IDEAS FOR DESIGNING

An Affordable New Educational Institution

A Project Of The Abdul Latif Jameel World Education Lab, MIT
September 2022

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Diana Henderson
Professor of Literature

Daniel Jackson
Professor of Computer Science

David Kaiser
Professor of Physics and History of Science

S. P. Kothari
Professor of Accounting and Finance

Sanjay Sarma
Professor of Mechanical Engineering,
Advisor, J-WEL

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Preface

This white paper is the outcome of a design exercise we began in the summer of 2021. Our objective was simple: to imagine a new institution that delivers high quality, affordable bachelor's-level education in fields such as computer science and business, and, eventually, in engineering.

We examined the many innovations of the last two decades in higher education. We considered and rejected what we think to be simplistic but misinformed panaceas such as delivering the entire program online, or eliminating humanities courses, or trying to achieve cost reduction through large class sizes. Instead, we focused on pedagogy, faculty, the academic calendar, co-op programs and stackable credentials within the bachelor's degree. We believe there is a thoughtful and holistic way to preserve the great benefits of traditional American higher education while also addressing the pressing questions that the industry faces.

We finalized this document in the Spring of 2022 — before President Biden announced the new debt forgiveness program in the US. Debt is, of course, a symptom of the ballooning cost of higher education, and forgiveness will offer much-needed relief to struggling students and families. However, as many commentators have noted, erasing debt does not remove the causes of debt. Nor will it address how efficacious education actually is. These are the underlying motivations for the ideas presented here.

Finally, this document should be seen simply as what it is: a white paper. It is not a comprehensive plan. Many questions related to the business plan of an operating institution cannot be addressed here, because these depend on a number of decisions we do not address — such as location and real estate strategy. All we do is offer some key levers. This document should also not be seen as a commitment by MIT, our parent institution, to create such an institution. It is a product of our thinking in our individual, and group, capacities.

Contents

Executive Summary

The conventional model of higher education is facing growing skepticism. With rising tuition costs, ballooning debt, and concerns about preparedness for the work force, many are doubting the value of higher education. Alternative credentials and online offerings are gaining currency.

Viable solutions to these challenges will require abandoning some of our long-held assumptions about how institutions of higher education should operate. But our core educational values—that each learner deserves individual attention and encouragement, and that education should nourish the entire person and not simply provide short-term skills—must be preserved. So we reject solutions that involve replacing teachers by robots, taking all lessons online, or demoting the humanities.

We describe an alternate model for baccalaureate education that offers key levers for addressing these challenges. We list the features of this hypothetical "New Educational Institution," or NEI, below. NEI is intended to be a new class of institution that is different from traditional R1 or R2 research universities. The focus of NEI will be on majors such as computer science and business, and eventually, broader areas of engineering and design.

REBALANCING EDUCATION AND RESEARCH

NEI will be focused on educational outcomes. For faculty, teaching will be the focus. Faculty will be encouraged to spend about 20% of their time on research or practice, and to take sabbaticals at partner institutions, companies, and organizations, but promotions and career advancement will place the highest emphasis on teaching.

RETHINKING CURRICULUM DEVELOPMENT AND DELIVERY

NEI is residential by design (with the addition of co-ops, which we describe later), but teaching will be based on a flipped classroom model almost exclusively. The online content can be drawn from the many online sources available today, and might be developed centrally at a major partner institution that could help not just create and maintain the curriculum, but also work with the NEI (or multiple NEIs) to finetune and improve the content.

HOLISTIC CURRICULA

A holistic education is essential for success in the world today. Graduates need more than fundamental ideas and the skills to apply them narrowly; they need to understand their context and implications, and to be able to work effectively with others in an increasingly complex society. The curriculum must therefore offer substantive classes in the humanities (including arts) and social sciences, thoughtfully integrated into the curriculum.

THE DEGREE AS AN ASSEMBLY OF MICRO-CREDENTIALS

We generalize the concept of majors and minors by turning the degree into a series of micro-credentials which are "stacked." Each micro-credential is composed of courses, but the courses fit into themes. Micro-credentials can be better matched to student capabilities and

interests than majors and minors; put students in a better position for employment in specialized areas; and offer greater value to students (especially those who leave the degree program without finishing).

TEAM TEACHING AND COURSE SEQUENCES

Faculty would team-teach the bundle of courses associated with a micro-credential. For example, a machine learning micro-credential might involve courses in mathematics, computer science, sociology, and ethics. Faculty from these fields would work together to manage and teach the curriculum.

