates, and by excess demand in allied health and other industries for vocationally trained workers in fields amenable to online education, the for-profit sector grew to represent about 10 percent of all student enrollments by 2010, with particular strength among adult and low-income students.[53]

Not-for-profits in all segments were slower to engage in online learning than for-profits. Where they did engage, movement was responsive to the same kinds of demand growth that propelled the for-profits, notably in the adult learning sector. It was initially apparent in extension programs that were affiliated with four-year, mostly public institutions that had historically been set up to serve adult and professional students and continuing education. With weaker forms of faculty-shared governance and greater reliance on nontenured instructors, extension programs were often more nimble with respect to educational innovation and a natural place for four-year universities in particular to experiment with online learning. From the early 2000s, initiatives spread onto the main campuses in both two- and four-year public institutions in which student course demand was outstripping supply, and in which per-student funding cuts energized the search for lower-cost instructional models. Different motivations were apparent among the early adopters. Some used online delivery to expand course-level access for enrolled students who, owing to funding cuts, the pressure of student numbers, and the scheduling challenges faced by working students and parents, struggled to find the courses they needed to graduate. Others, typically in the four-year universities and at the postbaccalaureate level, sought to break into new markets to meet the growing workforce demand for master's degrees in specific fields such as business, education, and various areas of computer science and engineering.

Engagement by private not-for-profits was even more restricted at the undergraduate level. Highly selective institutions were by definition elite and, as a consequence, not interested in expanding their undergraduate numbers in a way that would drive toward greater use of online modalities. As a result, engagement by elite nonprofits – engagement that attracted the lion's share of media attention – involved boutique, brand-building offerings designed to

show off research prowess and attract research and venture dollars (examples include Carnegie Mellon's Online Initiative or Stanford's early engagement with MOOCs) or, in the case of MIT's Open Courseware initiative, establish credibility in international markets. In the much larger nonelite part of the private not-for-profit sector, online never emerged as much of an option. The expense associated with an effective move online was prohibitive given small endowments and the revenues associated with low enrollments.

Unsurprisingly, by 2009, online instruction outside the for-profit sector was highly concentrated in a relatively small number of outlier institutions. In that year, Western Governor's University (WGU), established in 1997 by the governors of nineteen states and with a significant grant from the Bill and Melinda Gates Foundation, offered fully online courses to over fifty thousand students, Penn State's World Campus served twenty-five thousand (9,500 full-time equivalent) students, University of Maryland's University College had twelve thousand online students, and there were one or two others operating outside the for-profit sector at something bigger than fledgling scale.[54] There were also a number of headlining failures in the not-for-profit sector to point to, failures that reflected outright resistance to the genre, notably at the University of Illinois, where the Global Campus effort announced with great fanfare and with an investment of $10 million collapsed after only three years.[55] By comparison, in the very same year – 2009 – the for-profit University of Phoenix was nearing its high watermark enrollment of nearly four hundred thousand online students.[56]

Within a decade, the tables had turned. For-profits, under enormous pressure resulting from the Great Recession and a hostile regulatory environment, collapsed, losing as much as a half of all enrollments. Several of the biggest for-profits went out of business (Corinthian Colleges), were bought out by private equity firms (University of Phoenix), merged with not-for-profit institutions looking to accelerate their own online learning initiatives (Kaplan and Purdue Universities), or transitioned from for- to not-for-profit status. Large public universities and community colleges, meanwhile, moved in to pick up some of the slack. WGU grew to one hundred thousand enrollments and continues achieving 10 percent year-on-year growth. Arizona State University serves nearly the same number annually, and the University of Central Florida has grown to nearly sixty thousand students with almost one-third of all student credit hours taken online. Other evidence collected annually since 2002 has demonstrated how online learning has become part of the mainstream in higher education. Large public universities and colleges are particularly likely to offer a large share of student credit hours online. At these institutions, the faculty who teach in online courses have a significantly more favorable

view of their quality than faculty from institutions that offer few courses online. There, too, administrators see online courses playing strategically more significant roles in their institution's future than do administrators at institutions with a smaller online footprint.[57]

Acceleration of online learning in two- and four-year public institutions is perhaps best understood with reference to developments on the supply-and-demand sides of the market for online courseware products. On the supply side, large publishing houses and venture capital groups were, from the late 2000s and for different reasons, using technology to drive effective, lower-cost, and interactive forms of education. Publisher engagement reflected their long-running transition away from printed textbooks and the highly competitive and low-margin nature of their online markets. Venture capitalists, on the other hand, were expanding into higher education, an industry they saw as on the verge of "disruption" given the demand from historically underserved consumers.[58] Federal agencies, notably the National Science Foundation, played a role, too, as online learning acted as a focal point for emerging learning sciences, and so did philanthropies interested in online as a means of driving the completion agenda while at the same time lowering the overall cost structure of education.

On the demand side, larger two- and four-year public institutions were responding to market pressures: most notably, the downward pressure on public funding. They turned to online products (stoking demand that fueled developments on the supply side) for various reasons: breaking into new student markets including the adult markets, the grip over which was being relinquished by the for-profits; enhancing course access for existing (enrolled) students where access was threatened by budget cuts; lowering overall instructional costs in response to revenue pressures; and in select cases, improving outcomes for existing students. Work conducted by Arizona State University with the Boston Consulting Group demonstrated that these very different objectives required different strategies and had vastly different costs and outcomes. Breaking into new student markets was certainly possible as demonstrated by Arizona State, Southern New Hampshire, Western Governors University, and a handful of others. Where fully online modalities were used, instructional costs could be significantly reduced by comparison with fully face-to-face modalities. Marketing costs were high, but not high enough to counteract the savings on the instructional side. However, success as measured by student outcomes was typically lower than was available through face-to-face modalities, except in very focused and highly specialized postbaccalaureate programs that enrolled motivated and already very well-educated students.

Gains were also made using online modalities to improve undergraduate students' course access. Results were mixed, though. Online instruction proved less expensive than face-to-face, but in a study of California Community Colleges, economists Hans Johnson and Marisol Mejia found that students taking online courses performed less well as measured in their letter grades and course completion rates, but had higher graduation rates.[59] The study may help explain why, using IPEDS (Integrated Postsecondary Education Data System) data and comparing institutions within (and not across) sectors, we see that institutions teaching a disproportionately high number of student credit hours online have lower per-student instructional costs and higher graduation rates than those teaching fewer student credit hours online. It is as important to note that research also shows that outcomes for students in fully online courses vary significantly. First-generation, low-income, and academically at-risk students attending college directly out of high school, for example, perform markedly less well than students in other demographics. Implementation, too, appears to matter a great deal. A recent study published by Arizona State University and the Boston Consultant Group has demonstrated that at exemplar institutions, online undergraduate courses produce better student retention, higher graduation rates, and lower costs.[60] At the same time, there is ample evidence of implementations that depress student outcomes and add cost.

Of course, the industry is hardly static. Experience with online learning aggressively shapes implementation approaches as well as demand for better products, driving initiative on the supply side. Two potentially very promising trajectories are beginning to take shape. The first is the use of hybrid modalities: modalities that mix face-to-face and online instruction. Where implemented well, they appear to lower costs and improve student outcomes. This at least is the experience at the University of Central Florida (UCF). With undergraduates taking nearly one-third of their credits online, UCF shows the best course outcomes for students in hybrid courses (with outcomes for face-to-face and fully online falling behind in that order).[61] A second very promising development is seen in adaptive technology platforms and courseware that integrate data science to make machine-assisted learning directly responsive to individual students' needs and their progress and pace in mastering explicitly specified course competencies. By the mid-2010s, results were more rather than less promising for the technology demonstrating improved student outcomes for students from all demographic groups.[62]

Interestingly, while one would expect the technology to improve, thereby introducing even greater affordances with respect to student outcomes and cost, there are signs that implementation costs, requisite expertise, and scale economies are beyond the reach of all but large enrollment and/or highly

endowed institutions, at least with respect to implementations that are locally grown and managed. While there are other avenues for entering online education that rely on third-party partnerships (such as with online course providers like Straighterline and online program management companies like 2U and Academic Partnerships), they are relatively expensive (because they rely on a revenue share with the third party) and require an institution to outsource core academic functions, which is hard to accomplish politically. Thus, it is not wholly inconceivable that effective implementation of online learning may be a further differentiating factor that begins to define our higher education landscape, not necessarily in ways that advantage relatively wealthier and more selective institutions, but in ways that favor those able to operate at tremendous scale and as such are able to develop their own operational services that drive enrollment, control cost, and manage quality with respect to student outcomes.

Other implications of this trend are profound and unsettling. We are already seeing evidence that fully online providers acting at enormous scale are competing directly in regional markets for low- and middle-income students with the majority attending college directly out of high school. These are students who have historically been served by less- and nonselective four- and even two-year institutions using traditional face-to-face modalities. As the net average price of traditional experiences escalates, the fully online providers (which can cost the students between one-third and one-half as much over four years) will look increasingly attractive. Given data that question the efficacy of fully online education with this student segment, these market mechanics could result in further stratifying our educational ecosystem. Potentially, personalized, face-to-face experiences could be concentrated in more selective institutions for those able to afford their relatively high net average price, and less effective, more impersonal, fully online experiences would be available for the rest who cannot.

As a historian, I cannot bring myself to believe that the past is prologue; that the future is determined and entirely beyond our ability to shape. The observations I have made as an industry spectator, one-time investor, and sometimes institutional leader also point in a more optimistic direction. Essays in this issue of *Dædalus* show how the choices made by individual faculty members about how to engage in teaching and learning have a profound and significant impact on their students' outcomes.[63] At the institutional level, too, we all know of colleges and universities that have bent predicted outcomes for their historically underserved student populations, in some cases even eliminating pervasive attainment gaps between Brown, Black, and White and between rich and poor. These institutions are aligning

countless individual choices behind deliberately chosen strategic goals pursued by leaders who are competent in change management approaches that work in their sectors.[64] Finally, we can point to education public policies that show promise in altering the course of our future. In Tennessee and Ohio, for example, we see state governments that have designed and implemented policy regimes that lessen the degree of difficulty entailed for universities and colleges in their pursuit of more equitable outcomes. And while it is too soon to know the impact of various "promise" initiatives that tilt toward access to higher education that carries low or even no tuition cost for students (such as the Tennessee Promise Program), it is reasonable to claim that they reflect intentional policy choices designed to alter the path we are on and blend interest in greater social equity with workforce development goals.[65]

While none of this constitutes a solid evidence base, it does at least suggest that the future of higher education may be ours to shape; that the choices we make for ourselves, our institutions, and our public policies will determine the trajectory of higher education and its social impacts. Given the direction we appear to be headed, now is a good time for us to review those choices and think carefully about where they will lead our industry and with what impacts on our society. Now is a good time to engage deliberately (and with a view ultimately to aligned action) in a conversation about the future of undergraduate education.

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CREATE a Revolution in Undergraduates' Understanding of Science: Teach through Close Analysis of Scientific Literature

Sally G. Hoskins

The teaching of science to undergraduates aligns poorly with the practice of science, leading many students to conclude that research is boring and researchers themselves are antisocial geniuses. Creativity, a key driver of scientific progress, is underemphasized or ignored altogether in many classrooms, as teaching focuses on the complex integrated concepts and voluminous amounts of information typical of STEM curricula. Faculty, largely untrained in science education per se, teach largely as they were taught, through lectures based in textbooks. This situation could change, and students' understanding of research practice could be fostered relatively easily, if faculty began teaching classes focused on the journal articles they read in their professional lives. In this essay, I outline a novel scaffolded approach to guiding students in a) deciphering the complexities of scientific literature and b) the process of gaining new understanding of who scientists are, what they do, how they do it, and why.

"Activity without understanding seems to be a regular feature of classroom life for science students in American schools."[1]

"Argument and debate are common in science, yet they are virtually absent from science education."[2]

"All too often biology education appears to be defined by trivia – an impression that can alienate students from what is an inherently highly personal and intellectually fascinating subject."[3]

Science professors want students to learn how to think deeply and critically about key concepts; retain understanding developed in class; and sharpen analytical abilities that can be applied in novel situations. Yet

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what many science courses actually require from students – mere recall – does not promote the development of these skills. An undergraduate can complete multiple science courses by passing exams, yet have only a fragmented understanding of science. As a result, too many students lack the ability to apply creatively what was learned; for example, to relate physical and chemical principles to biological systems.[4] In upper-level electives, which should build on foundational knowledge acquired in prerequisite classes, teachers find themselves reteaching fundamentals that students previously "learned" in prerequisite courses, but did not understand or retain. Current approaches to undergraduate STEM education are failing many students, and have been for years.

The National Research Council compendium *How People Learn* proposed at the dawn of the twenty-first century that "to develop competence in an area of inquiry, students must: (a) have a deep foundation of factual knowledge, (b) understand facts and ideas in the context of a conceptual framework, and (c) organize knowledge in ways that facilitate retrieval and application."[5] Multiple lines of evidence support the argument that college science teaching errs by overemphasizing factual knowledge (via extreme content coverage) while neglecting the more complex issues of building conceptual frameworks. Students need to spend more time focused on synthesizing, extending, and applying what they have learned. Further, current teaching practices virtually ignore scientific creativity, a key driver of scientific advancement.

The nature of science is similarly neglected. Faculty members' deep knowledge of how scientific research is done is rarely communicated in the classroom, and opportunities for developing students' reasoning and argumentation skills are largely missed, as instructors and students alike confront the ballooning quantities of information. Despite years of efforts at reform supported by organizations including the National Science Foundation, the Howard Hughes Medical Institute, and the American Association for the Advancement of Science, the typical science course is still a lecture, and though faculty members may recognize the importance of higher-order cognitive skills, many test primarily for recall of details.[6]

Multiple attempts to reform college science teaching are in progress, with many focused on increasing student engagement.[7] These are often conveyed through publications, workshops for college professors, instructors, or postdoctoral fellows, and, in some cases, the addition of pedagogical training to graduate curricula. Ideally, changes in faculty members' (and future faculty members') understanding of best practices for teaching and learning will trickle down to the benefit of college students. This process, however, will be slow. Even faculty members who are motivated to hone their skills by attending teaching workshops find it difficult to shift their classroom practices

substantially.[8] When this training technique has been analyzed, only limited data support its efficacy.[9]

Many reform proposals seek more engaging ways for professors to convey material from college textbooks. We need a revolution in undergraduate science education: with teaching primarily based not on textbooks but on primary literature, and classroom focus on depth rather than breadth. Of course, core factual content is necessary, but it should not dominate what students learn. Just as one does not need native fluency in Spanish in order to travel successfully in Madrid, students do not need encyclopedic knowledge of scientific facts in order to engage in scientific discourse.

In this model, "fundamentals" courses will be present, but streamlined. Broad-coverage textbooks will serve as references rather than as the backbones of syllabi, and students will learn to read, analyze, and understand primary literature, and go on to review, intelligently criticize, and propose follow-up studies for published research reports. In this process, they will be able to define for themselves what they "need to know" and look up key content to fill in gaps, without losing focus on the broader picture of the logic of a study. They will see how the experiments or descriptive studies reported in a given paper led to interpretable evidence. In an unconventional but immensely valuable step, students will gain insight into issues not reflected in published success stories through an email Q&A encounter with authors. Class sessions will resemble lab meetings that range over the nature of science, scientific creativity, the logic of study design, and the motivations of researchers, in addition to the findings and conclusions of individual papers. Such activities will help students develop a deeper understanding of the subject at hand, coupled with transferable analytical skills.

There are many ways to teach using scientific literature. These include methods for using individual data panels from a paper as the focus of class discussion and providing closely annotated online versions of papers with prompts and suggested activities for teachers and students.[10] Primary literature–focused approaches have been adapted for large-enrollment undergraduate and graduate courses.[11] My focus here is primary literature analysis through the CREATE strategy (Consider, Read, Elucidate hypotheses or questions, Analyze and interpret data, Think of the next research study, Engage with the authors), which I began developing in collaboration with geneticist Leslie Stevens in 2003.[12] We felt that focusing on primary literature would: 1) leverage professors' deep understanding of the research process; 2) reveal to students how knowledge develops in science while consolidating their conceptual understanding of, in the initial iterations, biology; and

3) provide insight into the nature of research careers and the people who choose them.

In the past fifteen years, we and collaborators have evaluated the effectiveness of this teaching and learning strategy using an array of cognitive and affective assessments of a variety of student populations, across courses taught by faculty at diverse two- and four-year institutions. The original CREATE course was designed as an elective for upper-level students. Based on student feedback, we developed an additional CREATE course for first-year students; this freshman population included both future STEM and non-STEM majors. The core tenets of the CREATE strategy are the same in both courses and both use primary literature, although the readings differ. In the upper-level "Analysis of Scientific Literature" CREATE course, papers (such as from *Science*, *Neuron*, or *Developmental Biology*) are chosen to capitalize on upper-level students' (theoretical) core understanding of STEM topics from previous courses. The first-year "Introduction to Scientific Thinking" CREATE course uses literature on topics (such as animal behavior, infant cognition, or distracted driving) that do not require a foundational physics or chemistry background. Here, a newspaper or Internet report is often used to introduce the subject before diving into the primary literature. The first-year version of CREATE thus builds on the foundation of students' high school backgrounds. While many of these students have not yet chosen their major field of study, like upper-level CREATE students, they make significant gains, for example in critical thinking, self-efficacy, and expert-like scientific thinking, as well as in epistemological maturation.[13] Thus, for students who take a single general education science course in college purely to fulfill a requirement, a CREATE course would be substantially more beneficial than a mile-wide, inch-deep overview of general biological topics, much like the high school biology courses that likely inspired some students to avoid STEM in college.[14]

CREATE courses are built using modules: sets of papers that were either written in sequence by one lab or by multiple labs attacking the same challenge. CREATE instructors typically choose module topics that are within their own expertise, and the CREATE website provides sample modules and "road maps" for how to teach them.[15] CREATE instructors do not teach by telling students about the papers, but coach the class to discover why and how a given study was done and to think deeply about how (and sometimes if) the data drive particular conclusions. Classes are run much like lab meetings: students are guided in a stepwise process of decoding and deconstructing/reconstructing research studies (see Table 1). Substantial amounts of class time are spent on discussion and interpretation of data, with students challenged to analyze the data as if it were from their own research. For this constructivist

Table 1
Steps of the CREATE Process

Step	Activities
Consider	• Concept map introduction • Review main concepts • Relate old and new knowledge • Define knowledge gaps for review
Read	• Look up vocabulary, paraphrase key sentences • Annotate figures • Represent table data in graphical form • Sketch "what went on in the lab or field" for each experiment
Elucidate hypotheses or research questions	• Retitle each figure in your own words • Use the sketch of the study to derive question being asked or hypothesis being addressed
Analyze and interpret data	• Use templates as a framework for interpreting data • Learn to cope with jargon of scientific writing • Determine the organization/logic of each experiment • Discuss data in class • Write bullet points for your own discussion • Write your own title for the paper
Think of the next experiment	• Design and sketch two different follow-up studies for a given paper • Pitch your experiment to a student grant panel • Compare/debate/defend various proposed experiments
Engage with authors or experts	• Students brainstorm questions to ask • Faculty member edits list, sends single survey once to each author or expert • Students annotate, reflect on, and discuss responses

Source: Adapted from Sally G. Hoskins and Leslie M. Stevens, "Learning our L.I.M.I.T.S.: Less Is More In Teaching Science," *Advances in Physiology Education* 33 (1) (2009).

process to succeed, students must be very well prepared for each class session. Passivity is not an option. We recognized that students were unaccustomed to prepping intensely for class and devised methods to address this challenge.

Before class, students complete a variety of homework assignments that require employing a combination of pedagogical tools, including concept mapping, sketching, and paraphrasing key sentences (see Table 2). Students build their own textbooks throughout the term by compiling homework material and annotated research papers along with background information they sought out to fill self-discovered gaps in their knowledge. These portfolios are brought to every class and may be consulted during open-book exams. While upper-level CREATE classes have foundational prerequisites, we find that students have difficulty retrieving and applying knowledge from such courses; thus, it is key for them to begin to assess what they do and do not know and fill in where needed. In class, the instructor leads a discussion of each figure and table of the paper, examining what was done in the lab or field to generate these data. This is an important step often skipped in traditionally taught courses; many students are accustomed to analyzing results without considering how they were generated. This process is time-consuming but valuable. After completing the data analysis of a given paper, students propose and debate potential follow-up studies, experiencing the creativity and open-ended nature of scientific exploration.

Important for their potential to evoke revolutionary change in science pedagogy, CREATE teaching strategies can be easily learned and applied, since they capitalize on skills that college faculty members already possess though rarely employ in the classroom. As one faculty colleague noted, "I used to spend the 48 hours before any class running around making PowerPoints. Now my prep is my last ten years' research experience in this field." CREATE faculty need not be active researchers; those who have engaged in research for their graduate degrees also have deep knowledge of this art, which is rarely brought to class. The CREATE website provides guidance for those whose research experience is limited.

CREATE pedagogical approaches align well with advice from science educators, though the strategy was developed without strong influence from education literature. Like most college faculty members, Dr. Stevens and I were largely unaware of that literature when we began crafting an approach that could take students beyond a paper's abstract when they "read" primary literature in science. Our subsequent research, including collaborations with scientists Kristy Kenyon, Alison Krufka, David Lopatto, and Stanley Lo, has documented that students in CREATE courses make significant gains in critical thinking, experimental design ability, content integration ability, self-efficacy,

Table 2
The CREATE Strategy Fosters Creativity, Synthesis, and Analytical Thinking

Pedagogical Tool	Value for Students
Concept mapping	• Explicitly relate old and new knowledge • Build metacognitive skills
Cartooning	• Learn to visualize how data were generated in the lab or in the field • Create a context for the data analysis
Annotating figures and transforming tables	• Write identifiers and clarifying notes directly onto figures • Represent data from tables graphically
Paraphrasing	• Rewrite key sentences of the paper in your own words • Learn to cope with jargon of scientific writing
Analyzing data using templates	• Determine the organization/logic of each experiment • Engage closely with data by triangulating between figures, tables, methods, and results • Interpret results critically; evaluate the roles of controls
Grant panel activity	• Practice creativity and synthetic thinking • Hone critical skills of analysis • Develop communication skills through deliberation and debate of the proposed experiments
Surveying paper authors by email	• Gain insight into the people behind the papers • Recognize that scientists are diverse, much like the students themselves • Change negative preconceptions of scientists and research careers

Source: Adapted from Sally G. Hoskins, Leslie M. Stevens, and Kristy L. Kenyon, *The CREATE Teaching Handbook*, unpublished.

and attitudes toward science.[16] Students also undergo significant epistemological maturation and show more sophisticated (scientist-like rather than novice-like) thinking after a single CREATE course.[17] These courses are straightforward to develop and inexpensive to offer (there is no wet-lab component).

In principle, CREATE courses could be easily added to college science curricula, but in practice, changing how college faculty members teach is a tall order.[18] Fifteen years of research on the CREATE strategy have produced substantial data supporting its efficacy, but faculty members do not typically design courses or classroom approaches with reference to science education literature.[19] Many are constrained by long-standing tradition; for example, around the "content" question. Professors may feel a responsibility to cover all the material of the voluminous textbooks typically assigned for college courses. Yet covering is not teaching. At CREATE faculty development workshops, it has been typical for participants from a wide range of two- and four-year colleges and universities to note with frustration that their upper-level students seem not to have a working understanding of key information covered in course prerequisites, and that first-year students do not remember the material covered in their high school science classes.

Given the explosive growth of science since the mid-twentieth century, even if students were to remember 100 percent of the facts from their foundational STEM courses, they would not be prepared adequately for future scientific, teaching, or biomedical careers, or to vote intelligently on science-based issues of public policy. As knowledge expands and new techniques are developed, professors teach material that was not discovered until well *after* their own college years, and those engaged in research use methods that did not exist when they were working on their Ph.D.s.[20] Remembering how to clone 1990s-style does not prepare one for CRISPR technology, but knowing how to read and understand primary literature arguably does. Remembering all the steps of mitosis (covered in middle school, high school, and virtually every undergraduate general education biology textbook) does not prepare students to take a stand on the question of vaccines. Whether or not students in CREATE courses continue in science, they will benefit from having the ability to evaluate scientific claims.

It is the nature of science to grow and change continually, yet traditional educational approaches imply that if students master a finite amount of content, they will be prepared to go forward. Scientists constantly push into the unknown, often developing new studies by brainstorming with colleagues and working to interpret and understand unexpected data. Students, in contrast, often perform teacher-designed experiments with predictable results,

and fail to engage fully in the scientific process. That is, science as presented in typical classrooms only rarely reflects the practice of science. Many students taught in traditional ways 1) do not remember or understand deeply key content; 2) do not gain insight into the research process, the nature of science, or scientific creativity; 3) retain views of science and scientists based on negative stereotypes; 4) if STEM majors, change to a non-STEM field; or 5) if non-STEM majors, do not gain a real understanding of how research relates to societal goals.[21]

How did we reach this impasse between what we know science to be and how we teach it? Indisputably, faculty members play a key role in students' understanding of science. Yet unlike K–12 teachers, the vast majority of college instructors have limited – or no – training in the fundamentals of teaching and learning. Neither how people learn nor current research-based best classroom practices are a standard part of graduate or postgraduate curricula in science, much less in the lives of newly hired assistant professors. Lacking such guidance, many teach as they themselves were taught, modeling the behaviors of their own favorite college teachers, usually lecturers.