PEDAGOGY

The innovations described above are a departure from traditional practices at universities. Faculty would be trained in the latest pedagogy and use of pedagogical tools, and in the implementation of the approach described in this document.

A MORE EQUITABLE AND HOLISTIC APPROACH TO FACULTY

At the NEI, the practice of teaching will be central in the institutional ethos. Teachers will be celebrated, and will constitute a single, unified community without the usual divisions (into regular and teaching faculty, adjuncts, etc.) that undermine motivation and cohesion.

COOPERATIVE EDUCATION (CO-OPS)

Cooperative education will be central to the NEI's curriculum. Co-ops will be managed and curated by the NEI to ensure that students receive both working experience and educational benefits while spending time at partner organization. Co-op partners can be companies, museums, labs, or universities.

ACADEMIC CALENDAR

NEI divides its academic year into a three-semester (trimester) calendar consisting of a fall trimester, a spring trimester and a summer trimester. Each trimester is of equal length, and slightly shorter than a regular semester at a university like MIT. The trimester calendar is more compatible with longer co-ops, and also gives greater freedom in the use of the facilities. Students will spend at least 4 trimesters out of 11 trimesters in co-op programs. The calendar accommodates breaks and holidays.

EXTERNAL PARTNERSHIPS

Because exposure to the workplace will be central, partnerships with outside entities will be established and managed proactively by NEI. These entities will provide not just co-op opportunities, but also recruitment and sabbatical possibilities for those faculty who choose to avail of them. As with apprenticeship programs in some countries of Western Europe, partner organizations will be asked to help create a nurturing environment for students.

VISITING FACULTY AND FELLOWS

Partner organizations can also serve as sources of teaching professionals. "Reverse sabbaticals" from partner institutions will be welcomed, with professionals participating in teaching teams (after an appropriate selection process and pedagogical and curricular training).

EXTRACURRICULAR ACTIVITIES

We describe an intentional and deliberate approach to extracurricular activities for students at NEI. We recommend careful design, management, and delivery of these programs so that students receive the ideal combination of freedom and opportunities to grow.

FACILITIES AND INFRASTRUCTURE

It would be inappropriate for this document to delve too deeply into the brass tacks of building and running an institution, but we recommend modern, capital-efficient approaches to facility and infrastructure. We also recommend partnering with other institutions such as city libraries for mutual benefit.

Much of the implementation of a new educational institution will come down to the leadership of the effort and to the decisions made during implementation. We cannot anticipate the inevitable challenges that will arise, nor at this point can we prescribe a detailed course of action. The goal of this document is simply to propose some principles and ideas that we hope will lay the groundwork for the future, for an education that will be both more affordable and more effective.

Introduction

Humanity faces a period of uncertainty and flux. Human development—particularly in the form of effective, affordable, accessible, and equitable education—is becoming a pressing global need. In the United States, attending college, in addition to its traditional inherent value, has become an increasingly important step towards achieving economic prosperity and a steppingstone to a middle-class life.

This white paper explores how one model could provide high-quality undergraduate education at a significantly lower cost. Of course, higher education is a rich and diverse space, and the scope of our exercise is important.

1 First, our focus is on the United States. Though many of our ideas may be applicable elsewhere, they are particularly relevant for the opportunities and challenges facing the US economy and US higher education.

2 Second, our focus is on education in fields such as computer science and business, and eventually more broadly in engineering, design, and other areas. While the United States is the leader in liberal arts education, and we take inspiration from the long-standing traditions of the US model, our ideas are not directed at such institutions.

3 Third, we are not attempting to design an R1 research institution like MIT. R1 and R2 institutions are doing well, but as the contours of work and employment evolve[1], the availability of additional avenues for educational attainment must also evolve.

In general, this white paper is not intended as a rethinking of higher education. The opportunities and issues facing higher education are complex, multilayered, and nuanced. Rather, this is a design exercise with a sharp focus on how a standalone, de novo institution can deliver effective, affordable undergraduate education. In doing so, we hope to capture some of the better features of higher education as it is delivered today, while also identifying, and perhaps relaxing, some of the assumptions and constraints under which existing institutions operate.

MIT has a long history—more than 70 years—in the design and establishment of new educational institutions around the world. MIT and its faculty have been involved in the establishment of the **Indian Institute of Technology (IIT), Kanpur;** the **Birla Institute of Technology and Science** (BITS), Pilani, India; the **Instituto Tecnológico de Aeronáutica** (ITA, or the Aeronautics Institute of Technology), Brazil; the **Singapore University of Technology and Design** (SUTD); **Skoltech**, Russia; the **Asia School of Business**, Malaysia; and many more. Several of the authors of this white paper were involved in, or led, recent university development projects, and two of us, Kothari (BITS) and Sarma (IIT Kanpur), received our undergraduate degrees from these institutions. There was much innovation at these institutions, and we have attempted to bring some of this perspective to the design exercise presented here.