Teaching higher-order thinking skills has proven particularly challenging. Despite exhortations of decades of science education reform advocates, for example in the American Association for the Advancement of Science's science education reform report *Vision and Change*, the majority of college science courses are still taught in lecture format.[22] Regarding the consequences of lecture, biologist Philip Camill notes,

> Students exposed only to lecture information . . . are ill-prepared for graduate or professional school where they will be required to think independently, develop research programs, or react to novelty or uncertainty. More importantly, lectures and cookbook labs squelch student curiosity because they leave no room for students to take charge of their own learning.[23]

Today's science students are constantly exposed to PowerPoint versions of scientific processes that encourage a simplistic, linear, stepwise view, masking the often intriguingly tangled paths within research – plus the occasional serendipity – that lead to discoveries. As noted by higher education scholar Ian Kinchin, by the time a PowerPoint lecture has been prepared, the intellectual work of disentangling and making sense of the complexity of the topic at hand has all been done *for the student* before class, by the professor.[24] The student receives (and may simply memorize) a distortedly vectorial view of scientific discovery. Kinchin quotes John Dewey (definitely not discussing a PowerPoint in 1910): "Just because the order [of a lecture] is logical, it

represents the survey of subject matter made by one who already understands it, not the path of progress followed by a mind that is learning. . . . The latter must be a series of tacks, zig-zag movements back and forth."[25]

Putting this cognitive gap aside for a moment, one might expect that experiencing the hands-on activities of physics, chemistry, and biology in semester-long introductory courses that include labs would naturally lead students to begin to think more like physicists, chemists, and biologists. In fact, there is evidence that student thinking becomes significantly *less* expert, thus more naive, over a semester in such courses.[26] This finding is a clear signal that there is a need to modify introductory STEM courses to introduce more cognitive challenges.

Data collected over decades indicate that many STEM-interested students leave these majors due to disappointing experiences in introductory courses.[27] Intriguingly, the attrition is apparently not because students doubt their intellectual abilities, but rather largely because they are bored or overwhelmed by the material and the competitive atmosphere. Students who persist have a hard time gaining and retaining an integrated understanding of course material or a real understanding of how research is done, or how science advances. Thus, traditional teaching of science, a route often followed by faculty members because they survived it and/or because other job pressures mean they don't have time to experiment with anything that might be better, can have far-reaching negative consequences.

Participation in undergraduate research experiences can be pivotal for college students, inspiring some to choose research careers.[28] However, if previous coursework has reinforced a distorted idea about science (such as "science is boring"; "everything is known already"; or "it's all in my textbook waiting to be memorized"), students may avoid research opportunities. Students who must work to support themselves may not have time for extracurricular research. Distortions about "who" becomes a scientist are also relevant. Popular culture conveys an image of scientists as loner geeks/geniuses, potentially alienating anyone who is gregarious and does not have a straight-A transcript from even considering hands-on research.

Editorials in science journals urge reform, yet the encyclopedic nature of many twenty-first-century textbooks makes it difficult for students to understand what science "is," much less that biology, for example, has a primary literature of its own. By significantly underrepresenting scientific processes in their illustrations, traditional textbooks for introductory biology have made it difficult for students to recognize that the books' facts and concepts were derived from carefully designed research studies.[29] Some textbooks, however,

are grounded firmly in literature, for example, citing some four thousand authors over twenty chapters.[30] These help students recognize that there are researchers behind the conclusions, but still, individual research studies are compressed drastically, making it difficult for students to reconstruct the scientific thinking underlying the conclusions presented. The development of new textbooks focused in part on published data is a promising step, but there are still large aspects of the research process missing from textbooks: for example, the reality that scientists learn a great deal from experiments that fail as well as from those that succeed, and that they constantly revise their working models in the face of unexpected results.[31]

As scientists, we should look at the data and draw the obvious conclusion. Major change in STEM education at the college level is needed, and the sooner the better. Given the emphasis on grants and publications in tenure packages, however, the current situation is unlikely to change in a top-down, administration-driven way. The post hoc efforts of including teaching workshops in graduate training or using teaching assistantships (such as lab instructorships) as opportunities for pedagogical development, while positive, do little to prepare graduate students for the real rigors of designing and teaching classes. What this implies about how universities value teaching and learning compared with the many other activities in which their faculties are expected to engage is an issue for a different essay.

Refocusing science pedagogy largely on primary literature would leverage preexisting skills of faculty members and has the potential to benefit students and teachers alike, but this will require a major shift in teaching and learning methodologies. Primary literature is a key medium of science research that is usually ignored altogether in the undergraduate STEM classroom. When literature is used, it is often approached superficially, as when a student "presents" a twenty-five-page paper in five minutes, recapping the abstract and concluding paragraph, and tacitly accepting all the findings, then sitting down to watch classmates perform the same ritual. In literature and history, among other subjects, primary sources form the skeleton of many course syllabi. This can be equally powerful in undergraduate science classes, as learning to decipher primary scientific literature can help build sophisticated reading and critical analysis skills while simultaneously illustrating how new knowledge is generated, evaluated, and built upon. To gain perspective on how biological research is done, in order to really understand where the textbook information comes from, students need fluency and experience in the language of the field, as well as some sense of what it is like to be a working scientist. To gain critical thinking skills, students must engage in, and practice with, activities involving analysis, synthesis, and higher-order reasoning.[32] To learn

to evaluate societal issues influenced by science, students must read beyond content-rich introductory science textbooks focused on "science basics," and learn to decode the studies whose outcomes lead to new understanding in science. Higher-order thinking can be promoted in a cost-effective way through the close analysis of primary literature.

An important aspect of the CREATE process involves challenging students to tackle the question of how to follow up a given study. After fully analyzing a given paper, students individually design their own "next experiments" or follow-up research studies (recognizing that not all research involves experimentation), and then vet each other's proposals in an anonymous grant-review exercise (no one knows who designed which study). In our experience, this is the first time in a science course, whether in middle school, high school, or college, that students have been asked to exercise creativity and design a research study based on their own original idea. In the process, students recognize that research is rarely "finished," even though papers come to definite conclusions. The process also illustrates that a given published paper could be followed up in multiple ways and that choices are made based on the most recent data and not predestined from the start of a research study.

Depending on class size, there may be four to six student panels that deliberate by looking at the logic of the designs proposed by their peers, considering how a study flows from the work just analyzed, and factoring in the originality of the proposal and the potential impact of the work proposed. Logic- and evidence-based thinking can be done by students at any level, because it is not dependent on any particular body of background information beyond what was studied in class. The fact that the CREATE approach successfully builds both upper-level and first-year students' critical thinking skills and self-efficacy argues that the traditional approach – that the "first years of a STEM major are for the basics; then we'll get to the higher-order thinking in later years" – is needlessly limiting.[33] Students at all levels enjoy the freedom to create follow-up studies and to argue collegially about which are best, using evidence to back up their claims and thereby hone critical analytic skills. The faculty member may guide individual panels' discussions with prompts, and research-active faculty may also provide insight from personal experiences on such panels.

Experience has shown that these grant panels – all weighing the same contenders – often rank proposals differently. This situation surprises the student participants ("Experiment 6 was *obviously* the best! WHY did your panel pick experiment 12?!"), underscoring how peer reviewers bring their own preferences and opinions to the table and the reality that more than one excellent follow-up option exists. Education research supports the idea that projects

like this, which lack a single "correct" answer, stimulate creativity.[34] After the grant panel, students are highly interested in the follow-up the authors actually carried out, newly aware that the choice was one of a number of viable options. The process of analyzing a full paper, designing follow-ups, and evaluating them repeats with each paper in a set of two-to-four articles. This strategy allows students to build their skills and illustrates both the conceptual flow of a given project over a two- to ten-year period and shows research itself to be a creative and open-ended process. Most of our data are derived from CREATE courses in biology; findings in other disciplines, including chemistry and psychology, while less extensive, are consistent with the biology findings.

The intensive focus on research design and data analysis in the CREATE classroom is complemented by a look at the people behind the papers. Late in the term, students generate a set of questions for authors of the papers they have analyzed. These are compiled by the instructor into a single survey that is emailed to each author, including principal investigators, postdocs, and graduate students. Responses reveal insider information about the studies along with insights into the researchers' lives and motivations. These more personal reflections help dispel negative perceptions held by many students regarding research life (that it is lonely, boring, and open only to straight-A geniuses, for example). In a given semester, all authors are sent the same set of questions. Researchers seem to enjoy the opportunity to respond to students' questions, and a response rate of more than 50 percent is typical. The spectrum of responses is broad, underscoring for students that "scientists" are a widely diverse group of individuals with unique ideas and backgrounds. These replies can provide revelatory insights to questions such as:

- In your opinion, is it necessary to be "a brilliant person" to be a research biologist?
- How do you balance career and family? (if applicable)
- Do you ever get bored? Or frustrated when experiments don't work? How do you deal with it?
- What would be your "dream discovery"?
- Have you encountered any ethical dilemmas along the way? How were they resolved?
- What happens when there are differences of opinion within the lab? Who decides?
- Are there any clinical applications of your work, and if so, what are they?

- How do you choose the next step in your research program? That is, out of all the potential "research directions" to choose next, how do you decide which to do?

Students annotate authors' responses, noting comments that particularly surprised or inspired them. Class discussion of the authors' comments illuminates a number of rarely discussed aspects of science, including how the "next step" is in fact chosen for a given project, how researchers respond to setbacks, and that many successful scientists were not, in fact straight-A students. Further, passion and persistence are more important than genius. Numerous aspects of the nature of science also are highlighted: that knowledge changes over time; that science is creative; and that rejected hypotheses are critically important on the road to achieving understanding.

After the first three upper-level CREATE classes, we conducted postcourse interviews of students to complement other cognitive and affective assessments. We learned that even after three years of college science, students (mostly graduating seniors) came into the class harboring quite negative opinions about science and scientists. Such misapprehensions can deter students from considering research careers. CREATE courses can refute such fallacies, and the email survey likely contributes substantially to this by emphasizing the highly personal aspects of biological research.[35]

What follows is a series of student comments made during post-CREATE course interviews. Their reflections illustrate four conclusions about the efficacy of the model.[36]

CREATE changes students' ideas about research:

> "As far as research, I learned that one answer can lead to so many different things, and every person has their own ideas about where the ideas will lead. And I thought that was like the coolest thing, because I had always thought everybody would go in the same direction."

> "I think the biggest, kind of like enlightenment for me is that you can have your own ideas . . . and you can come up with your own interpretation of things and not necessarily be 'wrong.' I think there is a lot more creativity behind science than most people are aware of."

> "I always thought . . . that people do research and they spend all their lives on this one topic, and then it doesn't go right, and then, Oh, their whole life's work is, you know, screwed up. . . . But that's not really the way it works. You keep changing, and moving, and stopping/starting, 180-degree turn, stopping/starting, maybe go

back to where you were originally and then move in a completely new direction, so it's just a process of discovery."

CREATE changes students' ideas about scientists:

"I thought [precourse] they were close-minded. They just had one specific thing in mind and then bam-bam-bam they proved it and that was it. 'This is my evidence: a, b, c, d, e, f, g. Forget it; can't refute it.' That's it. [Now] I think scientists, they are always asking questions, they always want to know more. They have an angle in mind, and hopefully they strive toward that point. But they may be deviated from that by new discoveries along the way. Then they may have to reshape. So I think that . . . they have to be open-minded in a way."

"I learned how scientists think. Before, I thought scientists were like, you know, 'machinery kind of people.' . . . Somehow now they are more human. . . . It's kind of cool. . . . I feel like they are more relatable."

"[Before, I thought] yeah, just geniuses. Straight As, 4.0s, they were like just knockin' it away. . . . Before, I thought they didn't have any families; like 'This Was Their Life.' But now I'm like, no, they have families, they have careers, they have doctor's appointments; they have everything going on. . . . You realize they're people, trying to balance life, family, career, everything, just like a normal person; and anybody in the world . . . you know, like they are not just geniuses, that everything comes simple to them. . . . They just have a better understanding of a particular subject. But they are people."

CREATE changes students' ideas about who can be a scientist:

"Who can be involved in scientific work? It's not 'very rich people'; it's not the professors alone, it's not the students who are getting the As. But I think everybody is capable of being involved in scientific work, provided he gets the correct guidance. That's what I found out."

"I myself could be a scientist now. Before I was like, only 'some kinds of people' can be scientists and it has to be like these geniuses, who were, you know, like eight times smarter – I learned that it can be anybody. Anyone can be a scientist; it has to do with having a passion to do research, and just a drive, and not to get bogged down by failed experiments and things not going right, but just to go through a process, because there's a thinking process you have to go through, of elimination, and trying, and experimenting."

"Research, I thought, was just like, 'certain people' can do it; not everyone can be a scientist. Now I feel like if you train, if you get the right training and the right

> background knowledge . . . I could be a scientist if I wanted to. I could be a scientist. . . . Before I was like: I wasn't one of 'those people' that could do science, but now, reading the papers . . . I realized that I can be a scientist if I wanted to. If I really worked hard towards it."

Students perceive their gains in CREATE courses to be transferable:

> "I walked away with skills that are going to help me in every single class I take again, and even in life, really. I feel like I can take on my own taxes this year! Just being able to sit down and focus and not get bogged down."

> "I think for any future class I take or even for my own personal interests, looking for information and really understanding what's out there is going to be a lot easier for me. And I'm not going to be as afraid to read a twenty-page paper."

> "I'm not as intimidated when I'm learning something new, because I feel like this whole semester we've been learning new things. So, it helped a lot. . . . Pretty much in other biology classes they just give you information and ask you to spit it back out . . . and this class was really neat because . . . it allows you to think of things on your own and use your own creativity, so that was good."

The CREATE strategy helps students develop a deep understanding of a module's papers, which provide insight into how knowledge in a research area deepens over time. Moreover, the method works on multiple levels. In upper-level CREATE courses, learning the specifics of methods (such as fluorescence-activated cell sorting, confocal microscopy, CRISPR/Cas9 technology, or immunoprecipitation) helps students see key principles of biology, chemistry, and physics put to use, and emphasizes the multidisciplinary nature of scientific research. In both the introductory and upper-level courses, dissecting the logic of the experiments and closely analyzing the data help students think like scientists. Class discussions, personal experiences related by the professor, the repeated experimental design and grant panel activity, and the author emails provide additional layers of insight into the nature of science and of scientists. The components of CREATE likely work synergistically to evoke the cognitive and affective outcomes documented to date.

Published papers are of course not transcripts of lab activities. Textbooks largely omit the research process, and primary literature arguably sanitizes it, presenting only the successful efforts. Experiments that led nowhere are (understandably) left out of published papers, and rejected hypotheses are not discussed (unless the point of the paper is to upend a previously held idea). The thought processes behind the studies are thus implied rather than stated. These important aspects of research projects are issues for the CREATE

instructor to bring up in class. They are often also illuminated in the email surveys. In response to the question, "If your experiment does not turn out as expected, is this a problem? What do you do?" one author wrote, "I personally love it, because it means that it is time to check my premises and I thus may be getting closer to making a truly new discovery." A different author pointed out:

> This happens all the time – especially early in a project while exploring ideas – but is typically not a problem as long as things are working technically. One wants to always be open to different models and seek answers with exploratory hypotheses but an open mind. Something different than expected can in fact be exciting, because it can lead to deeper understanding. . . . Something was incomplete or wrong about a prior held view.

Students reported expecting a different answer: that researchers would be depressed or consider themselves failures. Instead, rejected hypotheses and confusing results were recast as unsurprising aspects of scientific investigation, and often a stimulus leading to development of better ideas. To a student question on whether the researcher had experienced "ethical dilemmas," the first respondent simply said "No." The second responded, "Yes, and if anyone tells you 'no,' they're lying!" Overall, the email interview activity provides abundant insight into both the research process and researchers themselves – insight difficult or impossible to achieve in traditionally taught science courses.

The topics of scientific creativity and science as understood by the general public deserve more comprehensive treatment than is possible here, but teaching and learning with the CREATE strategy has implications for both. Because traditional science courses overemphasize content at the expense of scientific reasoning, argumentation, and design, they render scientific creativity virtually invisible.[37] Unfortunately, creativity itself has proven problematic in education: work at the K–12 level has suggested that teachers may suppress student creativity rather than nurturing it; thus, a creative spark may end up being more of a burden than an asset for students.[38] In CREATE classrooms, students find that designing creative follow-up studies can lead to success in the friendly competition of the grant panel process, and they become increasingly aware of the creativity underlying scientific research in general.

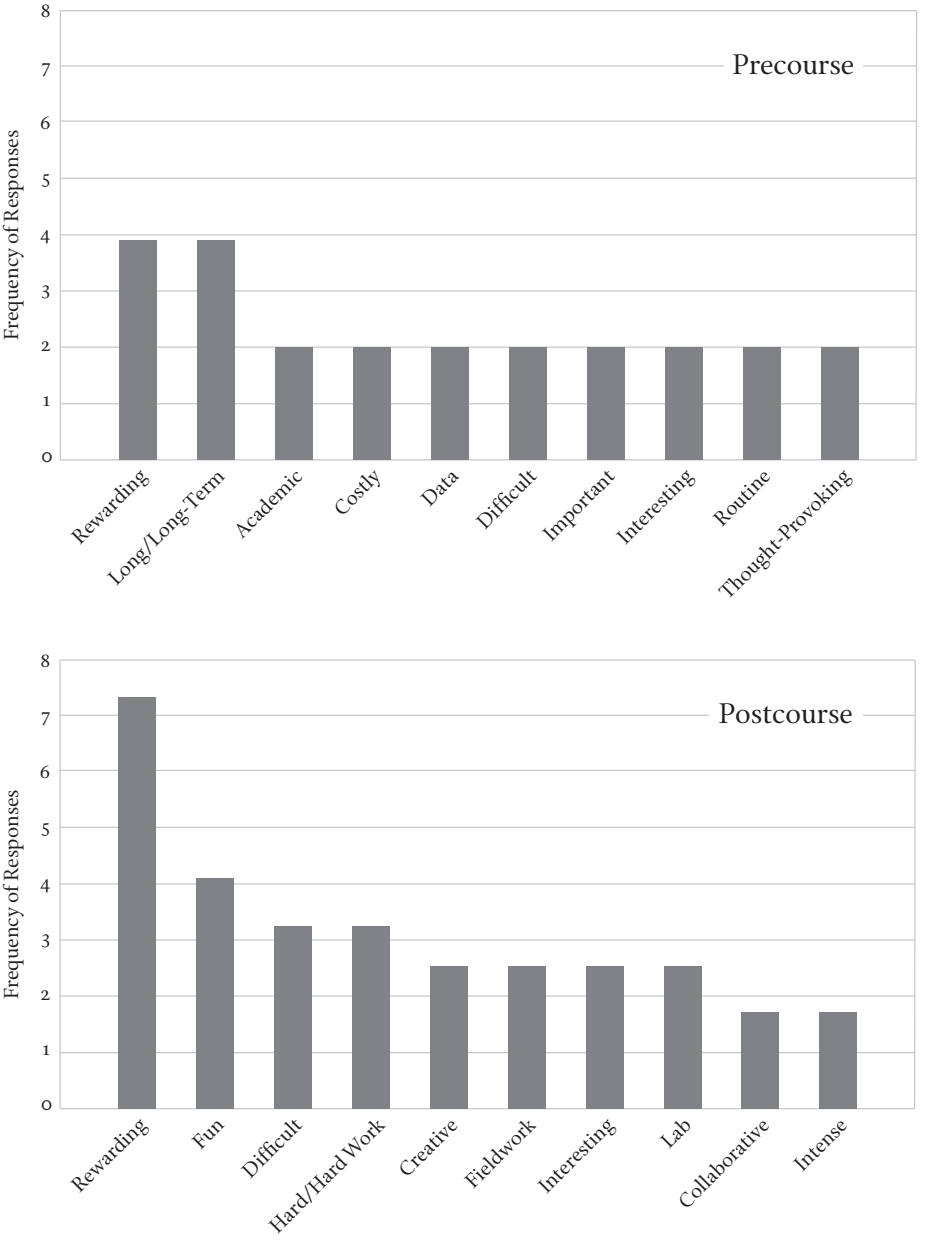
While every paper is, in principle, creative, papers also provide opportunities for professors to emphasize the everyday smaller-scale creativity inherent to research science. For example, one paper read in an upper-level CREATE

biology elective examines how growth cones, the amoeba-like tips of growing nerve fibers, find their way in embryos. The paper opens with the authors growing pieces of retina in sterile dishes and discovering that the retinal growth cones collapse in response to treatment with a particular growth factor. The investigators next carry out an integrated set of substudies of this phenomenon defining dosages, time-courses, and specificities of the in vitro assay. The bulk of the paper's experiments then use the collapse assay to study the molecular basis of this aspect of axon guidance in the visual system.

Students had never considered the fact that if you discover a phenomenon like growth cone collapse, you need to characterize it experimentally before moving forward. The investigators had no handbook to check for methodology; proper dosages and timing needed to be determined empirically. Mulling over issues like this helps students develop a richer understanding of research design. In every CREATE course, students comment on their realization that science is creative, or "more creative than I thought." Data from multiple iterations of City College of New York CREATE classes on a Likert-style survey of student attitudes and beliefs show significant gains on a statement suggesting that science is creative – gains not seen in a comparison non-CREATE course.[39] Thus, even in the absence of wet-lab activities, CREATE students come to recognize that designing, carrying out, interpreting, troubleshooting, and extending research studies is an inherently creative process.

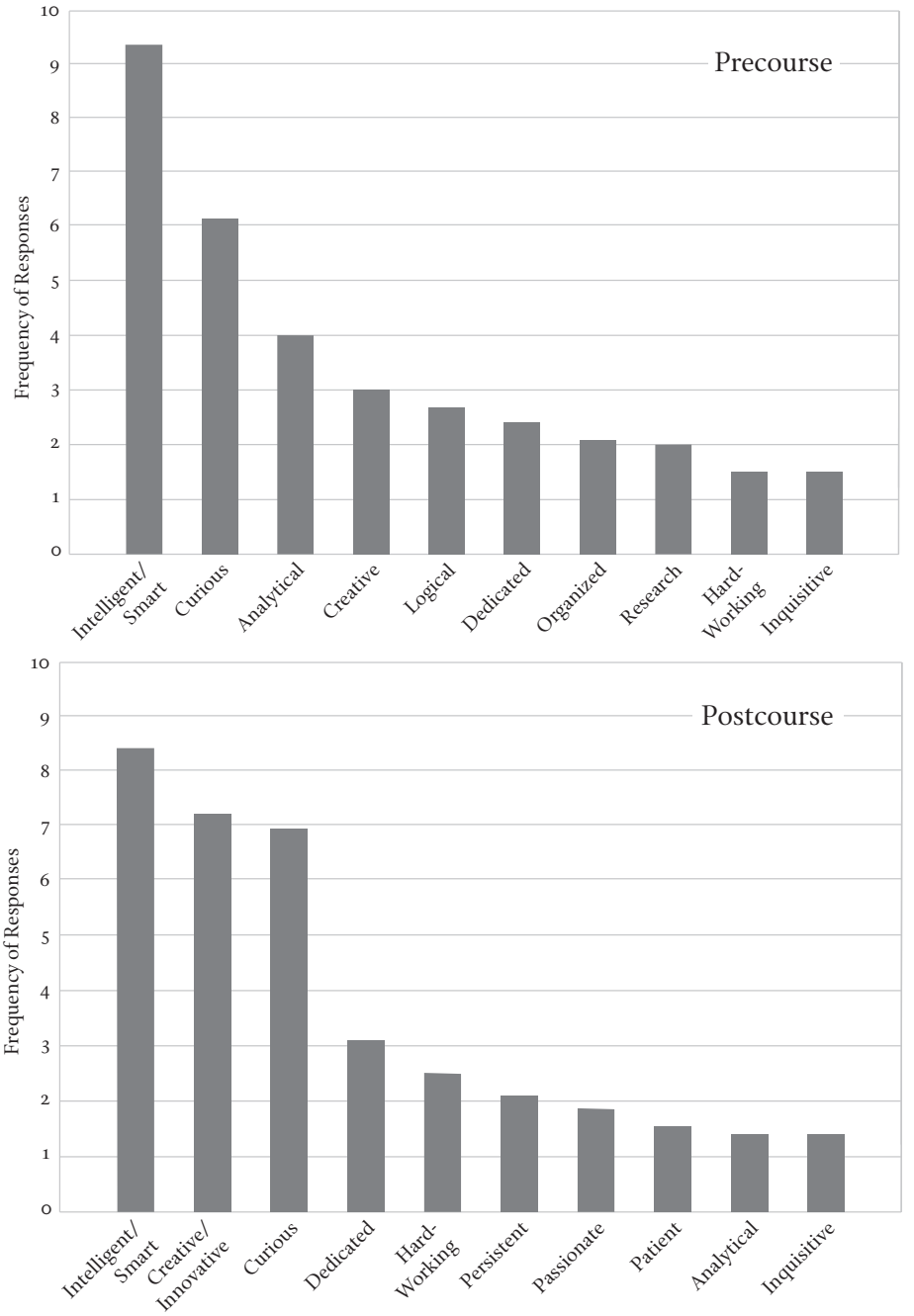
One of our anonymous assessment surveys included open-ended prompts asking students to write three to five words that they associated with "scientists" or with "research careers" (see Figure 1). In one study, the surveys were administered pre- and postcourse in a set of ten upper-level CREATE classes taught by faculty members in R1 institutions, public universities, and elite liberal arts colleges, all of whom had learned CREATE methods in National Science Foundation–sponsored workshops taught by Kristy Kenyon and myself. In pooled data from the ten CREATE courses, before the course, "creative" did not appear among the top ten words describing "research careers." After the course, however, "creative" appeared in the top ten for research careers (along with "fun" and "collaborative"), suggesting that the experience of a CREATE course shifts viewpoints to a more faithful reflection of reality, even in the absence of hands-on lab work. With regard to words associated with "scientists," "passionate" and "patient" were top-ten responses postcourse, but not precourse, and the frequency of mentions of "creative" increased postcourse, with "innovative" appearing as a new category (see Figure 2). These results suggest that over a CREATE term, students achieve a more nuanced (and accurate) understanding of and positive attitude toward researchers themselves. The no-cost email component can bring about significant changes in student perception and insight.[40]

Figure 1
Top Ten Words Associated with "Research Careers" in CREATE Courses at Ten Four-Year Campuses, Pre- and Postcourse



Source (Figures 1 & 2): Sally G. Hoskins, unpublished data.