To further frame and ground our thinking, we consider the history, the innovations, and the challenges in higher education in the United States. We then lay out some principles and proposals for the new institution considering the mission, academic structure, policies, curricula, calendars, pedagogical approaches, and student journeys.

For brevity, we refer to the hypothetical new educational institution as an "NEI" in the remainder of this document.

1 • Autor, David, David Mindell, and Elisabeth Reynolds. "The work of the future: building better jobs in an age of intelligent machines." MIT Task Force on the Work of the Future (2020).

US HIGHER EDUCATION:

Challenges and Opportunities

Higher education, particularly at the four-year undergraduate level, faces challenges on many fronts today, including cost, value, equity, and relevance.

Academia would be well served to confront these challenges and shape new models to ensure that the attributes that make education valuable are preserved as academia evolves. We believe that there is a fundamental difference between education and training, between a job skill and a life skill, and between operating and creating.

If academia leaves a vacuum, the solutions that emerge will likely blur these lines, and society will be the poorer for it. However, the runway is limited. The economic model of educational institutions, precarious to begin with, is hardly popular with students, parents, and the media. COVID caused a further disruption; remote education replaced the in-person teaching out of necessity during the pandemic, but tuition fees were not generally reduced.

This highlighted a question that will linger for years after the pandemic: If remote education is worth the tuition, then what is the worth of college?

The question we address herein is how educational institutions can evolve alternate models that can overcome some of these challenges.

RISING TUITION AND STUDENT DEBT

Tuition debt in the United States is more than $1.7 trillion today. About half of this debt is from borrowers who attend two-year or four-year colleges, and the other half is from students in graduate programs.[2] Debt accrued from attending for-profit institutions ballooned after the Great Recession of 2009; however, after regulatory changes, that fraction has dropped to about 12 percent (though it crept up again in the 2019–2020 time frame).[3] In other words, the bulk of student debt derives from attending nonprofit institutions.

Undergraduate debt has increased because: (a) college tuition has risen; (b) more students are attending college; (c) a greater number of students are borrowing to finance their education; and (d) public funding for higher education has decreased in the United States.

Debt on federal student loans cannot be discharged upon bankruptcy, creating a lifelong obligation.[4] This makes the problem particularly acute for students who are unable to complete their degrees, because the incomplete degree does not necessarily increase earning potential regardless of how close the student is to receiving the actual degree. Women take on most of the student debt, only to confront the gender pay gap when they graduate.[5]

There is also a racial disparity in student debt: Black and Native American students take on more debt than others[6,7]; and overall, underrepresented groups tend to struggle more to repay debt.[8]

Of course, the sticker price of college tuition is often argued to be misleading since students pay much less on average.[9] Many students receive financial aid from the government and from educational institutions, particularly at elite, well-endowed private colleges.[10] The average undergraduate degree recipient at a non-profit institution graduates with just $15,600 in debt.[11]

However, the earning potential enjoyed by the college educated has decreased[12] and debt remains a serious burden. Paying off even smaller loans on meager salaries can lead to significant student stress, and forbearance programs that roll interest into the principal can lead to a ballooning debt that is difficult to catch up with, especially after an earnings setback.[13,14]

While elite universities are doing well, thanks in part to the yield of their large (and growing) endowments, which effectively subsidize the cost of undergraduate education, the business model of undergraduate education is under stress, and many private and public colleges are struggling.

A significant portion of their income comes from government and private funding in the form of

2 • https://www.brookings.edu/policy2020/votervital/who-owes-all-that-student-debt-and-whod-benefit-if-it-were-forgiven/

3 • https://tcf.org/content/commentary/student-debt-surging-profit-colleges/

4 • Farina, Matthew S. "Schoolbooks and Shackles: The Undue Hardship Standard and Treatment of Student Debt at Bankruptcy." *Boston College Law Review* 62, no. 5 (2021): 1621.

5 • https://ww3.aauw.org/research/deeper-in-debt/

6 • Kahn, Suzanne, Mark Huelsman, and Jen Mishory. "Bridging progressive policy debates: How student debt and the racial wealth gap reinforce each other." (2019).

7 • https://educationdata.org/student-loan-debt-by-race

8 • https://www.jpmorganchase.com/institute/research/household-debt/student-loan-debt

9 • At MIT, the average tuition paid by students is only $11,000 though the official undergraduate tuition is $53,450. This is only because institutions like MIT are able to subsidize tuition with either endowment yield or government funding.

10 • Less than 20 percent of MIT students graduate with debt and the median debt is well under $20,000.

11 • https://research.collegeboard.org/media/pdf/trends-college-pricing-student-aid-2021.pdf

12 • https://files.stlouisfed.org/files/htdocs/publications/review/2019/10/15/is-college-still-worth-it-the-new-calculus-of-falling-returns.pdf

13 • https://www.cnbc.com/2018/05/05/for-some-student-loan-debt-is-doubling-tripling-and-even-quadrupling.html

14 • https://www.gao.gov/assets/gao-18-163.pdf

student loans, but with a moral hazard: It is the students who must pay back the debt. Some colleges have turned to international and out-of-state students to make the numbers add up.[15]

COVID-19 and the difficulties of travel dented this source of revenue. The rise of new lower-priced, employment-focused micro-credentials, particularly from massive open online courses (MOOCs), and job-oriented bootcamps are a new competitive threat—especially after the mass online migration that occurred during COVID-19.

Many colleges are today confronting an uncertain future in the face of these challenges.

15 • https://files.eric.ed.gov/fulltext/EJ1054975.pdf

THE VALUE OF COLLEGE

The Government of Australia made a startling announcement last year: Starting in 2021, degrees in the humanities, arts, and social sciences (HASS) and in economics would cost more than twice as much as degrees in STEM subjects because, the government said, they wanted to encourage more "job-ready" skills.[16]

While we do not support this thinking, and in fact see this dichotomy as false, the importance of job-readiness of a major cannot be dismissed lightly. Beyond the major, there is the question of whether the curriculum matches, and the faculty appreciates, what the working world requires.

The gaps can be classified into two categories: technical skills and human skills. "Technical skills," often referred to as "hard skills," refer to the specific knowledge that a person requires to perform tasks on the job.

For example, learning to write code in the R programming language to perform statistical analysis might be a technical skill. "Human skills," sometimes misleadingly called "soft skills," refer to personal attributes that help an individual succeed at a job. Examples include teamwork, communication, and conflict resolution.

Of course, college, done right, certainly succeeds at building the foundations necessary for job-ready skills. An understanding of the fundamentals of statistics is needed before a student can code in R, and an understanding of society, culture, history, and philosophy helps an individual better connect and empathize with a fellow citizen.

But the challenge is: Can college rise to the challenge of providing that "last mile" of preparation? Are professors cognizant of what employers value, and of the skills students need in a fast-changing economy?[17] There are now "return on investment" (ROI) rankings of institutions.[18] And while the consideration of financial outcomes is understandable, it runs the risk of ignoring the intangible benefits of college—unless colleges make those benefits more directly visible.

16 • https://www.bbc.com/worklife/article/20200728-why-australia-is-charging-more-to-study-history

17 • https://www.shrm.org/resourcesandtools/hr-topics/employee-relations/pages/employers-say-college-grads-lack-hard-skills-too.aspx

18 • https://cew.georgetown.edu/cew-reports/collegeroi/

DEGREES, CREDENTIALS, AND MODALITIES

The four-year undergraduate degree has been an unshakeable pillar of US education since the founding of Harvard University. The only alternative, a two-year associate degree, was first awarded at the University of Chicago in 1900. Associate degrees have flourished since, especially in community colleges.[19]

Either degree requires a substantial commitment, and the degrees themselves are "all or nothing." Overall, the dropout rates in higher education over six years hover in the 40 percent range,[20] and not completing a degree has a significant impact on earning potential. There is no real "partial credit" in the job market for incomplete degrees; it is up to the student to transfer credits elsewhere and try to finish the degree.

While academic and professional credentials—which are more granular than degrees—have existed for a long time, they have flourished in recent years.

Online education, specifically in the form of massive open online courses (MOOCs) from various platforms, has been a major driver of these credentials.[21] Often called "micro-credentials," they can refer to a single course that students display on their LinkedIn page to show that they have learned a skill, or to a more elaborate program such as the MicroBachelors, MicroMasters, and nano degrees.[22]

Students often receive many such credentials and "stack them" to build a résumé of achievement.[23] Micro-credentials need not be online only; so-called "in-person bootcamps" are another way to receive intensive instruction on topics such as coding. Bootcamp fees are often tied to employment outcomes.[24] Much has been written about the threat that micro-credentials pose to traditional college degrees,[25] and recent public opinion trends do indicate that the perception is real.[26]

Another question that persists is whether "seat time"—the time spent taking a course—is necessary if a learner's competency can be ascertained through other means, including certification exams. (For example, a driver's permit is a certification based on a competency exam—the driving test. How the student prepares is not considered.)