Figure 2
Top Ten Words Associated with "Scientists" in CREATE Courses at Ten Four-Year Campuses, Pre- and Postcourse



The first-year CREATE course could be adapted for general education science students, whose single biology course may be their only college science class. Teaching the nonmajors how scientists think, design research studies, evaluate data, and come up with new ideas, and guiding them in an email survey of selected scientists, could be a positive way to help them prepare to vote intelligently on science-related issues of public importance. As noted in *The Future of Undergraduate Education, The Future of America*: "Many of the country's founders . . . believed that the democratic experience had to be safeguarded and maintained and that the enduring success of a democratic government depended upon an educated citizenry."[41]

If biology students harbor negative preconceptions about science, one must assume that the nonscientifically educated public does as well. The situation is not helped by popular culture stereotypes of scientists as loner weirdos. Helping more students teach themselves to analyze data, creatively design follow-ups, and see their own questions answered by working scientists could help clarify the realities of science. Ideally all students will recognize that science does and should change; that new knowledge continuously challenges old; that scientists passionately pursue a quest for understanding; and that every time some "fact" is overturned by new data, it does not mean scientists "made a mistake." As our world becomes increasingly subject to biological challenges, for example those resulting from climate change, it is more important than ever that all citizens are science-literate. As a faculty-friendly approach with established cognitive and affective benefits for a wide range of students, CREATE courses could contribute significantly to this effort.

Some would use the evidence above to support the idea of adding single CREATE courses to traditional college curricula. The fact that both first-year and upper-level CREATE students make a variety of gains in a single-semester course suggests that this could be beneficial. But that may be only half of the revolution proposed in the title of this essay, and it would be insufficient. Imagine a STEM curriculum in which students delve deeply into the primary literature of not only one STEM discipline, but many, and in which students spend significant time thinking like geologists, astronomers, biochemists, or physicists, as well as biologists. CREATE courses immerse students in the language and logic of a particular discipline; physicists and biochemists encounter quite different challenges. Biochemists can do three different experiments in a week; in contrast, physicists working with the Large Hadron Collider may plan for years to carry out one study, and astronomers and paleontologists do not do classical-model experiments at all.

As projects become increasingly cross-disciplinary, we may eventually build a "fusion STEM" curriculum, but for now, colleges and universities design their programs around the departmental structure. I believe students could benefit substantially from reading deeply and closely in the language of *each* STEM discipline, and all STEM faculty could benefit from being able to bring their insider understanding of knowledge generation in that discipline to the classroom. Every STEM discipline is characterized by critical thinking, evidence-based analysis, and creativity; it would be very interesting to see how students might benefit from exposure to deep study in multiple areas of STEM through diverse CREATE courses. With regard to non-STEM students, it is essential to modify general education science courses so that they are not mere retreads of broad-coverage high school courses. The public must be able to read and evaluate scientific claims as they make critical decisions about their personal health and around issues of public policy. The present negative stereotypes about science and scientists can be dispelled and science literacy increased. While CREATE was originally developed for biology majors, development of a broad-based general education CREATE course based on the first-year "Introduction to Scientific Thinking" CREATE course and its widespread use in the United States could be the most important benefit of this evidence-based strategy.[42]

AUTHOR'S NOTE

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The False Dichotomy between Academic Learning & Occupational Skills

Thomas R. Bailey & Clive R. Belfield

What distinctions are there between vocational (career and technical) education and academic learning in college? In this essay, we compare broad academic and vocational program goals, embodied skills, tasks, and jobs, with a focus primarily on community college students. There is considerable overlap between the two types of education, so a separation of tracks presents a false dichotomy. In addition, vocational certificates, which often have little academic content, have attracted attention lately as a path to good jobs. New evidence indicates that degrees offer more substantial advantages than certificates in the labor market. We argue for an alternative framework for thinking about the optimal accumulation of skills in college. Rejecting the traditional distinction between vocational education and academic learning, we posit that educational paths are best understood as accumulations of general education followed by terminal work-related education. We label this the Gen-Tech framework and consider its explanatory power and implications for colleges and students.

Going to college is one of the most important economic decisions a person can make. A substantial body of research indicates that the average student benefits from going to college. Yet there is persistent controversy regarding the costs and benefits of higher education. As tuition and fees have risen, many middle-class families have found the cost of college burdensome; as debt levels have risen and wages have stagnated, more students have questioned whether the benefits of college are too meager. In the last few years, this skepticism has taken on a more concrete form: rather than attending a traditional college (although "traditional college" is not always well defined), many students enroll instead in programs designed more specifically to prepare them for work. The rationale is that college students should focus on accumulating vocational skills over academic learning.

This tension has existed for a long time and is currently institutionalized by the distinction between "career and technical education" (CTE) and

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"academic education" (at either two- or four-year colleges). We reject this distinction. We argue that it is based on an overly determinative notion of what skills workers acquire, need, and use, as well as an understanding of the evidence on the returns to vocational education that is insufficiently nuanced. Maintaining this distinction leads to a misguided stylization of educational pathways through college.

We propose an alternative framework for thinking about the optimal accumulation of skills in college. Specifically, we posit that educational paths are best understood as accumulations of general education followed by terminal work-related education. We label this the *Gen-Tech* framework and consider its explanatory power and implications for colleges and students, as well as for the future of education design.

Although many of these phenomena are present at four-year colleges, we focus primarily on community colleges because it is there that the tensions between short-term credentials and degrees and between academic and career and technical education are most salient. Moreover, even though four-year colleges explicitly prepare students for jobs, this instruction is not generally referred to as CTE. Our discussion does apply to some adults returning to college, but less so to adults who already have general skills and are returning for very specific occupational goals. For this reason, we emphasize that our discussion focuses primarily on the trajectories of younger students.

While short-term occupational or employer-based credentials have been a staple of community college offerings for decades, they have recently gained more public notice. Indeed, this trend is bipartisan. In 2017 and 2018, Republicans argued for an emphasis on short-term credentials or employer-developed certifications, expressing skepticism about the liberal arts curriculum that forms the foundation of a traditional college education. The Trump administration has also been enthusiastic about short-term occupational credentials and apprenticeships, on the assumption that they offer a more direct route to good-paying jobs without a diversion through academic instruction.

But Democrats and progressives have made similar arguments for many years, expressing skepticism about the "college for all" ethic (by which they generally mean a four-year college for all) and highlighting the benefits of short-term occupationally specific certificates, which often have minimal general education content. At the community college level, one advantage of these programs is that they often do not have academic prerequisites and therefore do not require students with weak academic skills to undergo remediation. Remediation is sometimes incorporated into substantive courses, but in general,

certificate programs get students in and out quickly with a specific job goal. Whatever these students may lose in general skills is compensated by a greater probability of completion and better immediate access to jobs. At least for students with weak academic skills and adults returning to school to upgrade skills, advocates argue that trading off the amorphous benefits of general skills for a certificate that leads to a concrete job is well worth it. Progressives have long been enthusiastic about apprenticeships as well. For example, rooted in a favorable view of European apprenticeship programs, Congress during the Clinton administration passed the School-to-Work Opportunity Act.

The tension between occupationally focused and academic instruction has a long history. The Smith-Hughes National Vocational Education Act of 1917 – inspired partly by a perception of German advantages in education and training – provided federal funds for "agriculture, trades and industry, and homemaking."[1] However, the Smith-Hughes Act led to vocational education being differentiated from other types of education within schools, and it generated an enduring constituency to the design and administration of the state-level activities funded by the Act. Since 1917, the Act has been replaced and renamed several times. "Vocational education" was changed to "vocation and technical education" and, later, "career and technical education"; "vocational" had taken on a pejorative connotation, characterized by a perception of narrow high school courses that were thought to track students into "dead-end" careers. This shift was accompanied by a call for the integration of academic education into vocational programs. This was based, in turn, on the idea that in the modern economy, academic skills were useful for some vocations: modern technology and work organization required all workers to be able to read, write, and communicate effectively. At the same time, however, new pedagogic perspectives suggested that general academic learning would be improved if it relied on more practical applications. Despite the blurring of the distinctions between academic and vocational learning, the century-old Smith Hughes Act and definitions therein have been repeatedly reinforced and reauthorized, most recently in 2018 as the Strengthening Career and Technical Education for the 21st Century (Perkins V) Act.

Thus, in the current labor market, CTE is advanced as a preferred route through postsecondary education for many students.

The distinction between career and technical education and academic education – along with the view that the former is superior to the latter – is a false dichotomy. We contrast the two in terms of their program goals, embodied skills, and implications for the jobs of college-educated workers.

One way to explore what distinguishes CTE programs is to look at the types of skills that these programs are designed to teach. Advance CTE is an organization of the "State Directors and state leaders responsible for secondary, post-secondary and adult Career Technical Education (CTE) across all 50 states and U.S. territories";[2] it lists the following twelve "Career Ready Practices . . . intended to establish goals for CTE programs":

- Act as a responsible and contributing citizen and employee;
- Apply appropriate academic and technical skills;
- Attend to personal health and financial well-being;
- Communicate clearly and effectively and with reason;
- Consider the environmental, social, and economic impacts of decisions;
- Demonstrate creativity and innovation;
- Employ valid and reliable research strategies;
- Utilize critical thinking to make sense of problems and persevere in solving them;
- Model integrity, ethical leadership, and effective management;
- Plan education and career paths aligned to personal goals;
- Use technology to enhance productivity;
- Work productively in teams while using cultural global competence.[3]

But this is a good set of goals for any educational program, and all occupations but the most menial. Certainly, it applies to the types of careers that "academic" students aspire to and could easily characterize the goals of a liberal arts education.

An alternative way to understand the need for different types of vocational or academic education is to look at the skills required by employers. Workers' skills may be vocationally specific (such as knowing calculus as an engineer) or general (such as diligence), and we might expect that employers would talk primarily of the vocational skills required for their particular needs.

But employers often claim they are seeking general academic skills. More than three-quarters of the executives and hiring managers interviewed in a 2018 survey by Hart Research Associates listed as "very important" for recent college graduates they were hiring skills that encompassed the ability to effectively communicate orally; work in teams and independently; communicate in writing; and apply knowledge/skills to real-world settings. The list of skills for college graduates also emphasized a set of character traits – ethical judgment, decision-making, or self-motivation – that is identical to the Advance CTE list above. Yet these skills and traits often require years of education to develop properly and it is difficult to see how they could do so in a short certificate program.

Analysis of job announcements reinforces the desirability of general skills. From a review of thousands of job postings, public policy scholar David Deming and economist Lisa Kahn identified ten job skills that employers claim to want.[4] Of these ten skills, three do appear to be directly technical (financial, computer, and software skills). Two skills appear to be quite general (social skills and character skills); college may help with these, but they are not contingent on whether the student is in a general or vocational program. Similarly, three other skills appear to involve managerial tasks (customer service, and project and people management) that are not typically conveyed in career and technical education. Finally, two of the most important skills – those most likely to be found in job postings – are labeled "cognitive skills" and "writing skills." Both are academic and are more likely – or certainly as likely – to be part of a general studies curriculum spanning both high school and college than to be part of a vocational curriculum. In fact, many job postings require both cognitive and social skills, so a balanced postsecondary education seems optimal.

When we turn to what happens in the workplace, the sense of what constitutes college-level vocational skills becomes even more nebulous. Workers possess skills that they acquired in college. Yet jobs are bundles of tasks that employers ask workers to perform. Workers may have skills that they use only infrequently (such as complex calculations) and others that they use a lot (such as managing social situations). It is challenging to identify college skills that relate directly to labor market tasks, and to demarcate those skills as vocational rather than academic.

Jobs throughout the economy involve a very wide range of tasks at varying levels of competency. Social scientists try to identify needed tasks by examining the activities carried out within occupations. But occupational mapping is not a precise science. Existing maps produced by economists suggest that the U.S. workforce is grossly overqualified, with perhaps as many as one-third of the workforce having college degrees they do not need. In light of data on the high returns to college, this one-third figure seems dubious.

The correspondence between college-level skills and specific occupations is also quite loose. Many occupations include workers with varying amounts of skill and education. Typically, a high-skill occupation is defined as one in which 50 percent or more of workers have a bachelor's degree; this allows for many workers who have not gone beyond high school to be working in occupations that are considered high-skilled. More in-depth studies find that occupations do not map well to skills: less than 10 percent of the variance in skill requirements is explained by occupation and, within each occupation, skill differences matter in explaining wages. A significant amount of wage inequality exists within occupations rather than between occupations; choosing a

specific occupation matters, but so does the worker's position within that occupation.

Perhaps the distinction between career and technical education and academic instruction is simply defined by the level of education required to do the related jobs. "CTE jobs" are those that require less than a bachelor's degree, while those that require at least a four-year degree are considered "academic jobs." Education in a four-year college that is explicitly for job preparation, such as for teaching, is not referred to as CTE. This distinction seems unnecessary: it is not clear why jobs requiring a lower level of education require a special title and a special (albeit modest) legislative agenda. It also ignores the many associate's degrees in general studies or liberal arts.

In any case, the concept of "jobs that require a bachelor's degree" is not well-defined. Up to 50 percent of workers in a high-skilled job might not have a bachelor's degree. Indeed, community colleges provide effective workers for almost every industry and occupation. In nearly every industry, persons with "some college," and many with associate's degrees, represent 30 to 40 percent of all workers (unweighted by employment size). There are some industries in which most of the workers are not college-educated (such as food preparation) and there are others in which most workers have four-year degrees or above (such as the judiciary). But there are almost no industries in which persons with some college predominate; instead, these workers are spread across the economy. The same spread is evident for occupations. Some occupations are closed off to associate's degree holders: lawyers and judges, physicians and surgeons, and teachers (these are occupations in which fewer than 10 percent of workers have only some college). Occupations in which associate's degree holders predominate are mostly in nursing and health care. Thus, associate's degree holders cannot be surgeons, but they can work in occupations that complement surgeons' work. This pattern holds true for most occupations across the economy.

Similarly, direct analyses of tasks do not provide a clear link to CTE programs. Most economists agree that routine tasks are disappearing, leaving workers to perform mostly manual, nonroutine, and cognitive skills. Yet, despite widespread computerization, some studies find the task mixture of jobs to be largely unchanged over the last two decades. College graduates do perform significantly more complex tasks than high school graduates (less time spent on repetitive/physical tasks and more time on management, problem-solving, and math). However, this task-based information is very general. It is difficult to design a college program around "complex tasks," "problem-solving," or "abstract tasks"; it is even harder to distinguish such a program as vocational.[5]

Finally, tasks and skills are dynamic. Workers have a range of skills that they can apply as the returns to each task change; firms can change the allocation of tasks or task composition of jobs in response to workers' skills. This suggests that whatever the skills defined for jobs at the point of hiring, employers may make use of higher-level skills, especially general academic skills, after someone is hired. Moreover, workers with social/general skills may be more adaptable, particularly if a team of workers is allocated multiple tasks and must work collaboratively.

Indeed, it is possible to erode the distinction even further. The notion that academic skills taught in liberal arts programs are not work-related has little support. Advocates of occupational education argue that a general academic education does not explicitly teach students valuable labor market skills. But this is not proven and certainly does not apply to all degree programs. Many teachers and professors, for example, studied academic disciplines at the undergraduate level that are of direct relevance to their employment. These academic disciplines might seem "liberal," but they actually represent early occupational training. This point was recognized by educational reformer John Dewey over a century ago:

> Many a teacher and author writes and argues in behalf of a cultural and humane education against the encroachments of a specialized practical education, without recognizing that his own education, which he calls liberal, has been mainly training for his own particular calling.[6]

For many workers, academic education *is* their vocational education.

Ultimately, the debate between academic versus vocational education might be settled in the labor market. If the returns to vocational programs clearly and systematically outstrip those for academic programs, then the distinction between these programs is meaningful. Here, we briefly review evidence on the economic returns to subbaccalaureate college.[7]

In general, the returns to community college occupational programs appear to outstrip the returns to academic or general education degrees. Initially, research distinguished between awards in academic disciplines versus vocational disciplines, with many studies finding that students who took vocational programs or pursued more quantitative academic disciplines had superior labor market outcomes and even that less technically oriented courses yielded no payoff at community college. Often these studies compared college graduates to high school graduates.

More recently, a series of studies have estimated the labor market returns within community college. These studies, using individual-level data across

statewide community college systems, compared associate's degree completers with community college noncompleters.[8] Their main conclusion was that there are robust and long-lasting returns to associate's degrees, despite some trends that appear to threaten those benefits.

Consistently, these studies find that the returns to associate's degrees are strongly positive. Given the slight differences in specifications, time periods, and cohorts, the results across the states exhibit a consensus. For each year after college, individual earnings are approximately $4,880 higher for male and $7,520 higher for female associate's degree holders (in 2018 dollars). With average quarterly earnings over this postcollege working period of approximately $30,240, the gains from associate's degree completion are 18 and 26 percent, respectively. Note that this one-year average gain (of $6,200) is close to the average debt per community college student. The studies also establish that the returns to associate's degrees persist after college exit. (Studies vary in how they model the persistence of returns, so it is not easy to provide a summary value for persistence of earnings gains.) Overall, the earnings gain for associate's degrees over noncompletion of community college appears to be high, durable, consistent, and robust.

Increasingly, studies have looked at differences in earnings across degrees in different subjects. At the community college level, the highest returns are in the health sciences, which are considered vocational programs. However, several factors offset these high returns. One is that health sciences programs are often selective, drawing more able students from the community college pool. Another is that the programs have higher drop-out rates, implying a lower prospective return to completion. And a third is that these programs often cost more than general studies degrees. Plus, students in occupational degree programs do get academic instruction. For example, students in health sciences may take a large proportion of coursework outside their department to, for example, satisfy humanities requirements or complete related business, math, and computing coursework.

Some academic or general education programs in community colleges are poorly organized or nebulous, sometimes serving as default programs for students who do not have a clear idea about what they want to do after college. But when the programs are more systematically developed, they are designed to prepare students to transfer, serving as the first two years of a four-year degree in which the more occupationally focused instruction would take place at the destination transfer institution.

Broadly, associate's degrees in vocational fields yield higher returns than those in academic fields. However, the average returns overall are still positive and a large proportion (more than 40 percent) of these degrees are Associate's

of Arts (not Sciences or Applied Sciences). So, associate's degrees in general yield positive returns, and gaps across disciplines may reflect unobserved differences in student characteristics, preferences, tuition prices, and program design elements related to transfer.

Often, community college students are faced with a choice between an associate's degree and a certificate, a choice that has received more attention lately as some policy-makers and researchers have emphasized the benefits of certificates. Degrees may have both academic and vocational content, while certificates are much more focused on specific occupational content. Again, using transcript-level data in analyses that account for individual workers' characteristics, recent studies have looked at the labor market returns to certificates and have found that, across the statewide analyses, returns are positive but modest. On average, the returns to male certificate holders are $530 and $740 to female certificate holders per quarter; this equates to $2,120 and $2,960, respectively, per annum. However, some studies find returns that are negative and others find returns that are not statistically significant, with estimates varying widely across states. Notably, different types of certificates have different returns, although broadly, certificates that require more credits generate greater labor market gains. Overall, returns to certificates are positive but temporary, and not robust across economic conditions, postsecondary contexts, or across econometric specifications. Certainly, these certificate programs are shorter, and their graduation rates are higher than for associate's degrees. But, given they only yield a temporary boost in earnings, it is far from obvious that community college students should earn CTE-based certificates and not associate's degrees that have a stronger academic component.

Students on the margin of enrollment may not experience the same returns. They may have lower interest or aptitude for college or may have higher opportunity costs. However, a significant number of students may face exogenous constraints or information constraints that hinder enrollment. These students may be expected to have returns close to the average: the reason they do not enroll has little to do with their ability to benefit. Indeed, many community college programs are open access, and students often register for courses immediately before classes start (rather than preparing for college in the last year of high school). Broadly, studies that have focused on marginal students have found returns that are either equivalent or only slightly lower than the average across all students.

Of course, just because the benefits of academic instruction have been high for the past half-century, there is no guarantee that the returns will be high over the next half-century.

While researchers and policy-makers have been discussing the tension between CTE and academic skills, labor market analysts have also been concerned about the employment implications of rapid technological change. This has already decimated the need for unskilled manual labor, and some analysts predict that jobs typically held by college-educated workers will be next, suggesting that even the academic skills learned by college graduates and that employers now say they want will not be adequate to protect graduates from advanced automation and robotization.

This fear is exaggerated. Fundamentally, increased capital increases labor productivity, which is the primary determinant of earnings and economic growth. In prior decades, this capital used to be physical (machines, automobiles); since the 1980s, it is increasingly computerized or robotized. More complex capital could replace some college-educated workers, but this replacement will not be economy-wide. Instead, it will apply only in the sectors in which robots are substitutes for workers. In other sectors, economic growth will accelerate employment: these include sectors that invent robots (like Silicon Valley) and those that use robots (such as ATMs or 3D printers) as new inputs in the production process. Moreover, if robots were eliminating many jobs, we would expect to see rapid productivity growth, when in reality, by historical standards, recent productivity growth has been slow.

Finally, the significant disruptive effects on employment generated by technology, if they do take place, would increase the importance of worker adaptability and flexibility, traits that are more likely to be learned in a curriculum that combines academic and occupational instruction rather than one focused more narrowly on job-related skills.

Associate's degrees are valuable degrees, at least on average. This conclusion holds as well for students on the margin. And we predict that this conclusion will hold up even with future trends that appear to threaten these benefits. By contrast, short-term credentials such as certificates have lower and more uncertain returns, and labor market threats to these returns appear salient.

Finally, the CTE versus academic distinction is a misreading of what students want to do. CTE programs are sometimes referred to as workforce development efforts: there is an implication in the use of the words "career" or "vocational" versus "academic" that vocational students are preparing for work and academic students are pursuing education. But this work-education distinction is hard to find: where are the academic students uninterested in employment? To be sure, education has value beyond effects on labor market prospects, but almost all community college students, as well as the vast majority of students in four-year colleges and graduate school, are expecting that their education will lead to higher paying or at least more fulfilling jobs. Even

the majority of four-year degrees are in occupational areas, such as business and health, and graduate schools are profoundly "vocational" in the sense that their programs very explicitly prepare students for work. Moreover, the broader goals of education, such as citizenship and cultural learning, apply to CTE students as well, as can be seen from the skills listed above by Advance CTE.

So, what is left? Both academic and CTE students are expected to learn general skills that cut across specific occupations, and almost all are receiving specific occupational training either in CTE programs, in liberal arts programs that are occupational training for some fields (à la Dewey), in four-year occupational programs, or in graduate school. And the vast majority of these students are hoping to use their education to improve their employment prospects.

Thus, we reject the CTE-academic distinction. It appears to be based on a misconception of the relationship between education and work, and the nature of skills and how they are taught. Notably, it masks the optimal educational path through high school and college for most students.

A typical educational path involves a stage of academic or liberal arts education followed by a stage of specific occupational education. This is true whether the student is earning an associate's degree or some other form of subbaccalaureate award, a bachelor's degree, or a Ph.D. Indeed, admission to many professional graduate schools, for example in education, law, business, medicine, policy, and social work, does not require a specific undergraduate major, although some particular courses may be required. Even within the social sciences there is some flexibility, once again, with some course requirements. By contrast, short occupational awards such as certificates may lack the flexibility to provide meaningful general skills, especially if they are treated as stand-alone "fixes" to skills shortages.

This emphasis on vocational education – as distinct from academic education – reflects a misunderstanding of how students should accumulate skills in college. Specifically, we argue for a Gen-Tech framework: college education should be considered as a progression from academic to vocational. Students should accumulate academic education and then, in the years immediately prior to entry to the labor market, should focus on vocational education that aligns most closely with the immediate needs of their intended job. Indeed, students should get as much academic education as they can, conditional on their need to enter the labor market at some future point. Occupationally focused programs, whether at the community college or graduate school level, should be defined primarily as conduits to the labor market, conditional on how much academic education students have had and how rapidly the

student needs to enter the workforce. This progression is desirable for two reasons. One, if the labor market changes rapidly, then occupationally specific skills need to be acquired in a timely fashion. Two, academic education conveys important skills that cannot be fostered immediately. Another important corollary is that many students who have never enrolled in explicit vocational programs should consider their final years of academic education as their version of vocational education.

The sequential mode highlights the entire student pathway. Students need to be thinking about their goals as they accumulate education. Career guidance and exploration is typically emphasized in CTE programs, but all students should have a structured opportunity to think about their future and its educational implications in high school and early in their college careers.[9]

In important respects, community colleges anticipated this message. In the 1990s, many occupational programs in community colleges were designed to prepare students for work immediately and were not transferable to a four-year institution. But, as the workforce became more highly educated and as employers shifted toward workers with bachelor's degrees rather than associate's degrees, college leaders perceived that students should at least have the option of transferring to acquire a bachelor's degree. This led to several changes, most notably the merger of state technical college systems that granted certificates or nontransferable associate's degrees with comprehensive community college systems that included many transferable programs. Colleges also placed new emphasis on transfer for both technical colleges and comprehensive community colleges.

We emphasize this sequential model primarily to highlight that this is not a process unique to any level of education for work. All students need the general education typically referred to as academic, but most students also get more specific occupational preparation. But we are not arguing for a rigid application of the sequential nature of the preparation for work, or for vocational education independently to address the skills needed for success in the labor market.