In this model, prior learning can replace a course if the student can demonstrate competency. While there are arguments for[27] and against[28], competency-based programs have been used successfully by institutions such as Southern New Hampshire University and Western Governors University to provide a new affordable form of online educational degree to hundreds of thousands of working adults.[29]

19 • https://www.census.gov/content/dam/Census/library/publications/2016/demo/p20-578.pdf

20 • https://nces.ed.gov/fastfacts/display.asp?id=40

21 • The term "MOOC" derives from this paper: McAuley, Alexander, Bonnie Stewart, George Siemens, and Dave Cormier. "The MOOC Model for Digital Practice," Technical Report (2010).

22 • Lemoine, Pamela A., and Michael D. Richardson. "Micro-credentials, nano degrees, and digital badges: New credentials for global higher education." *International Journal of Technology and Educational Marketing (IJTEM)* 5, no. 1 (2015): 36-49.

23 • https://hechingerreport.org/more-students-start-earning-stackable-credentials-on-their-way-to-degrees/

24 • https://www.coursereport.com/blog/coding-bootcamp-job-guarantees-guide

25 • Carey, Kevin. *The end of college: Creating the future of learning and the university of everywhere.* Riverhead Books, 2016.

26 • https://www.gallup.com/education/272228/half-consider-college-education-important.aspx

27 • McClarty, Katie Larsen, and Matthew N. Gaertner. "Measuring mastery: Best practices for assessment in competency-based education." *American Enterprise Institute for Public Policy Research.* (2015).

28 • Neem, Johann N. "Experience Matters: Why Competency-Based Education Will Not Replace Seat Time." *Liberal Education* 99, no. 4 (2013).

29 • LeBlanc, Paul. Students First: Equity, Access, and Opportunity in Higher Education. Cambridge, MA, USA: Harvard Education Press, 2021.

TEACHING AND LEARNING

Alongside all the issues involving the cost and structure of college, there have also been mounting questions about the best way to teach—and whether colleges today are generally using the right approach to fit the times. A primary question is one of student engagement. Higher education in the humanities, arts, and social sciences (HASS) has long recognized and implemented a discussion-oriented setting in which students read materials and prepare *before* the class.

Other fields, however, have more recently begun the journey to active engagement in the classroom. Lamenting the ineffectiveness of lectures in the early 1990s, Eric Mazur of Harvard developed a number of techniques in physics education to encourage active classrooms including clickers and peer learning.[30]

In 1993, Rensselaer Polytechnic Institute introduced a model called "Studio Physics" in which the typical classroom desks were replaced with work desks, often with equipment, and students were encouraged to work together on concepts rather than merely listening to lectures.[31]

Also in 1993, Alison King articulated a pithy expression that has impacted much of higher education in the decades to follow when she published "From Sage on the Stage to the Guide on the Side."[32] (We will use this metaphor throughout this white paper.) In 2000, MIT institutionalized Studio Physics with the creation of the Technology Enhanced Active Learning (TEAL) concept.[33]
The transition from "sage" to "guide," however, has not scaled. Much work needs to be done to truly transform institutions. The emergence of online education has offered a way to further replace the "sage on the stage," releasing more faculty time for the "guide on the side."

The first descriptions of this modality emerged in 2000 with talk of the "inverted classroom"—one in which students consume material online, enabling the repurposing of actual classroom time for active learning, rather than for lectures.[34]

The alternative term "flipped classroom" went viral following Sal Khan's 2004 TED Talk about the possibilities of reinventing education through videos from the remarkable Khan Academy. MIT's own TEAL further combined Studio Physics with MITx online courseware to create TEAL+x.[35]

An underlying theme in much of this innovation is that "liberating" faculty time from lecturing enables them to become coaches—the guides on the side.

There is much literature on the benefits of individuated feedback. "Mastery Learning" historically refers to the principle that students benefit greatly if they receive formative assessment, and individuated, targeted, and explicit feedback to ensure individual proficiency—in contrast to "one size fits all" mass instruction.

Although the concept first appeared in the 1920s, the eminent educational researcher, Benjamin Bloom, described "Mastery Learning" in 1968[36] and provided experimental evidence in his famous "The 2 Sigma Problem" paper

30 • Mazur, Eric. "Peer instruction: A user's manual Prentice Hall series in educational innovation." (1997).

31 • Wilson, Jack M. "The CUPLE physics studio." *The Physics Teacher* 32, no. 9 (1994): 518-523.

32 • King, Alison. "From sage on the stage to guide on the side." *College teaching* 41, no. 1 (1993): 30-35.

33 • Belcher, John W. "Studio physics at MIT." *MIT Physics Annual* (2001): 58-64.

34 • Lage, Maureen, and Glenn Platt. "The internet and the inverted classroom." *Journal of Economic Education* 31, no. 1 (2010): 11.

35 • Rayyan, Saif, and John Belcher. "8.02 TEAL+x: Students say 'Yes' to MITx in 8.02 TEAL," *MIT Faculty Newsletter*, vol. 28, no. 2, Nov. 2014.

36 • Bloom, Benjamin S. "Learning for mastery." (UCLA-CSEIP) *Evaluation Comment* 1, no. 2 (1968).

in 1984.[37] The paper describes how a 2-sigma improvement of student performance can be achieved through individualized tutoring—and the opportunity to give every student proficiency rather than merely sorting students by performance based on how they did with fixed "one-size fits all" pedagogy.

Of course, we note that what it means to "master" a topic depends on the topic. It may be easier to measure and confirm proficiency in some areas than in others; proficiency and competency in mathematics, for example, are easier to ensure than in critical thinking, teamwork, or creativity, where the intangibles are much greater and measurement involves more implicit, indirect variables.

The power of coaching also arises in a related approach called "deliberate practice," an education framework that involves intense practice with explicit feedback with a goal of building an expertise in a field.[38]

Long used in sports[39], deliberate practice was used in education in a Stanford Physics class with much success.[40] Unfortunately, none of these techniques are widely known or applied in academia today, and change has been slow, as the Nobel Laureate and educator Carl Wieman has lamented.[41]

Another educational principle is "learning by doing," which is captured in MIT's motto: *mens et manus*, Latin for "mind and hand." Related principles include "project-based learning,"[42] "problem-based learning,"[43] and "Action Learning."[44] The idea undergirding these approaches is to give students context and agency in simulated or real-world settings where the problem itself may be ill defined yet consequential.

A cognitive science principle called "embodied learning"—the idea that physical action shapes learning—underlies many of these approaches. In fact, several principles from cognitive science are relatively unknown, and scarcely applied, in much of higher education. Examples include retrieval learning, spaced learning, interleaving, and so on.[45,46,47]

In Bloom's "The 2 Sigma Problem," the "problem" as he describes it is cost. With the current system of education, the sage on the stage is cheaper—never mind the outcomes—than the guide on the side.

And in many ways, this, along with the structural constraints of current university systems, explains why, despite many of the known benefits of the practices described above, they are rarely adopted en masse.

37 • Bloom, Benjamin S. "The 2 Sigma Problem: The search for methods of group instruction as effective as one-to-one tutoring." *Educational Researcher* 13, no. 6 (1984): 4-16.

38 • Ericsson, K. Anders, Ralf T. Krampe, and Clemens Tesch-Römer. "The role of deliberate practice in the acquisition of expert performance." *Psychological Review* 100, no. 3 (1993): 363.

39 • Starkes, Janet L., Janice M. Deakin, Fran Allard, Nicola J. Hodges, and April Hayes. "Deliberate practice in sports: What is it anyway." *The road to excellence: The acquisition of expert performance in the arts and sciences, sports, and games* (1996): 81-106.

40 • Jones, David J., Kirk W. Madison, and Carl E. Wieman. "Transforming a fourth year modern optics course using a deliberate practice framework." *Physical Review Special Topics-Physics Education Research* 11, no. 2 (2015): 020108.

41 • Basken, Paul. "Crusader for better science teaching finds colleges slow to change." *The Chronicle of Higher Education* 59 (2013): 40.

42 • Thomas, John W. "A review of research on project-based learning." (2000).