There are two circumstances in which general and more specific work preparation can be combined. Indeed, many educators advocate for the use of contextualized general instruction. This is an approach through which the student's vocational interests are used to motivate their learning of academic or general skills. Thus, there is a place for specific work preparation skills in high school or community college. Moreover, we do not advocate a sharp transition. For example, as students proceed through college and approach more serious thinking about employment, internships become an attractive option for not only teaching specific skills, but perhaps more important, for

teaching general workplace skills. In his inaugural speech in September 2018, the president of Harvard expressed his hope that all Harvard students would have an internship experience. The majority of community college students already work, but their jobs are often unrelated to their studies. Connecting community college students with internships or part-time positions in their field of study could be of great benefit.

The concept of stackable credentials is another phenomenon that challenges the sequential Gen-Tech model. Students who may not be able to study for two or three years might want to earn a certificate and spend some time working, but with the ability to return to college to earn a higher degree without losing the credits that they had already earned. Yet, although there is considerable discussion of stackable credentials, their prevalence is very low: at most, 5 percent of the college-educated population have credentials that might generously be described as stacked. Short-term certificates seem to be more common for older workers or those who already have college degrees and are looking for a job upgrade.

The primary conclusion from our argument is that there should be no meaningful and robust distinction between occupational or CTE and academic programs for students. Any attempts to make a sharp distinction do not stand up to scrutiny. All students need a solid foundation of general skills, and all students need some instruction in particular jobs or occupations that they aspire to. The baccalaureate-subbaccalaureate distinction has been used as one possible way to differentiate CTE from other types of programs, but that is at best a vague and shifting demarcation. No one wants to make an explicit distinction between people who work with their hands and those who do not, although it might be fair to say that that distinction lurks in the background. Related, low-income students and students of color are disproportionately enrolled in CTE programs, and educators have struggled for years to convince these students that they will get good jobs. Consigning students to a CTE track may be creating undesirable social stratification.

The general sequential model highlights that, in most cases, students build occupationally specific learning on a foundation of general skills. But small amounts of occupational instruction without a general foundation, as students typically experience in a certificate program, too often lead to uncertain and short-term wage increases. At the same time, more or less unorganized general education of the type that many students get if they only take a general studies associate's degree may also have minimal value; instead, associate's degrees that have general skills and some vocational application are valuable, even as there is considerable variation among different fields. In

short, students will prosper most if, after a strong academic education, they are able to complete a vocational program with direct relevance to their intended work. Short vocational programs or ill-structured academic programs are less desirable.

It is a puzzle why the vocational-academic distinction remains so strong. Perhaps the renewed Perkins Act provides an institutional foundation to the continuation of the distinction. Perkins provides additional federal funding to the states, and perhaps that makes the distinction worth preserving. But Perkins is funded at $1.7 billion annually in both secondary and postsecondary education, while annual public spending on higher education is over $355 billion, and students and their families pay a total of $560 billion on private and public colleges. The ratios speak for themselves.

Our education system needs to provide a variety of educational pathways. All students should receive help in choosing those pathways and well-organized programs that teach the variety of skills they need to be successful workers, as well as citizens. Some programs will take longer than others, but whatever the length, they share an underlying foundation and structure. We should make sure that every one of those pathways is successful, rather than seeking to differentiate students into categories that carry fraught implications.

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ENDNOTES

[1] Kern Alexander, Richard G. Salmon, and F. King Alexander, *Financing Public Schools: Theory, Policy, and Practice* (New York: Routledge, 2015).

[2] Advance CTE, "Who We Are," https://careertech.org/who-we-are.

[3] Advance CTE, "The Career Ready Practices," https://careertech.org/career-ready-practices.

[4] David Deming and Lisa Kahn, "Skill Requirements across Firms and Labor Markets: Evidence from Job Postings for Professionals," NBER Working Paper No. 23328 (Cambridge, Mass.: National Bureau of Economic Research, 2017).

[5] For a full discussion of these issues, see Clive R. Belfield and Thomas R. Bailey, "The Labor Market Value of Higher Education: Now and in the Future," in *Higher Education: Handbook of Theory and Research*, vol. 34, ed. Michael B. Paulsen and Laura W. Perna (Basel: Springer Nature, 2019).

[6] John Dewey, *Democracy and Education: An Introduction to the Philosophy of Education* (New York: The Free Press, 1944 [1916]), 313.

[7] For evidence on these estimates, see Belfield and Bailey, "The Labor Market Value of Higher Education."

[8] Most of these studies apply Ordinary Least Squares or Fixed Effects (FE) regression models of earnings against highest level of attainment, controlling for work experience and other covariates. Often referred to as the returns from college, this coefficient captures the gross returns; it does not account for the cost of college. These approaches have two main problems. First, they only yield an unbiased estimate of the gains from college if all other variables that are correlated with education and that determine earnings are included: for instance, if there is no "omitted variable bias" (such as from ability). Second, these approaches do not account for the endogeneity of college enrollment: only students who think they will obtain high earnings do in fact enroll in college. However, these biases are not large and appear smaller for more recent studies that use FE models.

[9] Applying a similar framework, Derek Neal summarizes such a pathway as "learn to learn," "learn to earn," then "earn." See Derek Neal, *Information, Incentives, and Education Policy* (Cambridge, Mass.: Harvard University Press, 2018).

Mitigating Ethical Costs in the Classroom

Jennifer M. Morton

Students from disadvantaged backgrounds often find that succeeding on the path of upward mobility through education requires that they distance themselves from their communities, family, and friends. This distancing often involves the weakening or loss of aspects of their lives that are meaningful and important to them: their relationships with family and friends, their connection to their communities, and their sense of identity. These goods, by their nature, are not ones that are easily replaced. Yet their loss can be mitigated by the development of new relationships and new communities. In this essay, I argue that colleges and universities have an obligation to facilitate the mitigation of these costs for students from disadvantaged backgrounds. Doing so, however, is not as simple as it might seem. These students often feel alienated from campus life outside of the classroom and many do not even attend residential colleges. These two factors suggest that universities and professors will need to take more seriously the classroom as a central site for giving students from disadvantaged backgrounds opportunities to enter into new relationships and find new communities.

The degree to which students feel connected to each other, to faculty, and to campus life has important implications for student retention, academic engagement, and learning.[1] Well-endowed colleges and universities invest significant resources in fostering community on campus by building student centers, financing student clubs, and enabling a rich array of extracurricular activities. Some organize the first-year academic experience around learning communities: cohorts of first-year students who take several classes together or, as in my institution, are enrolled in a small and academically intensive writing seminar with a faculty member, ideally one in the tenure-stream. Learning communities are intended to encourage students to develop relationships with each other and with a faculty member. But for universities with limited resources, learning communities are an expensive scheme. On my own campus, our tightening budget inevitably leads

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administrators to question whether we should reconsider raising the student cap on first-year seminars.

The small, discussion-based seminar with a tenure-stream faculty member can easily seem like an expensive luxury rather than a necessity. There are excellent reasons to resist this thought. As William Bowen, former president of Princeton University, and Michael McPherson have argued, one of the biggest problems confronting higher education is the alarmingly high dropout rates, especially for low-income students.[2] If, as the research suggests, learning communities can lead to higher graduation rates, then they are an important investment. In the City University of New York (CUNY) system, where I teach, the four-year baccalaureate graduation rate is around 25 percent and the six-year graduation rate hovers around 50 percent.[3] These data give institutions like mine sufficient reason to continue to invest in learning communities.

I argue that there is an additional yet often overlooked *ethical* reason for institutions of higher education to foster community in the classroom. It is a way for them to mitigate the ethical costs that students from disadvantaged backgrounds bear in the path of upward mobility. Strivers, as I call those students who seek mobility through education, often find that succeeding on their paths requires that they distance themselves from, and thus weaken or lose, aspects of their lives that are meaningful to them: their relationships with family and friends, their connection to their community, and their sense of identity. This is what I call the ethical costs. Unfortunately, the nature of these costs is such that they are not easily replaced by the many gains that a college degree affords. Nonetheless, universities have a compensatory obligation to mitigate these costs by facilitating the development of new relationships and new communities for these students. Doing so, however, is not as simple as it might seem. Strivers often feel alienated from campus life and culture; many do not even attend residential colleges. These two factors suggest that universities and professors will need to take more seriously the classroom as a central site for giving students from disadvantaged backgrounds opportunities to enter into new relationships and find new communities.

I teach at the City College of New York (CCNY), which is part of the City University of New York system, one of the largest public systems of higher education. CUNY comprises community colleges, four-year colleges (like my own), and a graduate center with internationally renowned scholars. Our students are as diverse as the city we serve. Forty-two percent of them are the first in their family to go to college, 38.5 percent come from families that make less than $20,000 a year, and 78.2 percent are students of color.

Beyond the numbers, my students are a joy to teach. They have full, complicated lives and, when the circumstances are right, those experiences enrich the classroom in immeasurable ways. But they also struggle to complete their degrees. Many of them work more than twenty hours a week, live at home, and have obligations and responsibilities that pose obstacles to their academic success. Students will miss exams and assignments for a myriad of reasons: taking their grandmother to the hospital, working full-time to support their family, or escorting a cousin on her first day of preschool. In the most recent class I taught, I was offered all three of these reasons. Many of my students are caught in a difficult dilemma: prioritizing their obligations to their family, friends, and communities over their education can set them behind and endanger their academic success, but reneging on those responsibilities also comes at a significant cost.

Strivers are much more likely than other students to face conflict between their relationships with their family, friends, and community and their educational paths.[4] Upward mobility for strivers often involves sacrificing aspects of their personal lives that are important to them. These are *ethical costs* because they concern those elements of a life – friendship, family, community, identity – that are valuable to most of us. Many college students make difficult sacrifices in the pursuit of higher education, but these ethical costs are disproportionately borne by strivers.

Understanding why these costs fall on strivers requires that we situate the ethical costs in their socioeconomic context.[5] Briefly, I'd like to draw our attention to three factors: socioeconomic segregation, the inadequate safety net for poor families, and the mismatch between the culture prevalent in middle-class institutions and that of lower-income communities. We have good evidence that a large share of students born into disadvantage grow up in communities where poverty is concentrated.[6] These are communities in which educational opportunities are limited and middle-class professional jobs and housing are rare. Furthermore, it is not unusual for students born into poverty to also be a part of families that lack adequate health care, elder care, childcare, and other forms of support. Students born into these circumstances, like many I have encountered at CUNY, end up filling these gaps in the safety net by providing care or financial support to their families. Finally, there is compelling evidence that many students from disadvantaged backgrounds experience a cultural disconnect in college.[7] They have little familiarity with the culture that dominates the college campus, which can hinder their social and academic paths through college.

Against the background of these factors, finding opportunities for further education and socioeconomic advancement requires that strivers distance

themselves from their communities literally and metaphorically. They must find their way into other communities – in which educational and career opportunities reside – that are very different from their own. In the process, they are often unable to continue to provide the same level of support to their families. And as they make their way through college, they have to navigate a culture with which they are unfamiliar. This process can require painful sacrifices in relationships and identity, yet these ethical costs are often overlooked in discussions about the challenges low-income and first-generation college students face in pursuing higher education.

One might be tempted to treat these ethical costs like other costs that students face on the path of upward mobility, such as time and financial investment. But ethical costs are not easily accounted for. The financial cost of going to college, for example, can be offset by the economic gains that a college degree affords. When one's relationship with a family member or friend is lost or weakened, however, a new relationship does not simply erase the loss. We value people in their particularity: it is *this* sibling or friend who matters to me, not just anyone who plays that role.[8] An important part of our well-being is composed of goods that cannot be simply substituted or swapped by other similar goods.[9] I have provided extensive arguments for these claims elsewhere, but the important point here is that strivers often pay painful ethical costs to find a better life through education, and these costs are not easily compensated for by the material gains that a college degree may bring.

Much of the meaning and value in our lives, from very early on, is derived from our sociality.[10] Friendships and our connections to others in our community are central to leading good lives. Consequently, the ethical costs that strivers shoulder concern deeply important aspects of their lives. For many students, the initial financial cost of college is an investment that is offset by the many economic, educational, and social gains of a college degree. But it would be a mistake to try to account in a similar way for the ethical costs that disadvantaged students bear.

Notwithstanding this crucial point, ethical costs can be mitigated to some degree. A cost is mitigated when a new value or good comes into a person's life that makes his or her life better in a similar dimension to that undermined by the loss. Consider the immigrant who leaves his home out of necessity. In the process, he loses his connection to his community. This loss is not fully compensated or replaced by what he has gained from immigrating, but finding a new community can mitigate the loss. To see this point more clearly, consider what would happen if the community he seeks to join is hostile and rejects him; even if his life were greatly improved materially, immigrating would

have made his life worse along a very important dimension. In contrast, if he had found a new welcoming community, he would have gained something valuable that would not replace, but would mitigate, what he had lost.

Ideally, colleges and universities could mitigate the ethical costs that strivers bear by offering value along a similar dimension to the loss, such as new friendships and communities. Indeed, colleges often portray themselves as places where students can enrich their social lives; this is an important part of their marketing strategy. Residential colleges often feature student clubs, activities, and socializing prominently in their brochures and websites. And large public universities persuade out-of-state students, who often pay full price, to enroll by promoting Greek life on campus.[11] Unfortunately, though this might be good advertising, the reality for strivers bears little resemblance to the social world of college depicted in marketing materials. There are many reasons for this, but let us focus on two here: cultural mismatch and nonresidential colleges.

Psychologists and social scientists have been studying the cultural mismatch between the culture that dominates many colleges and universities and that with which low-income students have grown up. Psychologist Nicole Stephens and colleagues have shown that first-generation college students are much more likely to have an interdependent cultural model that emphasizes one's relationships to others and one's place in one's community, whereas students who are better off tend to arrive at college with an independent cultural model that emphasizes individual achievement. Stephens suggests that because colleges and universities tend to be built around the independent cultural model, first-generation college students tend to find college a difficult place to navigate academically and socially, with negative effects on first-generation students' academic achievement.[12] But Stephens's work also helps us understand why many strivers find it difficult to make those connections that would mitigate the ethical costs they bear.[13]

Some of the barriers strivers face are the result of cultural differences, but some of them are quite directly the result of the ways in which universities organize the social life on campus. Sociologists Elizabeth Armstrong and Laura Hamilton have shown how large public universities that seek to attract out-of-state students (and their tuition dollars) end up organizing the campus to serve those well-off students' social needs in ways that marginalize and underserve low-income and first-generation college students.[14] Greek life, for example, attracts students who are shopping for a college that offers a certain kind of social experience. But the creation of what Armstrong and Hamilton call the "party pathway" attracts students from wealthier families at the expense of serving those students who see the university as a path to upward

mobility. Students from lower-income backgrounds either end up participating in the party pathway at the expense of their academic and professional success, or they are alienated by it at the expense of their social and emotional well-being.

These barriers also affect the ability of strivers to develop relationships with professors. For students who have not had the opportunity to interact with many upper- and middle-class professionals or with wealthier peers, it can be difficult to figure out how to talk to their professors outside of the classroom. As one student explained to sociologist Anthony Jack:

> My being uncomfortable going to office hours: that's the [social] class thing. I don't like talking to professors one-on-one. That's negative because [Renowned University] really wants you to be proactive. And raise your hand. And talk. Freshman year, I didn't say a word. People who I had small classes with, if I see them on the street, I recognize them. They won't recognize me because I didn't speak.[15]

The kind of mentorship that a professor might offer is not only important to one's academic success, but to feeling a sense of belonging. And it is these forms of socializing that are the entry point into building the relationships and communities that could provide new sources of meaning in a striver's life.

As we have seen, cultural and organizational barriers can make it difficult for strivers to find new communities and build friendships. But even if we were to set aside those factors, there is another reason why strivers can have a hard time mitigating the ethical costs they face on the path of upward mobility: many do not attend residential colleges. Among all college students, more than half live off campus, while one in four lives at home with their families to save on costs.[16] Many are nontraditional students who have children of their own or are working many hours a week.[17] For these students, the culture around which the university is organized poses a challenge, but the biggest obstacle to finding those meaningful connections is that their time on campus is a precious resource. Commuting, obligations to family, and work all impinge on a student's ability to do anything but focus on schoolwork while on campus. Participation in student clubs, campus events, and other activities in which students might socialize requires students to find time in their already overburdened schedules. For some students, the "campus community" is a misnomer.

I have suggested that colleges and universities cannot assume that strivers will find those friendships and communities outside of the classroom. If we are going to provide students with entry points to building those relationships and finding those communities, we need to seriously consider the classroom as the place where ethical costs can be mitigated. But this requires that

we rethink what obligations universities and professors have to facilitate certain experiences for students in the classroom.

Before considering how the college classroom can play a role in mitigating the ethical costs of upward mobility, we need to establish that colleges and universities do have an obligation to mitigate these ethical costs. One might argue that because the factors that lead to disproportionate ethical costs for disadvantaged students are structural features outside of the university's control and purview, no university or individual professor has an obligation to mitigate those costs.

Let me articulate this concern more vividly. Consider a student who is failing my class because she has to work a full-time job to support her family or misses an exam because she has to take care of her sister's children. It's hard to see why the obligation to mitigate these costs should fall on the university or on me as her professor. The argument is *not* that I have an obligation to give her a pass on her assignments or to give her a grade she does not deserve. The argument is rather that, should this student cut back on her work hours or reject her sister's request for help in order to do well in my class and succeed in her path through college, the university and I have an obligation to structure her experience in the classroom to foster her sense of connectedness to the college community. That is, if the students who are making these difficult trade-offs do prioritize their educational paths over these other aspects of their lives, then we have an obligation to mitigate what they're losing.

Philosopher Gina Schouten has argued that an important function of higher education is to play a compensatory role in our society.[18] Wealthy parents can invest in better education for their children, educate them with the cultural capital that will give them a leg up in college and beyond, and advise them about how to get the most out of the college experience. Meritocratic admissions into university is meant to mitigate these inequalities by facilitating social mobility and improving the life prospects of those who are talented and willing to work hard but are born into disadvantage. The university is supposed to counteract those deep and pervasive inequalities, even though other social institutions, such as K–12 education, income inequality, and housing policy, are more directly responsible for them. Based on this argument, Schouten makes a persuasive case for why elite universities have an obligation to steer their students toward public service as a way of compensating for the significant positional benefits they confer on students who are already privileged by other institutions outside of the university.

Yet we care about equal access to higher education not just because we hope to counteract financial or educational advantages that are available

to those who are fortunate to be born into positions of privilege; we aim to equalize life prospects. Family, friendship, and community are crucial to leading good lives. Sacrificing in these areas of one's life for the sake of educational and career opportunities is a serious form of inequality borne overwhelmingly by students who are already disadvantaged. While a few strivers might come back to their communities as teachers or social workers, the socioeconomic structures are such that a middle-class life is more easily found away from their home communities, effectively making these sacrifices permanent. Consequently, if institutions of higher education are in the business of counteracting inequality in access to good lives, mitigating ethical costs is well within the purview of that compensatory function.

But we need not even resort to this compensatory argument in order to understand why the university has an obligation to compensate for the ethical costs disadvantaged students pay. Universities play a direct role in exacting these costs from students. As we saw in the previous section, the culture around which universities organize their operations often assumes a cultural model that is difficult for students from less advantaged backgrounds to navigate. Selective colleges and universities admit a disproportionate number of students from the wealthiest sectors of society and enable the operation of social clubs and fraternities that exclude and marginalize those who have grown up in disadvantaged circumstances. Furthermore, universities and colleges often make it difficult for students to attend part time or transfer between institutions; they provide little flexibility for those with family obligations. All of these factors make it difficult for strivers to keep their connections to their families, friends, and communities and succeed at school at the same time. And, as Laura Hamilton has argued, many universities increasingly rely on parents to do much of the advising and networking for their children, but this unfairly benefits those students with college-educated professional parents.[19] Strivers who need college to offer them an introduction to professional communities end up being left behind. Thus, universities have a duty to foster relationships and a sense of community for those strivers on their campuses, not just because universities generally play a role in our society as compensatory institutions, but because they play quite a direct role in exacting ethical costs from strivers.

The research on campus climate and belonging suggests that fostering a sense of belonging is important for the persistence and academic achievement of minority, first-generation, and low-income students.[20] My argument in the previous section is different insofar as I've made an ethical case for why universities have an obligation to mitigate the ethical

costs strivers might incur on the path of upward mobility. I have suggested that enabling strivers to find new friendships and new communities in the classroom might be the most effective way of doing so. One might ask whether universities should focus on structuring activities outside of the classroom that achieve this goal instead of putting the onus on professors to change what they are doing in their classrooms. I argue, however, that professors *do* have an obligation to mitigate ethical costs in their classrooms.

The first reason why they have such an obligation stems from how much control professors have over the dynamics in their classroom. Professors often play a direct role in making the classroom environment a place in which strivers are at a disadvantage. A class in which the professor mostly lectures and only takes questions from the most eager students is bound to replicate the class and racial inequalities we have discussed thus far. It is the students who already know how to navigate the campus culture that are more likely to participate in such a class and to take advantage of opportunities to attend office hours as a way of developing a relationship with the professor. Unfortunately, this kind of teaching is the path of least resistance for many in the academy who have themselves been educated in this way and who have succeeded despite it. For example, as a graduate student assistant at Stanford, I was told explicitly by the professor for whom I was teaching a section that I would only really teach the top 10 to 15 percent of the students who "got it." The rest, presumably, had to figure it out on their own. But the rest are often the students who have not gone to the private schools or upper-middle-class high schools where they were taught how to get the most out of a college classroom. A professor that teaches in this way is replicating problematic inequalities in his or her classroom that universities were meant to combat, and should take responsibility for doing so. In order not to replicate those problematic inequalities, a professor has to create a teaching environment that is inclusive of all students. Allowing strivers the opportunity to build connections with other students is one solution.

The second reason why professors have an obligation to think carefully about building an inclusive classroom community stems from their pedagogical obligation to be effective teachers for all of the students in their classroom. One might worry that seeing the classroom as a place for students to gain those interpersonal connections is incompatible with effective pedagogy. But, as I will suggest, it is in fact crucial to being an effective instructor.

For the final week of class, the students in my philosophy of race course were required to choose an artifact from contemporary pop culture such as a song, an advertisement, or a clip from a TV show, and explain in a five-minute presentation how it connected to one of the ideas we had discussed in class.

The point of the exercise was to get students to draw a connection between what they learned in class and what they were experiencing outside of the classroom. Students chose a diversity of cultural artifacts – episodes from the ABC show *Scandal*, lyrics from Migos and Kendrick Lamar, and even Kim Kardashian's cornrows – and most presentations, like my students, were engaging, thoughtful, and funny.

A few of the presentations challenged the class to approach the reading we had done in a different way. I had assigned philosopher Tommie Shelby's groundbreaking work on the inner city.[21] Shelby argues that those in the inner city often do not receive their fair share of the social contract and so do not have the same civil responsibilities as those of us who do benefit from society. A handful of my students had grown up in the Bronx and still lived there. Shelby's work was, in a sense, about places like their home. For his presentation, one of those students told us about how he was the only one in his neighborhood living a "civilian" life; so many of his friends had had encounters with law enforcement, it was as if they lived outside of civil society. He connected Shelby's works to the lyrics from a song he liked, but it was the tears in his eyes as he told us about how difficult life was for those friends, whom he so clearly loved, that left the class silent. I held back my own tears. And after a few seconds of silence, the class erupted in applause.

This moment was pedagogically important, but it was also the culmination of something that had developed throughout the course of the semester: the class had bonded. And it was this feeling of belonging that contributed to this student feeling comfortable enough to share his experience with his peers. It is this sense of connection or community that is so elusive and, yet, so critically important to the strivers' college experience. Another student in that class sent me an email after the course was over to thank me. She wrote that she learned a lot in the course, "but also about the students in our class.... I ... also formed valuable friendships which is actually quite hard in an urban college where a sense of community is almost non-existent." This is only an example, but it lends support to what research on effective pedagogy already shows: that a classroom in which all students, including strivers, learn is one that is inclusive of the perspectives of all students.[22]

Connecting what students learn to their lives and sharing those connections with other students is just one example of good pedagogical practice that enables student learning while also making the classroom more inclusive. There are many more than I cannot detail here. [23] The point is rather that the pedagogical obligation that teachers have is not incompatible with the goal of building community in the classroom; it is reinforced by it. Of course, one has to balance the different goals at stake. For example, the success of

the presentations in my philosophy of race class relied on there being a background of knowledge that students had acquired in more traditional ways: reading, a bit of lecturing on my part, and asking questions to get clear on the concepts. But fostering an inclusive classroom community was a critical part of the pedagogical process.

Even if one grants that professors have an obligation to create inclusive classrooms in virtue of the power they hold in the class and their professional obligations as teachers, one might worry that professors lack the skills needed to fulfill this obligation because they are not trained to engage in community-building in the classroom. This is a genuine worry. However, we should note that professors are also generally not trained in conventional pedagogy either. As Harry Brighouse argues in this issue of *Dædalus*, the academy is an odd institution that rewards professors for developing knowledge and skills that are not centrally related to their capacity as teachers, though teaching is a primary part of the job. Tenure committees at many universities and colleges expect excellence in research, but only minimal competence in teaching. This is not true across the board, of course; some community colleges and a few liberal arts colleges expect excellence in teaching. Yet across much of academia, teaching is disvalued. The answer to this situation is not to give up on our pedagogical goals, but to change graduate student training and the incentive structure within the university to encourage pedagogical development among faculty.[24]

This last point shows us that mitigating ethical costs in the classroom involves institutions, administrators, and professors working in tandem. In order for professors to successfully foster inclusive communities in the classroom, they must receive adequate training to do so. But we also need to think about who is being hired to teach. Educationalist Lisa Delpit has made the argument, in the context of K–12 education, that teachers from communities similar to their students' are more likely to recognize the cultural competencies that students bring to the classroom. Consequently, teachers who mirror the diversity of the student body are likely to be better teachers for those students who come from marginalized communities than those who do not share those experiences.[25] Might the same be true at the level of higher education? Perhaps university students are different because they are older and thus able to advocate for themselves in a way that children are not. But as we have seen, cultural mismatch can be a barrier to students' achievement even at the level of higher education. The evidence on this point is by no means conclusive, but I venture to suggest that having professors who are first-generation and/or low-income themselves might play a significant role in creating more inclusive college communities for strivers.

The same semester that I taught the philosophy of race class described above, I taught an eighty-person introduction to philosophy course. That course was meant to fulfill the writing requirement, yet I had no teaching assistant. I did not learn my students' names except for those of the few who talked to me after class or came to office hours. I lectured, a lot. I was behind on several research projects and I was investing a lot of pedagogical energy into my other class. My guess is that most students learned a bit about philosophy, few improved their writing, and even fewer got to know each other. Their experience of the classroom was starkly different from that of the students in my other class.

College students experience this kind of subpar classroom experience too often. I am not proud that I occasionally fall prey to it. But it is important to understand what factors contribute to this situation at precisely the sorts of colleges and universities that disadvantaged students attend: cash-strapped public institutions. The first semester I arrived at CCNY, introduction to philosophy courses were capped at twenty-five students; as the financial situation at our institution worsened, the cap increased. It is now thirty-eight to forty students. Double courses, like the one I taught, used to have a teaching assistant, but the university can no longer afford to pay for one. Financially strapped institutions often end up saving money by increasing teaching loads and student caps per course. Though this means that professors are teaching more students, it undermines the quality of that teaching and it makes it less likely that those professors will find the time to invest in pedagogical development, mentor students individually, or participate in campus activities. In fact, data suggest that increasing the funding that such institutions spend per student has a greater effect on student completion than giving that money to the students themselves.[26]

Financially strapped colleges and universities are also increasingly reliant on adjunct teaching and online learning. But these methods of cost-cutting make it more difficult for students to find those elusive connections. Adjuncts, who are underpaid and overworked, are often working multiple jobs at various institutions and unable to fully invest their time on any one particular campus as a consequence. This makes it difficult for them to mentor students, participate in campus life, or feel a sense of belonging within the college community. In other work, I have criticized online courses for not providing students with the space in which they can do much of the social and emotional learning that college can provide.[27] Another problematic dimension of online learning is that it does not require students to be on campus where they might find the kinds of relationships and community connections that might mitigate what they have lost. This is not to say that strivers cannot find communities or form friendships online; clearly students do. What I am suggesting is

that these are unlikely to provide a source of value in the same dimension as the friendships and communities that strivers sacrifice on the path of upward mobility.

Public universities and community colleges serve the vast majority of strivers and yet they are the institutions that have the most challenges in building community on campus. But without a flourishing community, students are unlikely to find the friendships and connections that will mitigate the ethical costs they bear. In addition to the research showing that the feeling of belonging is important for strivers' persistence and success in college, there is an ethical imperative for making sure that students develop deep connections with each other.

I have suggested that strivers are likely to face ethical costs – weakening of family relationships, loss of friendships, and severing of ties with one's community – on the path of upward mobility. Some of these costs are due to structural factors that extend well beyond the campus walls, but some of them are the result of social and cultural dynamics within the university. These costs affect important and valuable dimensions of a striver's life. Universities and colleges can be places where strivers find new connections that can mitigate, though not replace, the costs they pay. However, as I have suggested, it is difficult for strivers to find those elusive connections outside of the classroom. The college campus is often not a welcoming place for them, and many do not live on campus. Institutions of higher education and professors have to take the classroom more seriously as the place where those connections are fostered. However, doing so requires reconceiving of the role of the professor. Confronted with the far-reaching changes that such a refashioning of the classroom and of the professor's role in it would require, some might reject the role that the university should play in fostering community. But as I have suggested, the university has a compensatory obligation to do so.

Let me close with one further reason why it is important that strivers enter these new communities. A key factor in the ethical costs that strivers face is entrenched segregation in American society along class and racial lines. This segregation starts early with the neighborhood in which a child grows up and the school she attends. If we want to build integrated neighborhoods and integrated schools, we have to start with building integrated communities where they can thrive. Strivers are uniquely positioned to foster such communities, and universities are uniquely positioned to encourage them to do so. But it is not something that universities do simply by admitting more students from marginalized communities; it requires that administrators and professors be purposeful about encouraging those connections on campus and, in particular, in the classroom.

ABOUT THE AUTHOR

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ENDNOTES

[1] See Vincent Tinto, *Student Retention and Graduation: Facing the Truth, Living with the Consequences*, Occasional Paper 1 (Washington, D.C.: The Pell Institute for the Study of Opportunity in Higher Education, 2004); Vincent Tinto, "Learning Better Together: The Impact of Learning Communities on Student Success," *Higher Education Monograph Series* 1 (8) (2003); and Vincent Tinto, "Taking Retention Seriously: Rethinking the First Year of College," *NACADA Journal* 19 (2) (1999).

[2] William G. Bowen and Michael S. McPherson, *Lesson Plan: An Agenda for Change in American Higher Education* (Princeton, N.J.: Princeton University Press, 2016).

[3] CUNY Office of Institutional Research and Assessment, "System Retention and Graduation Rates of Full-Time First-Time Freshmen in Baccalaureate Programs by Year of Entry: Total University" (New York: CUNY Office of Institutional Research and Assessment, 2018), https://www.cuny.edu/irdatabook/rpts2_AY_current/RTGS_0007_FT_FTFR_BACC_UNIV_TOT.rpt.pdf.

[4] The argument in this section is drawn from my book *Moving Up without Losing Your Way: The Ethical Costs of Upward Mobility* (Princeton, N.J.: Princeton University Press, 2019).

[5] I discuss this in much more detail in chapter two of *Moving Up without Losing Your Way*.

[6] Gary Orfield, Mark D. Bachmeier, David R. James, and Tamela Eitle, "Deepening Segregation in American Public Schools: A Special Report from the Harvard Project on School Desegregation," *Equity and Excellence in Education* 30 (2) (1997); and Gary Orfield, John Kucsera, and Genevieve Siegel-Hawley, *E Pluribus . . . Separation: Deepening Double Segregation for More Students* (Los Angeles: Civil Rights Project/Proyecto Derechos Civiles, 2012).

[7] Nicole M. Stephens, Stephanie A. Fryberg, Hazel Rose Markus, et al., "Unseen Disadvantage: How American Universities' Focus on Independence Undermines the Academic Performance of First-Generation College Students," *Journal of Personality and Social Psychology* 102 (6) (2012); Nicole M. Stephens, MarYam G. Hamedani, and Mesmin Destin, "Closing the Social-Class Achievement Gap: A Difference-Education Intervention Improves First-Generation Students' Academic Performance and All Students' College Transition," *Psychological Science* 25 (4) (2014); Anthony Abraham Jack, "(No) Harm in Asking: Class, Acquired Cultural Capital, and Academic Engagement at an Elite University," *Sociology of Education* 89 (1) (2015); Anthony Abraham Jack, "Culture Shock Revisited: The Social and Cultural Contingencies to Class Marginality," *Sociological Forum* 29 (2) (2014); Anthony Abraham Jack, "Crisscrossing Boundaries: Variation in Experiences with Class

Marginality among Lower-Income, Black Undergraduates at an Elite College," in *College Students' Experiences of Power and Marginality: Sharing Spaces and Negotiating Differences*, ed. Elizabeth M. Lee and Chaise LaDousa (New York: Routledge, 2015); and Anthony Abraham Jack, *The Privileged Poor: How Elite Colleges Are Failing Disadvantaged Students* (Cambridge, Mass.: Harvard University Press, 2019).

[8] See Harry G. Frankfurt, *The Reasons of Love* (Princeton, N.J.: Princeton University Press, 2004); Troy Jollimore, *Love's Vision* (Princeton, N.J.: Princeton University Press, 2011); and Monique Lisa Wonderly, "Love and Attachment," *American Philosophical Quarterly* (forthcoming).

[9] This sets my view apart from other notions such as Amartya Sen's capabilities or John Rawls's primary goods, which are not particular in the way that the goods in question here are. Thanks to Michael McPherson and Sandy Baum for urging me to clarify this point.

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Financial Constraints & Collegiate Student Learning: A Behavioral Economics Perspective

Benjamin Castleman & Katharine Meyer

Gaps in college completion persist between low- and high-income students. These disparities can be attributed in large part to a lack of college affordability and information asymmetries about the process of accessing financial assistance as well as other campus-based resources and supports. While substantial policy investments have been made to address these inequalities, such as expanded financial aid programs and increased investments in college advising, these programs are not always fully utilized by students who might benefit from them. In this essay, we apply a behavioral economics perspective to examine how financial constraints affect students' navigation of the complex processes – financial, academic, and otherwise – required to succeed in American higher education. We conclude with a discussion of evidence-based behavioral strategies that policy-makers and educators can draw on to proactively mitigate these behavioral obstacles and improve student success.

For nearly half a century, higher education policy at the federal and state levels has focused on increasing college access for low-income youth. Policies have included need-based grants and loans to defray the cost of pursuing postsecondary education, such as the federal Pell Grant and numerous state-funded means-tested grant programs. The federal and state governments have also invested in advising and tutoring programs, such as GEAR UP and Upward Bound at the federal level and Advise TN in Tennessee, as a way to support low-income students' college readiness and preparation. Over this time, college enrollment has increased steadily, with notable gains among low-income populations.[1] However, despite increases in college enrollment, college completion rates have stagnated. Just under half of all degree-seeking college students in 1996 completed an associate's or bachelor's degree within six years of entry; in the five most recent cohorts of incoming college students, roughly the same proportion of students – 55 percent – completed a

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degree.[2] Socioeconomic disparities in college completion are pronounced and growing. Over half of the youth born into the top income quintile earn a bachelor's degree by age twenty-five compared with fewer than 10 percent of youth born into the bottom income quintile.[3]

Historically, much of the focus on improving student success once enrolled in college has been on students' academic experience, including several essays in this volume that address the classroom experience. In other work, both policy-makers and researchers have pointed to developmental education as an impediment to student persistence and completion. Two-thirds of community college students enrolling in 2003 – 2004 took at least one remedial course, as did about 40 percent of students enrolling at public four-year institutions.[4] Yet the evidence on the effectiveness of remedial courses is mixed. Some studies find that students who take remediation are more likely to persist in college,[5] while others find null or even negative effects of remedial courses.[6] Furthermore, disparities in college completion remain even upon controlling for academic achievement.[7]

In parallel, there have been numerous initiatives aimed at improving academic advising to increase completion rates. Coaching and mentoring programs yielded more consistent results than remediation at improving student performance and persistence, though advisors often address myriad student needs, not just promoting academic engagement.[8] Many community colleges have also invested in developing "structured" or "guided" pathways for students that include specialized course plans that help clarify for students what courses will count toward their intended degree or transfer path, as well as increased advising and monitoring of student performance to trigger early interventions.[9] While there exists a correlation between structured pathway participation and student persistence, few research studies have captured the effects of these innovations.

More recently, there has been growing recognition that making college affordable to *attend* does not on its own ensure that students will have the financial resources to complete postsecondary education. While the Pell Grant and numerous state grants are renewable, students may lose aid because they do not maintain sufficient academic performance, because they fail to reapply for aid each year, or because they take too many courses that do not count toward their degree and use up their aid eligibility before they graduate. Even for students who maintain their aid and use it efficiently, rising college costs mean that many students face gaps between their grant aid and the cost of attendance, which students may have to fill through a combination of loans, work, and family resources. Furthermore, many students face a host of costs not directly related to pursuing their degree – transportation, child care,

food – that they may not be able to cover through financial aid and income they earn while in school. Low-income students also arrive on campus with fewer insights into the academic resources available to them and often struggle to feel a sense of belonging among their more advantaged peers, which hampers their ability to engage with their studies.

While large, structural policy changes are necessary to combat many of the challenges students encounter in their pursuit of a postsecondary credential, insights from the behavioral sciences also provide a lens through which researchers, practitioners, and policy-makers can understand how students move through the postsecondary system. Over the past fifty years, numerous studies in behavioral economics, neuroscience, and social and cognitive psychology have explored how individuals make decisions, particularly under uncertainty. Recently, higher education scholars have applied lessons from these disciplines to better understand how students and their families make decisions about the investment in a college education. In this essay, we explore how behavioral science insights can help policy-makers and higher education professionals understand the challenges students face in college persistence and we consider the potential of behaviorally informed interventions to improve college completion rates.

Each day, we face hundreds of choices about how to allocate our scarce resources, particularly our time and money. Should I buy a salad or a burger for lunch? Should I walk to the store or drive? Should I study for the test in two weeks or watch *American Ninja Warrior*? At the same time, we are making choices about how we would like to allocate our resources in the mid-range to distant future. Should I go to college or work for a few years? Should I try to save up and buy a house or am I likely to move from this city soon? Traditional economic theory posits that individuals think about the costs and benefits of each of these decisions and choose the option that maximizes their utility and has the greatest benefits for the lowest cost. When it comes to investing in additional years of education, this cost-benefit framework evaluates potential costs (such as tuition and foregone wages) relative to benefits (such as higher earnings after graduation and forging relationships with classmates).[10]

Behavioral science research, however, has documented that individuals make different choices based on a number of external factors that traditional models would not expect to affect decision-making: for example, making a different choice in the morning than in the evening about what they would like to have for dinner that night. This framework for understanding human behavior recognizes that our ideal behavior is often different from our actual

behavior depending on whether we are engaging in slow, forward-thinking processes, or under stress and cognitive demands that shift us to faster, present-oriented thinking.[11] The hypothesis is not that people make irrational decisions, necessarily, but that they often make decisions using "bounded rationality": that is, rational given a set of practical constraints.[12] Starting with cognitive psychologists Daniel Kahneman and Amos Tversky's influential work in the 1970s, behavioral science research has long explored how the framing and context of choices affect individuals' decisions within bounded rationality, when they may not have the information, time, or cognitive bandwidth to engage in a thorough cost-benefit analysis.[13]

One easily relatable response to a complex decision is to put off the choice until later, under the hope that it will be easier to handle complexity tomorrow.[14] However, individuals are less likely to make optimal choices when the decision and rewards or costs are immediate, a phenomenon known as *time-inconsistent preferences*. For example, people have different stated preferences about how they will spend their time or financial resources in the future based on whether they are asked their preferences well in advance or immediately ahead of time.[15] Planning ahead of time, people often prefer options that have greater benefits in the long run, even if there are short-term costs.[16] Related, individuals are more likely to show a *present bias* and prefer a smaller reward now than to wait for a larger reward in the future; though, individuals are more likely to prefer the long-term reward when the short-run reward is moved just a little into the future (for instance, if an immediate reward is delayed fifteen minutes).[17] Time-inconsistent preferences are often influenced by *loss aversion*: a strong reaction to the idea of losing out on something, such as money or time, that we have already mentally designated for another purpose.[18]

In the face of some of these challenges, individuals may rely on heuristics or "rules of thumb" to make decisions rather than a careful evaluation of costs and benefits. Heuristics are shortcuts that the brain can use to simplify decision-making. One example is *availability bias*: the tendency to use easily accessible information to make decisions.[19] When it comes to important decisions about financial aid refiling once enrolled in college, for example, college students may rely on the experiences of their friends, who may not have gotten any additional scholarships for their sophomore year, instead of applying themselves and seeing what happens. Another common heuristic employed in decision-making is the use of *anchors* or *reference points*.[20] Often this comes in the shape of relying on peer behavior or achievements to benchmark effort and performance. For example, a growing literature finds that one's position relative to one's peers can strongly affect student outcomes. One study

examined the longer-run outcomes of students from different classrooms with similar academic achievement at the elementary level. The researchers found that the students at the top of their class have higher test scores, have more confidence, and are more likely to pursue science and technology careers compared with students with similar academic performance but that had joined higher-achieving classes in which they were at the bottom of their immediate peer group.[21] In higher education, particularly for courses with heterogeneity in average performance across course sections or discussions, similar peer effects may manifest as similarly performing students encounter different average peer environments.

One particularly powerful heuristic that policy-makers and businesses frequently leverage is individuals' tendency to go with the *default* option.[22] When people have to make a decision, there is frequently a stated default. For example, when you sign up for a new account with an online store, the stated default is to sign up also for their email list. You have the option to uncheck that box agreeing to subscribe, but few people do. Closely related to default options is a *status quo bias*: the tendency not to change systems already in place.[23] To continue the email-marketing example, once individuals have subscribed to an email, the typical unsubscribe rate per messaging campaign is less than 1 percent.[24] Both default and status quo bias are a product of individuals' tendency to avoid *hassle factors*: the small but time-consuming processes needed to accomplish a goal, even if an onerous investment of time tackling the hassles in the present would result in substantially better outcomes in the longer-term.[25] It feels easier just to delete Amazon's daily promotional emails than to log into your account and manage your email subscription preferences.

In the K – 12 setting, defaults and status quo bias have proven powerful tools to get parents to sign up to receive important updates about their children's performance and attendance rates. When parents had to reply and opt-in to receiving that information, only 8 percent of parents signed up; when the school set the default as parents receiving information, with the option of opting-out, 96 percent remained enrolled in the program.[26] In addition to lessons about how defaults and status quo bias could affect college student engagement with important sources of information about college and financial aid deadlines, in the postsecondary context, researchers have advocated for changing structural defaults such as modifying the default loan repayment plan.[27] Currently, the default "standard" repayment plan assumes a fixed monthly repayment amount that is consistent throughout the period of repayment. Recognizing that individuals' incomes tend to grow over time, there is also an income-based repayment plan that asks individuals to pay a percent of their income and adjusts the monthly repayment amount lower or

higher depending on how much individuals are earning. While anyone can opt-in to the income-based repayment plan, due to individuals' strong preference for the default option, many students who would benefit from the flexible and often lower payments under income-based repayment end up starting with the standard, fixed monthly repayment plan, and given the status quo bias, few students switch. Federal interventions have proven that targeted outreach sharing information about income-based repayment plans and particularly messaging that highlights loss aversion can increase take-up of the income-based plans, though advocates argue that setting it as the default repayment option would be more effective.[28]

Research on the psychological effects of scarcity inform why low-income students and their families may have an even harder time engaging with the necessary steps to maintain financial aid, remain enrolled, and succeed in college. When Congress established the Pell Grant in 1972 to ensure that financial barriers would not prevent academically prepared students from enrolling in college, the average award covered nearly all of students' tuition and fees at public colleges and universities. In the decades since, the purchasing power of the Pell Grant has declined substantially, while tuition, fees, and the cost of attendance have increased.[29] Students have three primary options for covering gaps between the grant aid they receive and the full cost of attendance: borrowing money, either through federal or state student loan programs or from private sources; working to generate income while in college; or drawing on family resources. The combination of borrowing, working, and drawing on family resources may impose substantial stress on students and contribute to their heightened levels of financial anxiety about how they will pay for college from one semester to the next.

Behavioral economics and psychology research demonstrate a strong link between the financial stress and anxiety individuals experience and the cognitive bandwidth that they can apply toward challenging and complex tasks. Many factors affect the cognitive bandwidth people are able to dedicate to decision-making: for instance, time limits, hunger, or stress from poverty.[30] Students whose time is divided between courses, work, and family commitments may be more likely to lose sight of deadlines or have insufficient cognitive attention to devote to their coursework or other important procedural tasks, like reapplying for financial aid. This challenge is likely even greater for low-income students who are also racial or ethnic minorities on their campus and face the cognitive demands of navigating racial bias.[31] In one experiment, researchers found that sugarcane farmers from India scored higher on cognitive tests after the harvest – when they were at their wealthiest – than

prior to the harvest, suggesting that financial stress impedes individuals' ability to access their various cognitive resources and knowledge.[32] In the college context, one experiment found that when college students were prompted to think about the financial burden of college, they performed worse on cognitive tasks.[33] Interestingly, when students were reminded of the financial burden of college – the costs – but concurrently prompted to think about their future occupation – the benefits – this cognitive impairment was lifted, suggesting implications for designing outreach and messaging campaigns to students to alleviate the cognitive stress of student borrowing.[34] Attention to pressing financial issues – for example, paying for car repairs or childcare – may "crowd out" individuals' focus on medium- to long-term financial issues such as refiling the FAFSA (Free Application for Federal Student Assistance) or constructing the optimal loan package.[35]

In addition to increases in traditional college costs such as tuition and fees and the academic consequences of students working and borrowing to address the gaps between grant aid and cost, the demographics of who goes to college have also shifted. Today, more low-income students are enrolling in college than ever before.[36] About 40 percent of students enrolled in a degree-granting postsecondary institution are over the age of twenty-five, with the majority of Pell Grant recipients over the age of twenty-one.[37] Community colleges enroll approximately 40 percent of all first-time college students in the United States.[38] College students today also have many responsibilities other than school; nearly one-third of all female undergraduate students have a child, as do 18 percent of male undergraduates.[39] With this compositional shift has come the introduction of and increase in additional cost categories (like childcare costs) that tax the mental bandwidth available to students to dedicate to college learning.

The share of students enrolled in a community college is an especially relevant shift to the discussion of financial stress and student persistence rates. Over the past few decades, about one-quarter of full-time undergraduate students and 42 – 44 percent of all undergraduates are enrolled in a public, two-year institution, making up a large share of the undergraduate population.[40] Several features of the community college landscape in particular likely exacerbate the behavioral biases that students exhibit when interacting with the complex financial aid and course registration systems. Community colleges primarily comprise students who commute to and from campus and who balance extensive work and family commitments outside of school.[41] Community colleges also tend to rely on communications channels – principally email, although increasingly technology-assisted advising tools as well – that have

low visibility and may not effectively reach students.[42] This combination of limited time on campus, limited attention because of other demands in their lives, limited access to advising, and ineffective institutional communication channels may mean that students are simply unaware of opportunities to earn guaranteed admissions to four-year universities in their state.

In addition to these large factors affecting student engagement and access to advising, low-income, adult, and student parents also face challenges in individual course engagement. When it comes to course success, the broad strokes formula is straightforward: show up to class, pay attention, and study.[43] Insights from behavioral sciences help explain why students in general might not complete these steps. For example, time-inconsistent preferences might sway a student to sleep a few additional hours after an overnight shift rather than go to class.[44] But additional responsibilities (such as a full-time job) and costs (such as children) outside of the college context introduce other obstacles to success and exacerbate behavioral responses to these challenges. For instance, student parents need to secure another adult to watch their children during class; 60 percent of student mothers and 38 percent of student fathers are single parents, requiring them to find other family members or professional care to watch their children.[45] When a caregiver is sick and unable to take care of the children, the student parent has few options to make it to class. To take another example, as noted above, students living off campus must find and often pay for parking at school. Unanticipated mechanical or logistical issues may prevent them from being able to attend class. At any of these barriers, it is easy to imagine how some of the behavioral and psychological responses we highlighted earlier can come into play: the stress and reduced cognitive bandwidth from a sudden loss of childcare might reduce students' ability to engage fully with difficult homework tasks, and time-inconsistent preferences might make a student less likely to incur the short-term cost of a cab to get to class, even if the long-term benefits of attending class outweigh the upfront financial outlay.

Succeeding in a course often requires substantial student-faculty interaction, such as students going to office hours for clarity on a point made in class or to tell a professor when they have a major life event or financial obstacle that might affect their course performance. Having meaningful interactions with faculty members is an important predictor of college persistence and completion.[46] But low-income students are less likely to engage with faculty members, and socioeconomic gaps in developing those student-faculty relationships may help explain some of the socioeconomic gaps in college graduation rates.[47] While more affluent students often have parents or other adult mentors in their life who let them know about the importance of faculty engagement (and

can also personally answer a host of questions their child might have about academic success strategies), parents of low-income college students often lack the information necessary to advise their children. In addition, students in a community college setting may not have peers with high levels of faculty interactions and course engagement to anchor their behavior to.[48]

Since the early 2000s, there has been broad recognition among educators, researchers, and policy-makers that informational and behavioral barriers associated with completing the FAFSA can impede college-ready, financially eligible students from receiving need-based federal or state financial assistance for postsecondary education.[49] Ten percent of college freshmen who would be eligible for means-tested financial aid do not fill out the FAFSA, and other academically prepared high school students may not make it to college because they do not complete the FAFSA and thus do not receive aid that would make college more affordable for them and their families.[50]

Awareness of the barriers created by the FAFSA has led to numerous initiatives to simplify the application, to make the process of applying for aid more visible and understandable, and to increase students' access to professional assistance when completing the FAFSA. Most of these efforts, however, have focused on initial FAFSA completion, especially among high school seniors in traditional public school settings. Comparatively less attention has been paid to the challenges students may face maintaining aid they initially receive, despite the fact that students have to renew their FAFSA every year to maintain access to federal – and in many cases state and institutional – financial aid. Descriptive research suggests that a sizeable share of college students fail to refile their FAFSA each year, even those who receive federal Pell Grants and who are in good academic standing. Drawing on data from the National Center for Education Statistics' Beginning Postsecondary Study, researchers found that one in six college freshmen who received a Pell Grant and who had a GPA of 3.0 or higher did not successfully complete the FAFSA for their second year in college.[51] Among those academically successful students who return for sophomore year, one in ten do not complete the FAFSA and therefore do not receive financial assistance for their second year. The study authors estimate that these nonfilers forgo approximately $2,000 in federal grant assistance, on average, by not refiling; and not surprisingly, failure to refile the FAFSA is strongly and negatively associated with staying in college or earning a degree.