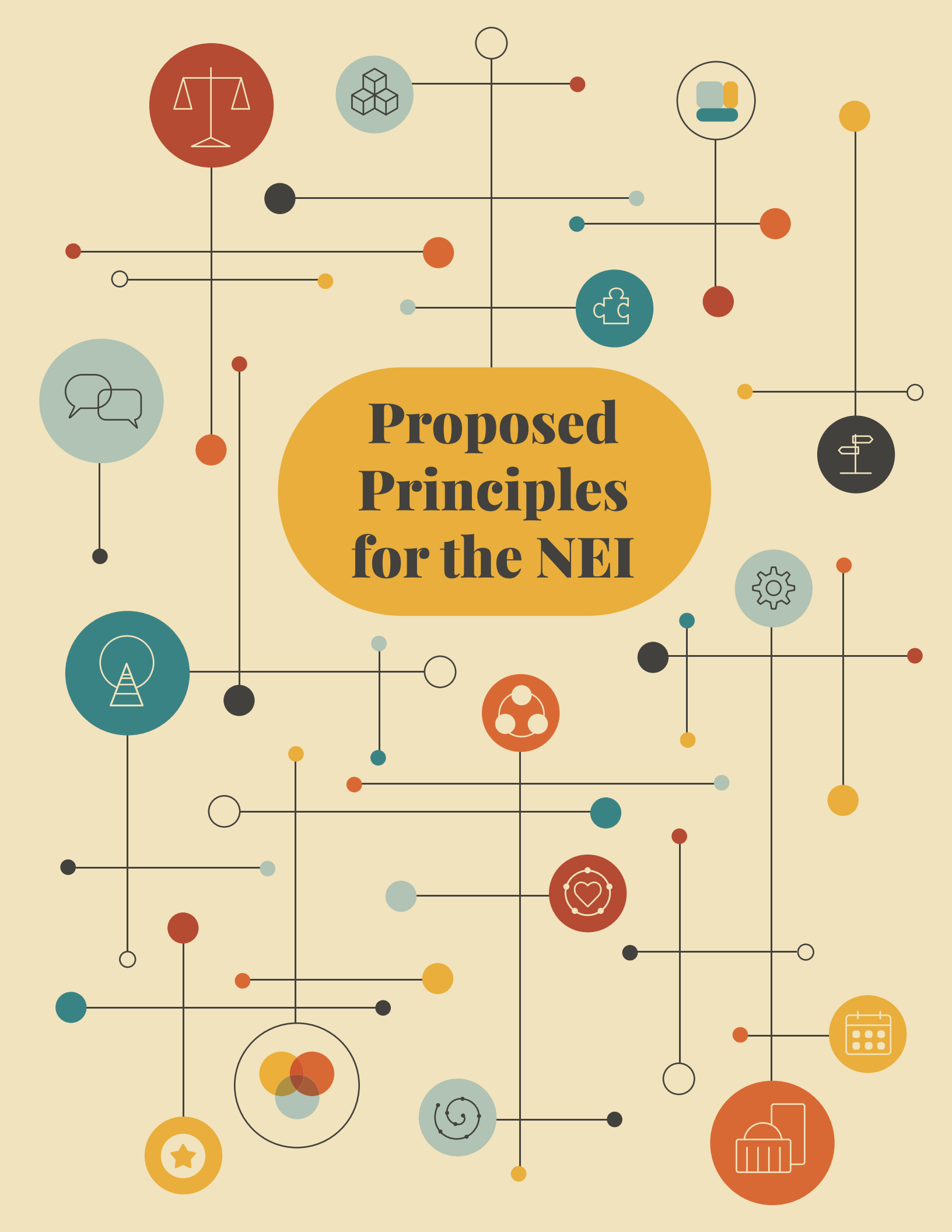
43 • Wood, Diana F. "Problem based learning." *BMJ* 326, no. 7384 (2003): 328-330.

44 • Revans, Reginald W. "What is action learning?" *Journal of Management Development* (1982).

45 • Brown, Peter C., Henry L. Roediger III, and Mark A. McDaniel. *Make It Stick*. Harvard University Press, 2014.

46 • Kosslyn, Stephen M., and Ben Nelson. *Building the Intentional University: Minerva and the Future of Higher Education.* MIT Press, 2018.

47 • Sarma, Sanjay, and Luke Yoquinto. *Grasp: The Science Transforming How We Learn.* Anchor Books, 2021.


Proposed
Principles
for the NEI

Proposed Principles for the NEI

A typical R1 educational and research institution is a complex organization with multiple missions and myriad undergraduate, graduate, research, outreach, convening, and international programs. Each of these programs requires an apparatus consisting of staff, leadership, administration, contractors, and facilities.

Over the years, institutions have grown to become complex, layered, and sometimes idiosyncratic systems. Running an institution is like running a small city. The complex and charming tapestry that is the modern R1 higher educational institution is what makes it a fascinating and enriching experience.