Behavioral economics insights help explain why students who already completed the FAFSA at least once, received grant aid, and were doing well academically might nevertheless fail to renew their FAFSA. To begin, first-year

students at residential colleges and universities are often living away from home for the first time and are no longer as closely connected to school counselors or other mentors on whom they may have relied for assistance applying for financial aid. The lack of regular connection with family, professional support, or mentors may mean that reapplying for financial aid is less at the top of students' minds. Even for students who remember that they need to refile the FAFSA, the lack of access to trusted sources of assistance may mean that students indefinitely put off FAFSA refiling in favor of more demanding or immediate tasks. This is particularly the case among students new to college, who may have limited attention to devote to FAFSA refiling amidst an array of new academic and social commitments. The behavioral challenge of refiling their FAFSA is likely to be particularly daunting for students at community colleges. Advising resources at community colleges are often severely limited and students typically have to work through confusing bureaucracies to get one-on-one academic or financial counseling.[52] The nonresidential aspect of community college also translates into students spending less time on campus than do their peers at residential four-year institutions, making it more difficult to find time to meet with financial aid support staff. These obstacles contribute to Pell Grant recipients at community colleges being almost ten percentage points less likely to refile their FAFSA than their peers at four-year institutions, holding constant other student and institutional characteristics.[53] In addition to the direct complexities and behavioral barriers associated with refiling the FAFSA, students may not maintain financial aid because they do not believe they are still eligible for financial support. More than half of all Pell Grant recipients report not reapplying for financial aid because they thought they were no longer eligible.[54] This may be due in part to institutions informing students that they are not maintaining satisfactory academic progress (SAP). In order to maintain eligibility for federal financial aid, students typically have to maintain a 2.0 GPA or higher and complete at least two-thirds of the credits for which they enroll. Yet SAP requirements may not be communicated clearly or proactively to students when they first matriculate to college, and, while enrolled, they may not receive timely updates that could serve as early indicators that they need to access additional academic support like tutoring. As a result, students may not understand the link between their academic performance and their ongoing access to financial aid.

Drawing on both national and state administrative data, researchers have found that over 20 percent of first-year Pell Grant recipients are at risk of failing to meet SAP requirements because they do not maintain a sufficient GPA.[55] Among community college first-year Pell Grant recipients, one in four

is at risk of not meeting SAP requirements because their GPA is too low. The authors find mixed evidence on how failing to meet SAP requirements affects students' persistence in or completion of college, but the interplay of academic performance and maintenance of financial aid eligibility may further exacerbate the broader set of financial challenges that can impede student success in college.

While many institutions, and particularly two-year colleges, serve a high proportion of low-income and adult learners, many low-income students struggle to find other students at their school from a similar background and facing similar economic challenges. This is especially the case at more selective institutions: students from the bottom income quintile represent about 4 percent of enrollees at highly selective "Ivy Plus" colleges and about 7 percent of students at selective private colleges.[56] Despite these institutions having more resources and higher graduation rates, some students feel isolated, struggle to connect with their peers, and experience low levels of social belonging with their campus.[57] These low levels of integration (or belonging) with the academic and social culture of their campus are associated with lower likelihoods of remaining enrolled and graduating.[58] Students may also experience stereotype threat, broadly defined as stress that their struggles might confirm another person's stereotype about a group to which the student belongs, such as being a low-income or older student.[59] Students experiencing these psychological stresses tend to perform worse on verbal and math assessments and broadly have lower levels of persistence in college.

Financial constraints may also serve as a more directly limiting factor in how college students form relationships; in surveys, more than half of all low-income college students reported they were unable to participate in social activities because they could not afford them and felt pressure to spend money they did not have to keep up with social engagements.[60] Particularly to the extent that college serves as a place where students make connections for their professional careers, the pricing out of social engagement may prevent lower income students from receiving the social mobility benefits of college.[61]

When low-income students experience financial stresses and psychological barriers to connecting with their institution, they are less likely to seek out help.[62] Qualitative surveys of undergraduate students suggest that first-generation college students are less likely to discuss social/emotional issues with their family and exhibit more symptoms of depression and lower life satisfaction than their continuing-generation peers. [63] Often students are unaware of available resources to address their problems, or may view seeking help

as a sign of weakness and confirmation of their self-doubts about belonging in college.[64] This creates a vicious cycle in which small challenges snowball, with advisors and faculty unaware of issues and the need for intervention.

As outlined in this essay, there are several financial challenges that make it difficult for low-income students to engage fully in the collegiate learning process. Not only have tuition and fees increased, with students working and borrowing more to fund their education, but the types of students enrolling in college have additional financial constraints, such as childcare and transportation, that make academic engagement difficult. At several institutions, students encounter dramatic financial inequities that result in stress and lower senses of social belonging, both of which negatively affect their likelihood of engaging with classroom materials and successfully persisting through degree completion. Here we propose evidence-based strategies that policy-makers and educators can draw on proactively to mitigate these behavioral responses and improve rates of student success. We identify the most promising changes that different levels of the higher education system could implement at the federal/state level, the state/institution level, and the institution/faculty level. We strongly recommend targeted financial investments at the federal/state level and note that while the interventions and programs we propose at the state/institution and institution/faculty levels will also help students, they are not a replacement for increased appropriations to support the higher education system.

At the federal and state levels, policy-makers should invest additional appropriations into supporting higher education, at the very least attempting to return appropriation levels to those of the early 2000s. Between 2003 and 2012, average state funding for public colleges decreased by 12 percent, with average per-student funding decreasing by 24 percent, dropping from $6,211 per student to $4,695 per student in 2012.[65] Although state appropriations have started to increase over the past few years, per-student appropriations remain lower than 2001 levels, with about 46 percent of higher education revenues coming from tuition compared with 30 – 35 percent in the early 2000s.[66] Declines in state appropriations relate to declines in institutional expenditures per student, which, at certain types of institutions, can make a big difference in the likelihood that a student graduates. Researchers have found that most of the decline in college completion rates over the past few decades at nonselective, public four-year colleges can be attributed to rising student-faculty ratios, although those shifts explain little of the variation in two-year college completion rates.[67] Given limited resources, states could prioritize increasing appropriations to schools that enroll more low-income

students and institutions that have experienced the biggest drops in per-pupil appropriations over the past decade. We caution, however, that the mixed effects of performance-based funding suggest that policies that differentially target institutions by student composition or student outcomes often have unintended consequences for equity and the types of credentials colleges encourage students to pursue.[68]

In addition to increased state appropriations in public higher education institutions, the federal government has the ability to increase investment in and availability of federal financial aid programs. The federal government has made some progress on this front, recently restoring "year round Pell Grants" (YRP), which allow recipients to access up to 50 percent of their annual award for summer studies (for a total academic year use of 150 percent of an award). Quasi-experimental research shows that YRP availability results in increased summer enrollment, higher associate's degree graduation rates, and greater benefits for older students.[69] However, to the point that students often struggle to refile the necessary paperwork to access fall/spring semester federal financial aid, low-income students and students enrolling part time or living off campus may struggle to connect with financial aid offices to access YRP aid, motivating additional interventions to increase awareness of the program. States, localities, and institutions also have a role to play in providing financial aid to supplement federal investments, with many merit-based programs and place-based full-tuition "promise" programs positively affecting student enrollment and graduation.[70]

States and institutions also have opportunities to invest in targeted support programs and offer additional advising resources to students to mitigate the costs of college enrollment and increase the likelihood that students will succeed in the classroom. Programs such as the Accelerated Study in Associate Programs (ASAP) at the City University of New York (CUNY) community colleges combine institution-level investments in intensive advising and structured pathways with student financial support (such as subway cards, textbook assistance, and tuition waivers) that have significant effects on students' persistence and degree attainment, as measured in a large-scale randomized controlled trial.[71] While access to high-quality advising can lead to substantial improvements in students' postsecondary outcomes,[72] many college advisors are overworked and unable to address all students' needs, and advising resources are often particularly limited at the broad access public institutions attended by most students.[73]

There are also some state policies that, at face value, target improving on-time graduation and students' academic engagement but have unintended consequences. Excess credit hour (ECH) state policies act as a "stick" incentive

by charging higher tuition rates for credits students take beyond a certain threshold: for example, more than 140 credits in North Carolina or more than 125 percent of the credits required for a student's degree in Virginia.[74] While intended to incentivize students to graduate quickly, ECH policies have had no effect on on-time graduation rates and have increased the amount of debt students take on, particularly for low- and middle-income students.[75] Eliminating these policies would likely alleviate the negative effects on student borrowing and could free up resources to direct to proven strategies.

At the institution and faculty/course levels, colleges have the opportunity to implement informational campaigns and interventions to help buffer students from the cognitive stress of financial insecurity and improve students' sense of belonging on campus. One writing exercise invited freshmen to read letters from seniors reflecting on their first year and talking about how they came to develop a sense of community on campus; students participating in the intervention earned higher GPAs throughout college and the Black-White GPA gap was cut in half by their senior year of college.[76] This model has a proven track record scaled up. Implemented at a public four-year institution with low graduation rates as well as at a highly selective college, one study found randomly assigning freshman students to complete social belonging modules as part of their orientation resulted in economically disadvantaged students earning higher freshman GPAs and reporting more close mentors and college friends at the end of their freshman year.[77]

Other interventions have targeted how students perceive college culture and goals differently by their backgrounds. First-generation and low-income students, for example, feel a greater sense of belonging, perform better on academic tasks, and have lower cortisol levels when an institution emphasizes the collaborative nature of the college community.[78] Similar interventions have called out students' different backgrounds in panels and asked participants to reflect on how their backgrounds affected their college transition. First-generation freshman students who attended these "difference education" panels earned higher GPAs at the end of the year compared with their peers who attended a general information session.[79] While it is important to implement these interventions with fidelity and adapted to each institutional context (and to acknowledge that the bulk of this research to date has focused on younger students), these interventions have promising records of accomplishment and are a viable avenue for colleges and individual classes to pursue.[80]

Colleges might also invest in improved, targeted communications about the availability of student support services, such as tutoring, that are likely to have a positive effect on student learning. For example, one intervention

found that sending students postcards about peer tutoring programs on campus resulted in a 23 percent increase in tutoring attendance over the control group, with most students induced to attend multiple tutoring sessions.[81] The intervention was low-cost, at about $4 to $15 per student, but while the intervention succeeded in increasing student take-up of tutoring services, there was no effect on students' grades.[82] Behavioral interventions that address students' time-inconsistent preferences in signing up for tutoring can effectively change behavior, but the effectiveness of these interventions is limited by the quality of the services students are nudged to participate in.[83]

Improving student learning and the value of the college experience requires multifaceted solutions, including targeting policies that less obviously affect students' daily course engagement. The rising costs of college, challenges acquiring and maintaining aid, the changing landscape of who goes to college and where, and the vast inequality and psychological stress students experience at even the most well-resourced schools all point to policy solutions that improve the financial well-being of students so that they may fully dedicate themselves to their studies.

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Toward a 2.0 Compact for the Liberal Arts

Earl Lewis

New demands on learning coupled with new concerns about a changing world have resulted in a new focus on what constitutes a durable learning experience in a liberal arts setting. While the noise of a crisis in the liberal arts can be distracting at times, what we learn is that different types of schools continue to answer the question of why the liberal arts remain an effective educational option. This essay argues that they are only beginning to address what is durable and adaptable about the liberal arts in the face of automation. While many have endorsed the LEAP (Liberal Education and America's Promise) framework developed by the American Association of Colleges & Universities, which called for the liberal arts to be in the nation's service, the original framework did not fully anticipate the rate, scale, and far-reaching impact of automation. What is needed is a liberal arts 2.0, one that prepares learners to become robot-proof in a world in which many will find themselves with robotic helpers.

Different types of schools have tried to answer the question of why the liberal arts remain an effective educational option, but they are only beginning to address what is durable and adaptable about the liberal arts in the face of automation. While many institutions previously endorsed the American Association of Colleges and Universities' (AAC&U) LEAP (Liberal Education and America's Promise) framework, which provided a foundation for understanding the purposes of a liberal arts education and has helped guide hundreds of colleges and universities to grapple with the intended objective of providing a liberal arts education, the original framework could not have fully anticipated the rate, scale, and far-reaching impact of automation. What is needed is a 2.0 version of the liberal arts, furthering the AAC&U's mission to promote undergraduate education in the service of democracy and, more important for the purposes of this essay, preparing learners to become robot-proof in a world in which many will find themselves with robotic helpers.

Students have long flocked to the liberal arts for a multitude of reasons, even in periods in which the value of the liberal arts is openly questioned. In

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the fall of 2017, the *Times Higher Education* strove to inform its international audience about American liberal arts colleges by reporting discussions with students from several small elite institutions about their experiences. One such student, Eleni Smitham, an international studies and Spanish double major at Haverford, offered: "I appreciate that from the first moment we step on campus, Haverford students are given a lot of trust and agency to shape our own college experience."[1] Rather than being a mere consumer of higher education, Smitham valued being an architect of her learning experience.

The testimonials of students representing some of the United States' most selective liberal arts colleges explain why some students so tenaciously seek the liberal arts curriculum. Often the curriculum begins with broad exposure to the arts and humanities and to the social, biological, and physical sciences in years one and two, followed by discipline-based concentration in years three and four. Swarthmore English literature major Katie Paulson spoke for others when she professed, "In these small classes, we fully engage with the subjects we study. Rather than listening to a professor summarize the points made by philosophers, students take charge of discussions, citing passages in texts and asking questions that move the class forward."[2]

Many praised the style of learning offered, which more often leaned toward integrative learning than simple mastery of an academic subject. Students sensed that future success might depend on problem-solving across domains of knowledge, thinking that required the learner to stitch together new answers to old and new problems. April Xu, a Pomona undergraduate from China, captured this idea precisely:

> I am often connecting different academic fields together and being a liberal arts undergraduate allows me to do just that. Schrödinger's cat from physics and bilingual literature from an upper division Spanish course, along with other disciplines such as political theory and theatre inspired my first novel. Ice cream socials at the college president's house and dinner invitations from my professors bring about thought-provoking exchanges that I may not get otherwise, even as a frequent visitor to professors' office hours.[3]

These students are not oddities. Over a prolonged period, interest in the liberal arts has risen and fallen, but never gone away. National data captured by the American Academy of Arts and Sciences' Humanities Indicators project, which maps student interest over time, show that recent claims of a waning interest are overstated. For example, bachelor's degrees in the humanities, one area of the liberal arts, have declined relative to a high watermark around 2003, but the 2015 percentages of total humanities degrees granted are comparable to 1987 levels. By contrast, the percentage of fine and performing arts

degrees as a percent of total degrees has remained relatively flat (3 and 5 percent, respectively) between 1987 and 2015, while natural sciences degrees increased from 6 to 11 percent of overall degrees awarded during that period. Most important, from 1987 to 2015, social and behavioral science degrees went from 13 to 15 percent of all degrees. This is to say that student interests have waxed and waned over the years, but the numbers don't support the conclusion that the liberal arts are in wholesale decline.[4]

Of course, worry about crises in the liberal arts is not new. Over four decades ago, the historian James Axtell returned to an earlier era in the history of American higher education, when prognosticators predicted the demise of the liberal arts college. The death ostensibly began in the crucible of the Civil War, which engulfed the nation and threatened the longevity of the heretofore-dominant political economy of slavery. The death was to be slow, lasting nearly one-quarter of a century, bookended by the transition from the agricultural age into the industrial age. During the decades in question, factories, mass production, labor unions, and conflicts between management and labor erupted on a predictable cycle; at the same time, the country lurched from one recession to another, which resulted in laws, political parties, and public figures championing a new America for a new day. Against these broader macro-social, -political, and -economic changes, higher education, too, would change. And, indeed, after the Civil War, the nation invested in land grant colleges, supported by the Morrill Act, and by the century's close, attention had shifted from smaller liberal arts colleges to a handful of research universities, schools poised to advance scholarship and offer the new doctorate in philosophy (Ph.D.). The combination of the research university and land grant institution was as much ballyhooed in its day as online education is today. At some level, they were the imagined disruptors, altering the higher education landscape.[5]

Axtell, in "The Death of the Liberal Arts College," exposed the tendency to write off an enterprise that had yet to expire and that, by all indications, was healthy and adapting. From the vantage point of 1970s America, Axtell knew the liberal arts college had not disappeared – not after the Civil War, nor World War I, World War II, or the Korean War. Even through the tumultuous years of Vietnam-era student activism and social conflict, representatives of the species endured. In fact, many of them rivaled their university companions in prestige, student demand, leadership development, social experimentation, and quality of the student experience. In the years since, many liberal arts colleges have gone on to brag that a larger percentage of their students graduate within six years, fill worthwhile jobs, and lead productive lives than those who attend nearby public universities.

In fact, rather than die, the liberal arts as a form of learning expanded significantly, on pace with the expansion of higher education. After World War II, the number of higher education institutions grew twofold, going from 1,708 in 1940 to 3,535 by 1990. Former teacher colleges became state colleges and universities. New state systems appeared to handle a new demand for postsecondary education, spurred in part by the GI Bill and the growth of a managerial class after the war. The nation had always needed experts, but the 1950s and 1960s witnessed the cultivation of the expert culture in government, social policy, and even childrearing advice.[6]

The expansion of the higher education landscape broadened the range and ways of receiving a liberal arts education after World War II as well. Too often we are too quick to talk about the liberal arts experience. Over time, at least six variations on a theme formed: the small, selective private liberal arts college; the public liberal arts college; the private research university with a liberal arts college; the large public research university with a liberal arts college or colleges; and the small- to midsized private and comprehensive public school that offers a liberal arts curriculum. If we judge their contributions by the old criterion of offering access to opportunity, the larger public institutions have been the most successful. New research on higher education as an escalator to social mobility emphasizes the outsized work done by these institutions compared with the traditionally highly regarded private colleges and universities. Economist Raj Chetty and colleagues have found that California State University, Los Angeles, for example, sends more graduates who entered college from the lowest economic quintile into the top quintile than more selective schools, which disproportionately pull students from higher socioeconomic classes.[7]

What worked in the past may not be a great predictor of what is needed in the future. As we enter a period of accelerated change, higher educational institutions will most certainly require a sharper articulation of purpose and value. After all, students starting elementary school today face a starkly different future by the time they graduate high school and enroll in college around 2030. McKinsey & Company, the global consulting firm, projects a loss of nearly 800 million current jobs worldwide within four decades. Its consultants go on to predict that in the United States, fifty-four million of today's jobs will disappear by 2030, roughly one-third of the current American labor force. The explanation? Automation. The rapid introduction of machine-readable applications and artificial intelligence (AI) are slated to replace routine work in all sectors.

McKinsey's report dramatizes the extent of disruption to be expected from AI. The advent of the driverless or semi-autonomous vehicle is a familiar

example. Approximately two million men and women make their living driving tractor-trailers, cabs, limousines, and other vehicles. Nearly three times as many make their living supporting the drivers as operations managers, logisticians, dispatch operators, and customer service representatives. While no one knows for sure when semi-autonomous vehicles will command the streets and highways of America, few doubt this day will occur.[8] This conclusion usually leaves leaders considering how to plan for future work.

Often the answer to the foregoing question is a college education. And for good reason. Coming out of the Great Recession, the data seem to show that some college, let alone a baccalaureate degree followed by a graduate degree, inoculated the majority of holders from prolonged periods of unemployment. In fact, as education scholar Anthony Carnevale and colleagues at Georgetown University have shown, by 2015, of the 11.6 million new jobs created, 8.4 million went to individuals with at least a bachelor's degree. An additional three million went to those with at least some college. High school graduates and nongraduates made little headway, claiming only eighty thousand of the net jobs.[9]

While no one knows for sure what new jobs are in the offing, the McKinsey report hints that a college education alone is not a sure protector. In a 2015 study, the firm estimated as many as 45 percent of current jobs could be automated. We are led to believe that any job that can be routinized will be automated. On the streets of San Francisco, one can already find cafés run by robots; Phoenix heralded the first robot-operated McDonald's; and one can easily imagine, in time, Alexa and company becoming as capable of laying bricks as they are of arming security cameras.[10]

As a counter to such existential uncertainty, Northeastern University President Joseph Aoun, in *Robot Proof: Higher Education in the Age of Artificial Intelligence*, has made the case for a learning model that builds on the core elements of the liberal arts, integrating the arts, humanities, and branches of the sciences (social, physical, and biological) rather than what is learned from science, technology, engineering, and math (STEM) or medicine fields alone. Stated another way, if we find ourselves visited by extraterrestrial beings, as biologist E. O. Wilson has imagined, it is laughable to think they will want a tour of our technologies: their arrival signals their technical superiority. They may, however, want to know something deeper about humanity. These space-traveling visitors may be interested in music and other aesthetics, how we record history, what we consider art and beauty, how languages evolve, or how myths and narratives tie and divide us. They may want to know why we can boast that all humans share 99.9 percent of the same DNA, yet document the ingenious ways we conquered or annihilated one another over a measly 0.1 percent of noted difference.[11]

If STEM alone is not the answer, then what else should guide us, even if we aren't visited by extraterrestrials? Aoun has argued for a learning model predicated on creative, critical, and systems thinking and on entrepreneurship, cultural agility, and mastering the new literacies of technology, data, and what he calls human literacy or the ability to discern and create space for creative problem-solving. Similar to complex systems scholar Scott Page, who has found in culling numerous studies that complex problems are better solved by diverse teams of actors, Aoun believes a degree becomes robot-proof – which serves as metaphor for employability, since many workers will have robotic helpers in the future – when it equips its holders with the tools to think horizontally rather than vertically.[12] The vertical thinker can only marshal tools from his or her subject-matter toolbox and apply those tools in a linear fashion. The horizontal or systems thinker looks across knowledge domains to assemble teams with diverse subject-matter expertise. Here, the key is knowing which questions to ask and knowing what is needed to provide adequate answers.

Also looking to the future, literary scholar and academic administrator Cathy Davidson has argued in *The New Education* that education in the twentieth century shifted from the founding "mission to train ministers toward the selection, preparation, and credentialing of future leaders of new professions, new institutions, and new companies." She has concluded that the new education "means refocusing away from the passive student to the whole person learning new ways of thinking through problems with no easy solutions. It shifts the goal of college from fulfilling course and graduation requirements to learning for success in the world after college."[13]

In other words, a forward-looking liberal arts curriculum should begin with attention to the whole person. The learning experience should promote intellectual challenge, personal development, and exposure to diverse people and diverse ideas as well as scientific and humanistic methods. A student should gain some knowledge of at least the rudiments of coding, but they should also know something about art and creativity. Ultimately, they must acquire a penchant for taking domain-specific knowledge and applying it skillfully in a digital environment.

In light of the changing social, economic, and political landscapes, are liberal arts colleges and universities effectively embracing the implications of automation? Here, the evidence is less persuasive. The heterogeneity of the American higher education landscape requires us to take a more nuanced look at the liberal arts model across institutional types because while talent is evenly distributed across the nation, access to opportunity is not.

Some students learn early on to compete for attendance at the most selective national institutions; others are encouraged to seek out a school closer to home. Others still may believe any college education is beyond their reach. As a result, it is important to know how distinct schools, representing specific types, across varied geographies, explain the liberal arts approach or approaches they deploy. What they say, and how they say it, tells us a great deal about how prepared they are for a 2.0 compact for the liberal arts.

To gain at least partial insight into what institutions claim, I surveyed the websites of several schools representing the six types – the small, selective private liberal arts college; the public liberal arts college; the private research university with a liberal arts college; the large public research university with a liberal arts college or colleges; and the small- to midsized private and comprehensive public school – and in some cases, spoke with institutional leaders. After all, these websites provide the documents a prospective student and his or her parents would consult before applying and enrolling.

Our exploration begins with three institutions whose roots lie in liberal arts education. At one private Lutheran-affiliated liberal arts college, academic and administrative leadership put forward the aim of educating the whole self, whole life, and whole person in anticipation of new demands. Concordia College in Moorhead, Minnesota, is fueled by its commitment to its founding mission as a Christian, church-affiliated liberal arts college. It does not possess a large endowment valued in the hundreds of millions of dollars, nor with the exception of a distinct period in the 1970s, has it been blessed with a notable racial and economic diversity. Instead, it has long relied on recruiting young people who came of age in the upper Midwest states of Minnesota, North Dakota, Montana, Iowa, and to a lesser degree, Wisconsin. And from its beginnings in 1891, it embraced a curriculum combining the classical liberal arts and commerce or business.

With its traditional demographic pool in numerical decline, Concordia, tuition-dependent and faced with an ever-growing discount rate (the amount of financial aid required per student to offset the tuition list price), finds itself explaining the value of a liberal arts education somewhat differently than it did a generation ago. One-quarter of a century ago, success depended on luring students as freshmen and graduating 70 percent or more of them within six years. The school could sell intangibles such as a world-class choir, competitive small-college athletics, higher-than-average medical school placement rates, and a faculty willing to spend inordinate time grooming students. Compared to less expensive nearby state options, Concordia could claim that a student had a greater likelihood of graduating in four to six years there than from North Dakota State University or Minnesota State University Moorhead.

More recently, Concordia's administrative and faculty leaders have come to recast the value of the overall educational experience. The school advertises what is called the PEAK (Pivotal Experiences and Applied Knowledge) experiences during the undergraduate years. As of 2017, entering students are required to register at least two PEAK experiences in their portfolio for graduation. The experiences can range from creating a documentary to participating in a cell biology research project, from building a house through Habitat for Humanity to working on a sanctioned service-learning project. The effort hopes to showcase the connective tissue of integrative learning and actualize the tagline "Building your best future at Concordia is about being thoughtful and experienced, not just informed."[14]

Mission and vision statements often illuminate the issues faced by prospective students trying to assess what it means to attend a given school. The University of Minnesota–Morris, founded in 1960 as one of thirty public liberal arts colleges, proclaims on its website that a liberal arts education "develops your creative, analytical, investigative, and intellectual strength." If you are a college-bound student or a student's parent, you may ask, how? How do you demonstrate that a course of study, or a combination of curricular and extracurricular activities, will catalyze creative, analytical, investigative, and intellectual talents? Morris's homepage does not answer this question directly. But in reading beyond the first page, you discover that Morris boasts an Office of Academic Success and employs success coaches to help first-year students settle into campus, learn how to seek appropriate help, and navigate the relationship between personal concerns and academic accomplishment. Moreover, it is the only school I examined that has explicit resources for Native American students.[15]

By contrast, Berea College, founded by abolitionists in Kentucky in the nineteenth century, as the country inched ever closer toward civil war, steadfastly holds on to its original identity as a college created to advance the mission of service to Christianity, and we are left to infer that religious exposure, in a liberal arts context, shapes learning, values, and the self. Without saying so explicitly, Berea professes, in the language of Cathy Davidson, to educate the whole person. It does so through a set of "great commitments" that speak to the value of a Berea educational experience, experiences that promote the value of diversity, community service, democratic engagement, concern for Appalachia, and a residential college environment. Not only are these commitments publicized, but they also serve as a tacit contract between the school and the student, obligating the one to the other. Berea fulfills its mission in a racially and economically diverse learning environment. Remarkably, no Berea student pays tuition, 96 percent are Pell Grant eligible, and the

student-faculty ratio is 10:1, enabling faculty and staff to know students and become personally invested in their learning and maturation.

Concordia, Minnesota–Morris, and Berea are members of the AAC&U LEAP College Action Network. They are not only aware of the AAC&U's commitment to promulgating the value of a liberal arts education, but they have also pledged to further that work. And it can be said that their websites nod toward one or two, if not all, of the framing concepts noted earlier. Yet at this time, one senses the need for a liberal arts education 2.0.

What should a 2.0 version of the liberal arts look like? There are several key elements. Each school would do more than trumpet the value of a liberal arts education and more clearly sketch a pathway for the learner. For example, schools know the value of exposing students to a world beyond the geography of the campus. Emphasizing study abroad opportunities have been one way to address this pedagogically. For many low-income students, the hurdle begins earlier. Few, if any in their circle of family or friends, travel internationally, unless they are in the military. A 2.0 campus might make it a requirement that all students who are eligible will acquire a passport in their first year, with assistance from the college, if needed. Of course, under current conditions, Dreamers would get a pass until legislation makes it possible for them to participate. With that hurdle cleared, then an action plan for studying outside of the United States can be crafted. As University of Michigan football coach Jim Harbaugh has shown, programs can be designed for student athletes, too.[16]

More than sending students out into the world, liberal arts 2.0 approaches learning differently. Instead of broad subject-matter exposure in the first two years, it would emphasize broad exposure in year 1, more tailoring and subject-matter focusing in years 2 and 3, followed by concrete problem-solving work in year 4 that is tied to a major or course of study. In all likelihood, calls for robot-proofing will hinge on demonstrated abilities to work in teams, oftentimes with robotic helpers, across knowledge domain fields, in real time and on real problems. As in the past, institutions must play a role in shaping new learning possibilities.

Institutions that lead the way will do something more. They will pioneer a shift from a STEM-plus approach to education and learning (that is, STEM plus the arts or STEM plus the humanities) to an emphasis on the interplay among the humanities, engineering, arts, technology, and science (or HEATS). STEM-based learning is important and other essays in this issue of *Dædalus* discuss how to do it well. In a 2.0 world in which STEM education is important but perhaps not sufficient, a HEATS approach portends a new and possibly

important innovation, as a recent National Academy of Sciences study provisionally suggests.[17]

This means developing a new list of required curricular elements. In addition to the long-standing focus on sound and broad exposure to critical writing, mastery of the fundamentals of sciences, second-language acquisition, and cultural exposure, a 2.0 education would require students to study digital tools and essentials, such as coding and design opportunities for them to work with individuals from varied racial, ethnic, religious, and national backgrounds. A 2.0 education assumes that not all students will be eighteen-to-twenty-two-year-olds, that some will be in residence but others may come to classrooms virtually, and that a hybrid learning experience may soon become the norm (online plus in-residence learning). Finally, liberal arts 2.0, with guidance, gives students more say in the structure of their educational journey and more latitude in its construction as long as there is a capstone experience enabling synthesis.

Hints of what's achievable can be found in current practices at some institutions. Much larger than Concordia, Morris, or Berea is Emory University, located just outside of Atlanta. Founded in 1836, Emory now houses schools of medicine, business, law, nursing, and public health, as well as a graduate school, school of theology, and two liberal arts colleges: one four-year, Emory College, and the other two-year, Oxford College. Unlike almost any other research university in the nation, Emory runs its own version of a "posse program" at scale. Posse refers to a New York City–based program that pairs selective colleges and universities across the nation with hand-selected students of color and economically needy students from many of the nation's largest urban areas. Typically, the Posse Foundation programs send ten students to a given campus per year.[18] By contrast, each year, nearly 450 freshmen enroll at Oxford College, twenty-plus miles outside of Atlanta and the main campus. There, in a bucolic exurban setting, students are exposed to a liberal arts–intensive curriculum, free of the structures of a dedicated major. The university makes a pledge to each Oxford College student, that upon successful completion of a two-year course of study, they will have a seat waiting for them in either Emory College of Arts and Sciences, the Goizueta Business School, or the Nell Hodgson School of Nursing.

At Oxford, faculty interests in students are well noted, but what is also noticeable is a social milieu that develops more than the academic self. Because Oxford boasted no upperclassmen or upperclasswomen, students began filling leadership roles in their first year. Liberal arts 2.0 will demand more leadership development opportunities for students as well. What if more conscious

attention is given to forging leadership opportunities in the first year or two rather than waiting for students to become juniors and seniors?

For example, one leadership measure is election as student body president. Prior to the early 2000s, Oxford transfers were not allowed to stand for election, an honor typically bestowed upon a native Atlanta student in the junior or senior class. When students voted to erase this distinction, treating all as native students unless they came from a non-Emory campus, the Oxford students mobilized and elected one of their own as student body president. The four-hundred-plus students moving from Oxford to Atlanta each year (the number was closer to three hundred in 2005) also formed a kind of posse, as they moved from Little Emory to Big Emory. Friendships, study networks, peer counseling, support groups, and all of the attributes usually associated with the posses absorbed by a select number of the country's leading colleges and universities played themselves out in what I call the "Oxford experiment." In addition, students found they could mobilize the network to form a bloc and win student government elections. Such leadership development moments speak to one of the factors that will make future college graduates robot-proof and need to be more than organic achievement; instead, schools must design conscious pathways for leadership opportunities in the future.[19]

Boasting a larger undergraduate population than Emory's seven thousand students is Bridgewater State University in Massachusetts. Founded as a "Normal School" for the preparation of teachers, it educates about 9,500 undergraduates. In its materials, the university acknowledges its continued commitment to preparing and educating a teaching force for southeastern Massachusetts, while making clear that it has broadened its scope over the years. Its website maintains:

> Since its founding in 1840, Bridgewater State has remained steadfast in its commitment to empower individuals and instill in its community an abiding desire to advance the public good. Our rigorous and dynamic academic environment encourages students and faculty to develop their strengths and become leaders in their fields. At the same time, we strive to lead by example. As the university continues to build momentum, we continuously reinvest in the success of our students and our region.[20]

Bridgewater offers traditional liberal arts courses and majors in the arts, humanities, and all branches of the sciences, but its mission statement, rather than offering an independently crafted commentary on the purpose and value of a liberal arts education, directs attention to the range of postcollege opportunities and career paths a Bridgewater education provides. A video introduction

to the liberal arts champions its centrality to the educational experience and argues that the liberal arts offer flexibility for a rapidly changing world.

Bridgewater joins Emory as one of two schools in the sample not to have joined the LEAP network as of yet. Does that imply that a Bridgewater State (or Emory, for that matter) is less prepared than its peers for a 2.0 version of the liberal arts? No. In fact, what they propose on websites and in published materials is in keeping with mainline positions on the liberal arts. References are made to critical thinking, effective communication, learning to work in teams, and preparing for lifelong learning. Like a number of schools, Bridgewater boasts an honors program, an undergraduate research opportunity program, service-learning opportunities, and a paid internship program. The latter seeks to connect students with experiential learning in actual workplaces. Given its history of adaptation, a case can be made that Bridgewater may be better poised to anticipate 2.0 needs, and drive innovation and experimentation that redounds to all of higher education.

In recent years, a number of historically Black colleges and universities (HBCUs) have seen an uptick in applications and enrollments. Some attribute this to the highly visible racial incidents on historically White campuses and general social unease since 2016. Whatever the factors, HBCUs should not assume the past is a single predictor of a salutary future. Like others, they and the handful of remaining same-sex institutions will need to prepare for a 2.0 world, too.

With the exception of Emory, few of the schools so far discussed would share an admission pool with the University of Michigan and its College of Literature, Sciences, and the Arts (LSA). Michigan boasts several options at the undergraduate level and two ways of claiming an arts and sciences or liberal arts education. Broadly speaking, a student can receive an undergraduate degree in a host of units, from engineering to social work, from business to public policy, from arts and sciences to music, architecture or art. An arts and sciences student can either enter through the LSA or the more focused Residential College (RC) nestled within the LSA. The RC offers a distinctive interdisciplinary approach to learning and living. Created in 1967, faculty there offer the arts, humanities, foreign languages, and natural and social sciences in an integrated manner. Or as they say in promotional materials on the website:

> The RC curriculum is interdisciplinary and engages students in creative exploration of the humanities, the social and natural sciences, intensive foreign language study, and the visual and performing arts. We seek to foster a genuine appreciation and lifelong passion for learning; not merely individual quests for knowledge, but preparation and encouragement that lead to effective and responsible engagement in the real world.

The LSA is the largest school on the University of Michigan's Ann Arbor campus. With more than seventeen thousand students spread over four years of study, the school insists,

> The College of Literature, Science, and the Arts at the University of Michigan delivers a purposeful, pragmatic liberal arts education that provides students with adaptable skills to solve problems in an era when new fields disappear as quickly as they emerge. The College's faculty are on the frontlines of new ideas and pioneering research across every discipline. LSA provides a limitless education that emphasizes curiosity, collaboration, and adaptation.

There are noted references to internships, undergraduate research, community-based partnership and learning, and working with world-class faculty on the cutting edge of research breakthroughs. There is no easily digested statement about pedagogy and approaches to learning, although the above referenced quote uncovers traces of a 1.0 approach morphing into a 2.0 design. Here the College anticipates the call for robot-proofing education without outlining the specifics of a curriculum redesign as of yet.

One pathway forward may build on the current assessment of the link between learning and postgraduation opportunity. More powerfully than many, the LSA captures the value of an education through a visualization of majors and resulting jobs.[21] What the research reveals is a plethora of majors that fuel an endless array of job and career possibilities. A rich educational experience seems the primary predictor of success rather than a discrete major. It is no surprise economics supplies a number of workers in the finance industry, for example. Yet the data show that jobs in finance went to other social science majors as well as humanities and arts majors. At a university in which 90 percent of undergraduates complete their course of study in six or fewer years, and in 2017, 96 percent recorded either a job or admission to graduate school by graduation, the distribution of jobs seems to depend on the match between opportunity and human talent. As a result, biology accounts for one strong path into medicine, but doctors majored in a wide variety of disciplines in the LSA, from communications studies to history, from psychology to women's studies.[22]

In fifteen or twenty years, what might that visualization feature contain? Is the twentieth-century reliance on a major sufficient in a world that will ask new questions about not just work, but the dignity of work? Would a new tool contain not only a course of study, but also a matrix showing courses taken that array along a scale from novice to intermediate to accomplished learner? What if that tool included a way to capture both academic and nonacademic engagements? Could you imagine a time in which a redesign of the senior

thesis or capstone experience is factored into not just one's first job after graduation, but also a range of jobs and careers? Moreover, rather than a snapshot, this is a continuous assessment that connects individual reports, IRS data, employment records, and other data that show the link between learning and future endeavors.

The University of Redlands in California cannot claim two hundred years of history, as does Michigan. Its niche in the higher education ecosystem turns on its status as a midsized private university with three thousand undergraduates devoted to the liberal arts, but with a strong preprofessional emphasis, boasting majors in accounting, business administration, and computer science alongside the more traditional liberal arts. Like its counterparts, the school welcomes a curious, diverse group of learners seeking to understand the interplay between knowledge acquisition and leadership development. In their statement, the university offers, "Redlands emphasizes academic rigor, curricular diversity and innovative teaching." This statement of purpose says less about the attributes of success and more about the overall ethos of the institution. Characteristics of that ethos are further amplified in a broadening statement about the campus, its culture, and the composition of the community:

> Redlands fosters a community of scholars and encourages a pluralistic notion of values by challenging assumptions and stereotypes in both classes and activities. A Redlands education goes beyond training to embrace a reflective understanding of our world; it proceeds from information to insight, from knowledge to meaning.
>
> Welcoming intellectually curious students of diverse religious, ethnic, national and socioeconomic backgrounds, the University seeks to develop responsible citizenship as part of a complete education. Redlands encourages a community atmosphere with exceptional opportunity for student leadership and interaction. For working adults, the University offers innovative academic programs at convenient locations and times.[23]

Fundamentally, the education is designed to foster leadership development and citizenship traits. In that sense, Redlands proclaims education is best when it produces scholar-citizens.

Students on all campuses find their own paths to academic, social, spiritual, and personal success. Redlands offers about two hundred students per year the option of the Johnston experience, in which hierarchies are flattened, learning is student-driven, and the university is outward-facing. Johnston students connect with their surrounding communities and take pride

in integrative learning. As part of a living-learning community since 1969, Johnston students draft their own educational experience. That commitment comes in two stages. As sophomores, students "map out a plan that brings together classes from multiple departments, experiential learning, and cross-cultural experiences to fulfill an educational vision." Entering their senior year, they transform the graduation contract into a statement of accomplishment or graduation narrative. The latter "describes what you studied, what you learned, your plans for the future, and how your time in the Johnston community and the wider university impacted your education."

This hands-on ownership of one's education results in not only an individualized course of study, but also one founded on the principle of domain knowledge and horizontal thinking. Domain knowledge refers to the ability to probe a subject area with sufficient thoroughness to command all basic concepts and to understand advanced practices, philosophies, and findings. Horizontal thinking, as discussed earlier in the context of "robot-proofing" undergraduates, reflects an ability to see across subject areas and to mobilize discrete information to solve complex problems, either alone or in partnership.

It is noteworthy that a successful Johnston student has a pedagogical tool to do both. Many colleges invite students to write an original research paper that blends their command of basic knowledge with advanced, independent inquiry. Johnston students are invited to write expansively and reflectively about how four years of coursework, projects, and experiences connect. This is an advised process, with students receiving feedback from peers and from professors. The dozen or so recently submitted final products found on their website provide powerful examples of critical thinking, synthesized learning, and clear explication.[24] Students illustrate what they have learned, by naming their learning experience and explaining why it matters. Of all of the public presentations of a successful experience, the sampled set is exemplary. And it is the closest application of a 2.0 design that I found among the schools examined, hinting at what is possible.

In sum, each of the schools referenced in this essay offers some version of a liberal arts education. Except for Emory and Bridgewater State, each is a member of AAC&U's LEAP network. They have not succumbed to worry about the future of the liberal arts, but have instead dedicated themselves to advancing liberal arts in the nation's interests by preparing women and men for their roles as workers, citizens, and heirs to a democratic society.

Yet, with perhaps one exception, none has fully anticipated the need for a 2.0 version of the compact. Automation is poised to alter the future of work. Dramatic reductions in known jobs are forecast, and while new jobs are

anticipated, no one can say what they will be. This places higher education at the center of an emerging discussion of who will work, what preparation is needed, and how many will need to be trained or educated. Joseph Aoun has led the way in calling for colleges to imagine what it will mean to produce a so-called robot proof education.

The next generation's Elenis, Katies, and Aprils may find that a liberal arts education 2.0 is exactly the recipe for a thoroughly educated worker-citizen. Like their contemporary selves, they will have a hand in designing their educations. But in the future, the educational experience will emphasize more tailored opportunities, with breadth quickly followed by deep subject or domain knowledge acquisition, followed by intense applications through internships, research projects, or policy-directed activities. Fortunately, all schools will have a say in a 2.0 version of the liberal arts in the nation's service – that is their opportunity to claim.

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ENDNOTES

[1] "What Is It Like to Study at a Liberal Arts College?" *The World University Rankings*, October 19, 2017, https://www.timeshighereducation.com/student/blogs/what-it-study-liberal-arts-college#survey-answer.

[2] Ibid.

[3] Ibid.

[4] American Academy of Arts and Sciences, Humanities Indicators, "II-1b: Shares of All Bachelor's Degrees Awarded in Select Academic Fields, 1987–2015," https://www.humanitiesindicators.org/content/indicatordoc.aspx?i=198#fig198.

[5] James Axtell, "The Death of the Liberal Arts College," *History of Education Quarterly* 11 (4) (1971): 339. With a hint of sarcasm, he offered the following faux obituary:

> Washington, D.C., 2 July 1862. The American Liberal Arts College died today after a prolonged illness. It was 226 years old. Born on the salty backwashes of the Charles River in Cambridge shortly after the Massachusetts Bay Colony was founded, the scion of Puritan Reform and Renaissance Civility grew to sturdy usefulness in the colonial years by overseeing America's leaders prior to their war for independence.
>
> When the new nation emerged, however, demanding a larger, more expert citizenry, The College was unable to overcome its aristocratic origins and shortly contracted the disease that eventually led to its demise - arteriosclerosis. In the 1820s, when Jacksonian Democracy was urging needed reforms on American Institutions, The College's role in society contracted into a stance of pugnacious conservatism with the Yale Report of 1828. Even a number of its own reform-minded members could not edge it into the American Mainstream of Technological Growth and Democratic Expansion.
>
> Today, after a recent cardiac arrest, its heart stopped on the floor of the House of Representatives, just as the roll call for Justin Morrill's Land-Grant Act had ended. The vote was 90–25.

For more on the research university, see Jonathan Cole, *The Great American University* (New York: Public Affairs, 2009).

[6] Thomas D. Snyder, ed., *120 Years of American Education: A Statistical Portrait* (Washington, D.C.: U.S. Department of Education, National Center for Education Statistics, 1993), 65–67; and James Axtell, *Wisdom's Workshop: The Rise of the Modern University* (Princeton, N.J.: Princeton University Press, 2016). On the rise of the expert culture, see, for example, Alice O'Connor, *Poverty Knowledge* (Princeton, N.J.: Princeton University Press, 2001); and Ann Hulbert, *Raising America: Experts, Parents, and a Century of Advice about Children* (New York: Vintage Books, 2004).

[7] New efforts by The Andrew W. Mellon Foundation to support researchers attempting systematically to document the value of a liberal arts education may prove a notable intervention. The first dividends of that effort can be gleaned from reviewing research reports at the Andrew W. Mellon Foundation, "Research Reports," https://mellon.org/research/research-reports/. See also Raj Chetty, John N. Friedman, Emmanuel Saez, et al., "Mobility Report Cards: The Role of Colleges in Intergenerational Mobility," 2017, https://opportunityinsights.org/wp-content/uploads/2018/03/coll_mrc_paper.pdf.

[8] James Manyika, Susan Lund, Michael Chui, et al., *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation* (New York: McKinsey Global Institute, 2017), esp. 9–10.

[9] Anthony Carnevale, *America's Divided Recovery: College Have and Have-Nots* (Washington, D.C.: Georgetown University Center on Higher Education and the Workforce, 2016).

[10] Around the corner from the mounds of human discard on Market Street stands CafeX, on Sansome. There a robotic barista and its human helper provide coffee. Meanwhile, McDonald's heralded its first all robotic restaurant in Phoenix. See Sam Francis, "McDonald's Shares Reach Record High as It Launches New Wave of Automation," *Robotics & Automation News*, June 26, 2017, http://roboticsandautomationnews.com/2017/06/26/mcdonalds-shares-reach-record-high-as-it-launches-new-wave

-of-automation/13111/. On robots as bricklayers, see Quoctrung Bui and Roger Kisby, "Bricklayers Think They're Safe from Robots. Decide for Yourself," *The New York Times*, March 6, 2018, https://www.nytimes.com/interactive/2018/03/07/upshot/bricklayers-think-theyre-safe-from-automation-robots.html.

[11] Joseph Aoun, *Robot Proof: Higher Education in the Age of Artificial Intelligence* (Cambridge, Mass.: The MIT Press, 2017), esp. introduction, chap. 1–3; Edward O. Wilson, *The Meaning of Human Existence* (New York: Liveright Publishing Corporation, 2014), esp. introduction, chap. 1.

[12] Aoun, *Robot Proof*, introduction; Scott Page, *Diversity Bonus: How Great Teams Pay Off in the Knowledge Economy* (Princeton, N.J.: Princeton University Press, 2017).

[13] Cathy N. Davidson, *The New Education: How to Revolutionize the University to Prepare Students for a World in Flux* (New York: Basic Books, 2017), 3, 8–9.

[14] I have knowledge of Concordia as an alum and as the current chair of the board of regents. Additional information about the PEAK program and other aspects of the school and its academic program can be gleaned from its website. See Concordia College, https://www.concordiacollege.edu/about/.

[15] See University of Minnesota–Morris, https://www4.morris.umn.edu/. See especially the home page and academic and student success sections.

[16] Here I am referencing University of Michigan football coach Jim Harbaugh's success in taking more than 150 football players abroad each spring to see another part of the world and to learn.

[17] See David Skorton and Ashley Bear, eds., *Branches from the Same Tree: The Integration of the Humanities and Arts with Sciences, Engineering, and Medicine in Higher Education* (Washington, D.C.: The National Academies of Sciences, Engineering, and Medicine, 2018).

[18] My knowledge of Emory is augmented by nearly nine years of service as its provost (July 2004 to December 2012). For additional information, see Emory University, http://www.emory.edu/home/index.html. Size is explained at Posse Foundation, "Program Components," https://www.possefoundation.org/shaping-the-future/program-components.

[19] Observed during my several years as provost.

[20] Bridgewater State University, "History & Tradition," https://www.bridgew.edu/the-university/history-tradition.

[21] University of Michigan, College of Literature, Science, and the Arts, "What Will You Do with an LSA Degree?" https://lsa.umich.edu/lsa/academics/what-will-you-do-with-an-LSA-degree.html.

[22] University of Michigan, College of Literature, Science, and the Arts, "Mission and Tradition," https://lsa.umich.edu/lsa/about/mission-and-tradition.html.

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The Human Factor: The Promise & Limits of Online Education

Sandy Baum & Michael McPherson

The idea that online learning might revolutionize higher education, lowering the cost of high-quality learning opportunities for students with limited access to traditional higher education, follows similar hopes for earlier technologies, including radio and television. If such a revolution is to come, it is still far from a reality. Strong evidence indicates that students with weak academic backgrounds and other risk factors struggle most in fully online courses, creating larger socioeconomic gaps in outcomes than those in traditional classroom environments. The central problem appears to be the lack of adequate personal interaction between students and instructors, as well as among students. Hybrid learning models do not exhibit the same problems and there is potential for online learning to develop strategies for overcoming these difficulties. Meanwhile, narrowing gaps in educational opportunities and outcomes requires considerable skilled human interaction.

Since the beginning of the twentieth century, there have been several attempts to revolutionize higher education on the basis of innovations in communications technology. The most recent and best known of these is the provision of widespread online learning. In its "pure" form of courses whose content is delivered directly to students with no face-to-face contact between teachers and students, online learning has become widespread in for-profit higher education, as well as in some broad-access public and private nonprofit universities.

Long before computers, let alone the Internet, made their appearance, broadcast radio offered the promise of an innovative instructional technology with vast scale at low cost. In the mid-1920s, one commentator reported "visions of radio producing 'a super radio orchestra' and 'a super radio university' wherein 'every home has the potentiality of becoming an extension of Carnegie Hall or Harvard University.'"[1] Many universities established radio

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stations on their campuses and "the enthusiasm for radio education during the early days of broadcasting was palpable."[2]

The enthusiasm was short-lived: by 1931, the number of educational stations had fallen from 128 to 49, most with only a small geographic reach.[3] Apparently, a big problem was simply getting students to tune into the programs. Even listeners who clamored for educational programs actually preferred to listen to comedians.[4]

In the late 1950s, visions of the potential impact of educational television were even more grandiose than those of the radio had been. Educational television pioneer John Schwarzwalder argued that any subject, including physics, manual skills, and the arts, could be taught by television. He predicted that:

> Educational Television can extend teaching to thousands, hundreds of thousands and, potentially, millions. . . . As Professor Siepman wrote some weeks ago in *The New York Times*, "with impressive regularity the results come in. Those taught by television seem to do at least as well as those taught in the conventional way." . . . The implications of these facts to a beleaguered democracy desperately in need of more education for more of its people are immense. We shall ignore these implications at our . . . national peril.[5]

Educational television has had a continuing life mainly as a substitute for traditional forms of education for those who live in isolated environments.

Public radio and television have continued to play a powerful role – often, in fact, an educational one – by providing culturally rich and often highly informative programming in forms that appeal to audiences in ways that lectures from college professors rarely do. But they did not revolutionize college education.

Anytime innovators attempt to replace an existing product or service with a more technically advanced one, they must decide which features of the product or service they aim to replace and which will remain crucial. For example, designers of cell phones judged from the outset that the central activity of telephoning was a person conversing with a distant other. So, whatever else they had, cell phones needed an earpiece to hear a distant speaker and a mouthpiece to speak to her.

Televisions and radios speak to their audiences, but they are not designed to enable the listeners to talk back. If one considers the affordances of educational radio and television, it is pretty clear that the enthusiasts for these new educational services judged that the central activity of higher education was lecturing: teachers speaking and students listening. The model of learning that fits best with lecturing is that of transmission of information, with the teacher actively sending the information and the students passively receiving it, with the hope that they will be able to recall the information later.

Even though lecturing remains the predominant mode of instruction in undergraduate education, most serious students of learning and teaching in higher education – including several authors in this issue of *Dædalus* – now recognize that this mode of instruction and its accompanying conception of learning have serious limitations, many of which are related to student engagement. An inspiring or charming lecturer can certainly get students to pay more attention, but there is a lot of evidence that students retain information better and – much more important – come to understand it better when they work actively with the material they are trying to master than when they merely try passively to absorb it.

It is especially challenging to impart skills or know-how through lectures. Simply displaying or describing an expert performance of a skill is a poor substitute for working with a student to help develop the skill. Imagine, for example, trying to teach someone how to drive a stick-shift car through lecture.[6]

In retrospect, television and radio suffered from several important obstacles in their quest to become large-scale suppliers of higher education. One was the tyranny of schedules: a broadcast had to be tuned into at a fixed time; in current lingo, the instruction was synchronous. A second obstacle was how to get people to cover the costs of providing the lectures. Broadcast shows on radio or television are public goods, available to all; there is no straightforward way to limit access to the program to those who will pay for it. Both of these limitations have been overcome to some degree, the first through videotaping and its more up-to-date equivalents; the second through cable television and other forms of subscription.

The third obstacle is more fundamental: the experience of watching television or listening to the radio is one-way and mostly in isolation. In university settings, even in very large lecture halls, students often have some opportunity to ask questions or even (shudder) to be called on. Lecture courses usually provide some organized opportunity to meet together with a section leader in smaller groups. And, significantly, in-person lectures provide a shared public experience in the sense that they are heard and seen together by a group of people.

How does delivering education online differ from delivery through television or radio? As long as live interaction is not included in the instructional program, the problem of synchronicity is easily solved, with students logging in whenever it is convenient for them. Colleges can restrict access to their online courses so that only registered students can log in. But providers of MOOCs (massive open online courses) and related online education have solved the payment problem less by restricting access to their courses than by providing credits and degrees only to those who register and pay.

What about the problem posed by the one-way and essentially private characteristics of television and radio instruction? After all, the big contrast between the Internet and other media channels has been its high level of interactivity. Yet so far, the delivery of online education to large numbers of undergraduates, which started out as largely one-way, has proved slow to change.

When MOOCs burst onto the national scene in 2012 (*Time* magazine's "Year of the MOOC"), courtesy of two Google spin-offs (Coursera and Udacity), classes consisted largely of lectures taped in the studio, interrupted by brief quizzes designed to verify that students were still watching. The centrality of lectures and the model of learning as passive receipt of knowledge survived the move from television to the Internet.

But MOOCs, as attention-getting as they have been, have never been the main source of online education. For-profit, career-oriented institutions and large public universities have been the major providers at the undergraduate level, although several private nonprofit institutions now enroll thousands of online students.[7] Today, more than 40 percent of all undergraduate students take at least one course that is offered purely online; 11 percent – including 12 percent of those in bachelor's degree programs – study entirely online.[8] Although rich descriptions of online course delivery are hard to come by, the lecture model still appears to predominate.[9] As a result, the effectiveness of online coursework to date is likely far below its potential.

The availability of online courses and majors offers several advantages to both for-profit and nonprofit university providers: it extends an institution's geographical reach; it serves a population, especially adults, who are not able to travel to attend a college; and, in many cases, it increases revenue by allowing institutions to charge as much or more for an online course, with lower overhead at an increased scale, as for the on-campus equivalent.

One of the most compelling arguments about the value of online learning for students is that this mode of delivery has the potential to increase access to postsecondary education among students facing constraints that make classroom work infeasible. Older students with work and family obligations, those in rural areas who do not have the option to relocate, and those whose employment responsibilities do not fit with college schedules stand to benefit significantly from the geographical and scheduling flexibility of online coursework. But supporting these students, who frequently face an uphill battle to earn college degrees, requires a clear understanding of the strengths and weaknesses of online coursework for improving their learning experiences. Narrowing gaps in educational opportunities and outcomes across demographic

groups requires understanding and developing the environments and pedagogical methods that will best allow students with weak academic preparation to overcome the barriers they face.

The evidence about learning in online versus classroom environments is mixed. Some studies show similar test scores regardless of the setting. Educational psychologist Mary Tallent-Runnels and colleagues' review of research on online teaching and learning, which includes primarily descriptive and qualitative studies, found a consensus that online learning outcomes appear to be the same as in traditional courses, although students with prior training in computers are more satisfied than others with online courses.[10] But studies that focus on course completion rates as opposed to test scores generally show weaker outcomes when courses are entirely online.[11] Moreover, recent randomized controlled trials of semester-long college courses have found lower test scores for students in fully online courses than for similar students in traditional classroom settings – but no significant difference in outcomes between those in settings that mix technology with classroom experience and students in fully face-to-face courses. Economist David Figlio and colleagues compared a fully online course to a classroom course; economists William Bowen and Ted Joyce each had teams comparing traditional courses to those replacing some live instructor time with online learning; and labor economist William Alpert and colleagues studied all three models.[12] The results of these studies are consistent. Classroom instruction time can be reduced without a negative impact on student learning. But eliminating the classroom and moving instruction entirely online appears to lead to lower course completion rates and worse outcomes, even when guidelines are followed for best practices for generating online discussion. The weaker results for students listening to lectures online instead of in a classroom with other students suggests that it may not be just personal attention, but being in a social environment that contributes to student learning. It is also possible that the more structured scheduling of classroom courses is important for some students.

Regardless of the overall success of students studying online, the potential for technology to break down barriers to educational opportunity and reduce the gaps in educational attainment across socioeconomic groups depends on how well at-risk students fare in this environment.

Unfortunately, a growing body of evidence suggests that moving coursework fully online increases gaps in success. Outcomes for students with weak academic backgrounds suffer most from the loss of personal contact with faculty and other students.[13]

Comparisons of online and in-classroom outcomes rarely focus on the actual pedagogical methods embodied in the courses, either in the classroom or

online. Many compare a single classroom course to one with the same content offered online. Others focus on groups of courses. It would be surprising if the results were not affected by the course design. Synchronous online courses with intense faculty involvement bear little resemblance to courses consisting entirely of recorded lectures ; classroom courses range from large, anonymous lecture halls to small, interactive seminars. Nonetheless, the findings of these studies raise a red flag about assuming that easy access to online courses and programs will reduce the persistent inequality in educational opportunities and attainment.

In some environments, grades and other outcome measures may be similar overall for purely online and classroom courses, but less-prepared students and those from underrepresented groups can be at a significant disadvantage in the absence of the classroom structure. Not surprisingly, students with more extensive exposure to technology and with strong time-management and self-directed learning skills are more likely than others to adapt well to online learning.

Two rigorous large-scale studies of community college students by the Community College Research Center (CCRC) found lower course persistence and program completion among students in online classes.[14] These studies found that students who take online classes do worse in subsequent courses and are more likely than others not only to fail to complete these courses, but also to drop out of school. Males, students with lower prior GPAs, and Black students have particular difficulty adjusting to online learning. The performance gaps that exist for these subgroups in face-to-face courses become even more pronounced in online courses.

According to the CCRC, the differences are even greater for developmental courses than for college-level courses. In a study of online developmental English courses, failure and withdrawal rates were more than twice as high as in face-to-face classes. Students who took developmental courses online were also significantly less likely to enroll in college-level gatekeeper math and English courses. Of students who did enroll in gatekeeper courses, those who had taken a developmental education course online were far less likely to pass than students who had taken it face-to-face.[15]

Another community college study focused on Latino students. Educational leadership scholar Raymond Kaupp found that in California community colleges, Latino students in fully online courses experienced particularly large drops in success rates, grades, and completion relative to their performance in face-to-face sections of the same classes, increasing the gaps between their outcomes and those of White students. In interviews, Latino students identified the absence of a strong student-instructor relationship

as the key difference between their face-to-face and online educational experiences.[16]

Similarly, demographers Hans Johnson and Marisol Cuellar Mejia found larger gaps in success across racial and ethnic groups in online courses than in face-to-face courses at California community colleges. They found that younger students, African Americans, Latinos, males, students with lower levels of academic skill, and part-time students were all likely to perform markedly worse in online courses than in classroom courses. The success gaps were smaller for students who already had a college degree, those who were following paths to transfer to a four-year institution, and students with GPAs above 3.0.[17]

These findings are not limited to community colleges. A large study of students at a for-profit institution that offered courses with the same syllabus, instructors, requirements, and assessments found consistently worse outcomes for students taking the courses online. The online classes reduced grades by more for students with below-average GPAs prior to the course.[18]

At a major research university, when students in a large introductory microeconomics course were randomly assigned to either live lectures or watching these same lectures in an Internet setting, the performance of those with low GPAs suffered in the online context. Instruction, supplemental materials, and other course elements were the same for both groups. Figlio and colleagues found no significant difference for students with high GPAs coming into the course. Negative results, however, were particularly strong for Hispanic students, male students, and lower-achieving students, confirming other research finding at-risk students particularly likely to suffer from fully online courses.[19]

Not all of the news about online learning is discouraging. As noted, hybrid learning models, in which technology supplements in-person interaction rather than replacing it, yield much more positive results. Sophisticated individualized learning models that can respond to the particular issues facing students hold great potential. And despite lower success rates in fully online courses, the availability of these courses may well ease the path to degrees even for the at-risk students who struggle with this mode of learning.

Johnson and Mejia have suggested that, contrary to the findings from the CCRC, online coursework may increase degree completion. Educational theorist Peter Shea and educational psychologist Temi Bidjerano have also found evidence supporting this idea.[20] Using data from the Beginning Postsecondary Student Survey, a nationally representative sample of students who began college in 2003 – 2004, the authors found that in the nation as a whole, controlling for relevant background characteristics, students who enrolled in

some online courses during their first year at a community college were more likely than similar students who did not take any of these courses to complete a credential within six years. Online courses can provide needed flexibility, particularly to students struggling to combine school with family and work responsibilities. Even if success rates are relatively low in online courses, the availability of these courses may allow students to enroll in more courses each term, leading to the accumulation of more credits.

Online technology and pedagogy have developed considerably over time and this progress is almost certain to continue. There is every reason to be optimistic that outcomes will improve over time as faculty and institutions have more experience. But progress requires both confronting existing shortcomings in online learning and improving the quality and economic and social value of online credentials.

Understanding the problem. Online courses, particularly those in which students can do the work on their own schedules, require more self-discipline and time-management skills than traditional classroom courses. They are also likely to limit opportunities for networking and interacting with peers, mentors, and instructors, potentially weakening the educational experience.[21] These realities make it unsurprising that students without strong academic skills and preparation struggle without the classroom structure, even if some students thrive.

These problems do not arise from integrating technology into coursework, but from relying on it too much, and from removing the mechanisms for external structure. Negative findings about outcomes in online learning come from fully online courses, not from hybrid courses, which do not eliminate the course structures and components that support students. Hybrid courses that integrate technology into face-to-face classrooms generally yield similar or improved outcomes relative to standard classrooms.[22]

Taking an asynchronous class without an engaged instructor requires high levels of self-motivation, self-regulation, and organization, but incorporating the strengths of online classes for weaker students – such as the opportunity for students lacking self-confidence to participate in online discussions and some of the individualization facilitated by technology – into courses and programs that maintain a significant level of face-to-face interaction has the potential to generate much more positive outcomes.[23]

Some of the better news about online programs comes from efforts targeting students who have already proved their ability to succeed in advanced academic work. Georgia Tech's widely cited computer science master's degree program is getting very positive reviews and appears to be opening opportunities to new students, rather than diverting them from face-to-face

programs.[24] Since this is a graduate program, all of the students have already earned bachelor's degrees and, in the case of Georgia Tech, passed rigorous admission standards. Evidence about success in MOOCs confirms the reality that students from higher-income and more-educated backgrounds are most likely to participate and succeed in these courses.[25] These positive findings create important opportunities, but they do not solve the problem of supporting underprepared students with limited resources in their efforts to compensate for the disadvantages with which they arrive at the door of postsecondary education.

It is not easy to disentangle learning outcomes, the paths to postsecondary degrees and certificates, and the completion of these credentials. As proponents of increasing the focus on online programs have argued, this framework can provide needed flexibility, particularly to students struggling to combine school with family and work responsibilities. Even if success rates are relatively low in individual online courses, the availability of these courses may allow students to accumulate more credits. In other words, low pass rates might not be inconsistent with increases in the number of at-risk students earning degrees.[26]

Quality. Even if students complete credentials, it is important to monitor the quality of the online credentials they earn. Numerous surveys document significant skepticism about the value of online education among faculty, academic administrators, employers, and the public. While traditional faculty members are resistant to change, they are also well positioned to monitor quality. Faculty have been and remain apprehensive about the promise of online learning.[27] Less than one-third of chief academic officers surveyed by the Babson Survey Research Group from 2002 to 2015 reported that faculty accept the value and legitimacy of online education, with no upward trend over time in positive reactions.[28]

In a 2012 survey of a nationally representative sample of more than 4,500 faculty, two-thirds reported that online learning outcomes are inferior or somewhat inferior to face-to-face courses, compared with just 6 percent who said they were superior or somewhat superior. Less than half agreed that online education can be as effective in helping students learn as in-person instruction.[29]

The general public also remains skeptical about online education, believing that it provides lower quality instruction and less rigorous grading and testing, and is less credible to employers.[30]

Negative perceptions may be disproportionately influenced by visible examples of fraudulent institutions and programs, which are not representative of the potential of technological innovation. A 2011 U.S. Government

Accountability Office undercover investigation of fifteen online for-profit colleges found that most of the institutions admitted students with fake high school diplomas and many failed to respond to seriously substandard student performance.[31] But even highly respected institutions have faced difficulties with their online programs. For example, in a 2016 lawsuit against George Washington University, a group of former online students argued that they had paid a higher price but received a lower quality education than their on-campus peers, citing a lack of instruction by and limited interaction with faculty.[32]

Arguably, employers are the ultimate arbiters of the value of online education since they are better positioned to compare the skills and knowledge of online graduates, and ultimately decide whom to hire. The consensus of a number of studies investigating the perceptions of employers is that they view online credentials as inferior to those from traditional classroom programs. The primary concern cited by employers about online learning is the lack of interaction and, in particular, face-to-face communication between students and faculty. Employers do appear to be more accepting of online degrees for lower-level positions than for upper-level positions.

These unfavorable perceptions likely contribute to weaker employment prospects and lower rates of return on their education among online students.[33] Consistent with the results from surveys of employers, a 2016 experimental study of the value of online degrees in the labor market found that job applicants with bachelor's degrees in business from a for-profit online institution were much less likely to receive a callback than those from a nonselective public institution.[34] Regardless of the actual quality of the learning in fully online programs, students who earn these degrees will have limited labor market opportunities as long as these strong views persist among employers.

Some students, particularly older students with work and family responsibilities and those in rural areas, may be choosing between purely online education or no postsecondary education at all. But there is a real risk that both cost-cutting efforts and well-intentioned moves to expand access to higher education could lead to greater numbers of disadvantaged students being relegated to cheap and ineffective online instruction.

The availability of online courses – either exclusively online or with some face-to-face component – may make it easier for some of these students to complete their programs. But entirely online *degree* programs are likely to be another matter altogether. A college education is more than the sum of a specified number of independent courses. The findings about particularly poor outcomes for at-risk students in online coursework raise concerns about efforts like California's new wholly online community college, which has been

designed for adults seeking new labor market opportunities and will offer only certificates and short-term credentials. It will take careful and innovative planning and design if there is to be a reasonable prospect of delivering meaningful college-level work – as opposed to just the transmission of information – through this route. Without thoughtful innovation, moving vulnerable students online may be more likely to widen attainment gaps than to solve the seemingly intractable problem of unequal educational opportunity.

Behind the successive would-be revolutions in the technology of delivering college education seems to lie a desire to minimize, if not eliminate, the need for messy, often inconvenient, and always costly human interaction in the college-going experience. This desire is particularly evident when the concern is for mass higher education. A purely automated delivery system for much of higher education would appear to be very cheap and efficient, and perhaps even higher quality than traditional higher education because everyone could be exposed to the best lecturers. Unfortunately for this dream, developments in psychology and learning theory over the last two decades have made ever more clear how central the social, emotional, and interactional dimensions of learning are.

Any model of teaching and learning that focuses on the one-way transfer of information from teachers to students risks underestimating the value of student-teacher and student-student interaction in the learning process. This can be a major challenge in traditional face-to-face classrooms, as well as in online settings, especially in courses in which the student-to-teacher ratio is very high, as in many introductory courses. There are at least two broad purposes for creating opportunities for interaction, whether virtual or face-to-face.

One purpose is to create a supportive and effective learning environment that can encompass both emotional support and the development of good study habits. This kind of support can be vital to student success across a wide range of course content. Charles Isbell, the chief architect of the very successful online master's program in computer science at Georgia Tech, a program whose students are carefully selected as capable and successful undergraduates, was recently asked at a conference what the biggest stumbling block for students in the program was. His answer did not address inadequate preparation or the pressure of other work and responsibilities. Rather, he said the biggest cause of failure was a feeling of isolation. Leaders in this purely online program provide online discussion opportunities, virtual communities, and other ways for students to connect. How well these strategies substitute for actual personal interaction is an open question. Students can avoid these

opportunities, missing the chance to see that most students struggle with the material, need to ask for help, and show resilience in the face of these difficulties. An isolated student is more likely to blame himself for his struggles, and may find it hard to develop a positive mindset about the program.

Students at the undergraduate level, particularly those who are first generation or have attended weak high schools, may struggle with developing good study skills. This is especially important if there are not strong structures in place to ensure that students are keeping up. Some habits of mind that are essential to success in learning can be taught directly: show up on time, take good notes, stay on top of assignments, work steadily without cramming, and so on. But it is also valuable, and maybe more so, for students to see these habits in practice. These "noncognitive skills" or dispositions are critical to academic success, but they can also be of great value both for career success and in accomplishing personal or community goals.

The second, more directly instructional element to preserving some faculty-student and student-student interaction is that a substantial portion of the valuable learning in college is best – and sometimes only – developed through interaction with other people.

At least for most people, developing the ability to reason well does not occur in isolation. Harvard physicist Eric Mazur pioneered a teaching technique that illustrates the power of students reasoning together. He uses "clickers," simple handheld devices that let students select among multiple choices. Mazur presents a puzzle or problem to the class and asks them to vote on the correct answer. If the class is sharply divided on the answer, Mazur invites the students to argue with one another about what the right answer is. This exercise makes students think and practice judgment. The class comes abruptly to life and tends to converge quickly on the right answer.

Much of the content of college – what is to be learned – inherently involves interpersonal engagement. Much of human problem-solving is a team activity. Skill at reasoning is developed in conversation or disputation with others. (The great economist Jacob Viner used to comment on the "nonsense people can come to believe if they think too long alone.")[35] In many fields, including the natural sciences, research relies heavily on teamwork. Creating project teams for undergraduates allows them to develop both practical teamwork skills that will be of use in later life and an understanding of how scientific advancement proceeds.

Creative writing and studio art programs tend to rely heavily on an instructional practice called "critique," in which a piece of student work is the object of criticism and advice from other students. These exercises can be powerful learning experiences, not only helping students doing creative work to receive

criticism constructively, but also helping students develop their own sensibilities and capacity for judgment. It is important to appreciate that these and other interactive educational practices are not incidental, but are integral to learning. Whether or not these collaborative learning experiences can be successfully replicated online, where students do not know each other and have not actually met their instructors, is an open question.

As technology plays an increasingly central role, gaining further understanding of the ways in which personal interaction affects learning and student persistence is critical for the future of higher education. As is the case for brick-and-mortar classrooms, online coursework can be designed in a variety of ways. Incorporating meaningful interaction among students and between students and faculty may be more challenging absent physical proximity, but it is surely possible.

While rigorous evidence about the significant characteristics of the personal interaction that most effectively fosters learning is scarce, numerous surveys and studies strongly suggest that the absence of meaningful connections contributes to weaker outcomes for students in online courses compared with traditional classrooms.[36] Some of the evidence comes from student responses to questions about the shortcomings of online classes.[37] The consensus is that frequent and constructive student-instructor interaction increases student satisfaction.

Reviews of the literature on the effectiveness of online coursework consistently cite the importance of faculty-student interaction, although they shed little light on the exact mechanisms through which this interaction facilitates learning and course completion. The general conclusion is that student-faculty interaction must be frequent and substantive. Instructors must communicate clearly about the content of the course material, not just provide moral support.[38]

Students' ability to learn is affected by their environments and by the messages they get from those around them. The notion of "cognitive frames" as a factor in learning success has become increasingly prominent. This line of thinking started with psychologist Claude Steele's influential work on "stereotype threat," in which an individual's performance in a field is hampered by a socially induced belief that his or her type of person is bad at this work.[39] There is now strong evidence supporting psychologist Carol Dweck's widely influential idea that people's ability to learn is significantly improved if they believe that their performance is determined by their own efforts, rather than just by inherent, immutable traits.[40] This is the difference between saying "I'm just not a math person" and saying "my roommate is more successful because she manages her time better." A great deal of work in elementary and

secondary schooling has shown that seemingly small interventions can lead to students developing such positive mindsets.

Fostering a positive, encouraging environment for learning is important for students at all levels, and especially so for students who have encountered discouragement in their past school experiences. There is good evidence that well-informed, timely, and energetic – even "intrusive" – advising can help keep students on a path to success. At Georgia State, a pioneer in using big data to identify key signals that a student may be headed for academic trouble, computers play a major role in identifying when a student needs attention, but for the most part, the intervention is conducted by a person.

There is, in short, no way that an effective college education can escape from the need for productive human interaction as a core part of the instructional process. That is true in virtual as well as traditional settings, and it provides reason for doubt that online education, absent some spectacular improvement in technology, can be cheap. Human interaction is inherently expensive.

But this need not imply that all of that human interaction needs to be face-to-face. Virtual teams can be fashioned. The professor in a course can hold virtual office hours. Other staff can schedule online discussion groups for students. Certainly students can be induced to enter into arguments and debates online. Some, but perhaps not all, elements of student advising can be handled through virtual communications. But none of this is free. And none of it is yet well-developed, particularly for meeting the needs of underprepared students who lack both the skills and the self-confidence to succeed without personal support from people they perceive as caring about them.

Classrooms are not perfect either. It is important to acknowledge that traditional classroom teaching will not always skillfully handle the need for emotional and intellectual engagement. The shortcomings we worry about in online education may be evident in many brick-and-mortar classrooms. It is not appropriate to compare the average online course to the best and most expensive education available. In many traditional settings, lecturers and section leaders have little training in teaching and sometimes little interest in it. Students working in large, impersonal settings can easily become isolated or disaffected.

Residential colleges certainly have a built-in advantage in having students spend more time together and in creating opportunities for teachers to interact with students outside the classroom. But getting good educational results out of a residential environment is far from automatic, and there are many ways for things to go off the rails.[41] And most students studying in traditional classrooms are not actually in residential environments, which are simply not compatible with the life circumstances of many students.

The painful truth is that many of the colleges and universities that disadvantaged students attend are woefully underresourced. There is growing evidence that relatively modest increases in expenditures per student in these schools can yield significant increases in student success.[42] There is a good case to be made for making significant investments in our colleges and universities, especially those that disproportionately serve disadvantaged students. This would pay off in economic terms, in strengthening our democratic functioning, and in enriching our cultural life.

As economists Michael McPherson and Lawrence Bacow have argued: "If technology is used in broad access institutions to drive cost down without regard to quality, and at the same time is used in elite higher education to further increase the cost and restrict the availability of the "best" education, we will wind up with a society both more unequal and less-productive than it could be."[43]

Continuing efforts to strengthen educational opportunities and learning outcomes for underprepared students and to reduce the cost of offering high-quality experiences are critical. Technology has the potential to greatly expand the options for achieving these goals. But the evidence is clear that much of the existing online coursework is moving this effort in the wrong direction. Students need access to education – which involves meaningful interaction with faculty and other students – not just provision of information and the promise of credentials. They need meaningful learning opportunities that engage them with instructors and other students, and support the development of self-discipline, time management, problem-solving, and learning skills in addition to in-depth knowledge of their chosen fields.

Taking advantage of the potential for the flexibility of online learning to expand meaningful educational opportunities and reduce inequality of outcomes across socioeconomic groups will require developing cost-effective, individualized, and adaptive learning strategies for integrating the strengths of technology with the unique qualities of the social process of education.

Much of the potential cost reduction of technology is based on the idea that a single professor can reach a large number of students with the same investment of time and energy normally expended in a standard classroom. Recording lectures is the most obvious example. Putting lectures and simple materials online can be done without a big investment. Eliminating the need for classroom space and other physical facilities is a cost-saver. Unfortunately, this has not proven to be an effective instructional strategy.

Predictions of a revolution quite clearly exaggerated the near-term prospects for change. But that does not mean we should give up on technology's

potential to enhance college learning opportunities. It does mean we should be cautious about proponents of innovation who overpromise. We must carefully analyze the results of new strategies that are implemented with the goal of broadening access and/or reducing costs. At least for now, a focus on using technology to minimize costs (and potentially prices for students) is likely to lead to large-scale, simple, and easy-to-produce programs. It is not likely to generate creative, personalized, and up-to-date courses that are part of programs that involve a high-quality mix of online and face-to-face interactions.

Bret Stephens of *The New York Times* recently observed that the reason "technology so often disappoints and betrays us is that it promises to make easy things that, by their intrinsic nature, have to be hard."[44] Effective teaching, whether online or in traditional settings, is hard.

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