It is, however, also likely the reason for many of the challenges academia faces—especially for those institutions without the reputation and resources of R1s that aspire to compete with or join them. Studies indicate that university costs are related to complexity. Consider, for example, the cost burden of a single issue: regulations. (We emphasize that what follows is not a commentary on regulation per se; rather, it is an illustration of the complexities of managing an educational institution.)

A study of 13 higher education institutions commissioned by Vanderbilt University found that regulatory compliance constituted 3 to 11 percent of universities' nonhospital operating expenses, and 4 to 15 percent of staff and faculty time.[48]

Research-related regulatory expenses amounted to 11 to 25 percent of all research expenses, while higher education related regulatory expenses constituted 2 to 8 percent of all non-research expenditures. Across higher education, the research indicated that institutions deal with about 18 different federal agencies and approximately 30 different areas of regulations, with more than 200 laws and guidelines. In other words, as institutions take on more activities, the regulatory burden multiplies, and the overall cost escalates—to the tune of several thousand dollars per student. Each additional activity adds further responsibility: human subject compliance, for example, or export controls.

Universities like MIT and Vanderbilt—which have large research programs and endowments—are able to engage in, and opportunistically seek resonances between, hundreds of activities. But focus and deliberate intention can further help higher education tame the runaway cost of entropy.

Among other factors, competition—for students, for faculty, and for prestige—drives complexity, which in turn drives two major elements of costs: buildings and administration. In 2015, higher education collectively spent $11.5 billion on buildings while, paradoxically, facing a deferred maintenance shortfall of $30 billion.[49]

New buildings are required for new activities and to compete in the marketplace, and are also easier to fundraise for. But deferred maintenance adds to the complexity of managing universities, and this has led to a vicious cycle.

Overall university debt has gone up, and interest from that debt amounts to about $750–$1,289 per student at public and private four-year colleges, respectively.[50] On the administrative

48 • https://cdn.vanderbilt.edu/vu-news/files/20190417223557/Regulatory-Compliance-Report-Final.pdf

49 • https://www.theatlantic.com/education/archive/2016/07/the-paradox-of-new-buildings-on-campus/492398/

50 • https://academic.oup.com/ser/article/14/3/507/2599064?casa_token=_Z-fEKw5ro0AAAAA:APQmr7qz-Ba2l9qDDf_5dyORqqNZHLct-LI2TEBFZIpaRBDWoYCECslsjSP58PzAGsJXZa5x0IDVP

front, meanwhile, the ratio of instructional staff to administrators decreased by about 40 percent at most institutions between 1990 and 2012, according to the Delta Cost Project.[51]

The silver lining, however, is that the actual cost of instruction amounts to less than a third of total expenditures for four-year colleges today.[52] This indicates that if some institutions can reconsider their structures and focus entirely on instruction, there is a significant opportunity to deliver more, and better, for less.

Below, we describe some principles for an undergraduate-focused college with these questions in mind. We note that our ideas build on much prior work on the future of higher education including that by Bacow[53], Wieman[54], and LeBlanc[55]. We end with a section on community, culture, and values because the design "levers" in the earlier sections enable us, we believe, to also establish a more modern ethos at the NEI.

REBALANCING EDUCATION AND RESEARCH

The coupling of research and education has many benefits: Faculty are at the forefront of knowledge creation, which gives students unique insights into research, discovery, and creation. While there is a clear benefit to graduate students, undergraduate MIT students also benefit from the atmosphere of enquiry through the **Undergraduate Research Opportunities Program** (UROP), a wider range of courses (**such as a course on COVID-19 that was taught as the pandemic was unfolding**), and access to advanced equipment.

However, as we have discussed, combining research and education also has its disadvantages. First, research increases complexity, which increases overall costs in a diffuse way for the institution. Second, research faculty can spend less time teaching, which reduces teaching productivity and effectiveness. Third, it complicates incentives: Is a professor promoted for research or for the quality of teaching? (In many ways, modern R1 and R2 education enterprises revolve around the professor.) And finally, precisely how much undergraduates generally benefit from the research milieu needs to be carefully assessed; ensuring significant impact requires extensive programs like UROP, which are run by dedicated staff with significant funding.

For all these reasons, we recommend that the NEI reproportion research and teaching. This does not mean that we recommend removing research altogether. Rather, while a faculty member is at the educational institution, teaching should be the 80 percent focus. And that research, we argue, should be "low overhead" scholarship.

In fact, we recommend broadening the definition of research and scholarship to embrace different types of contributions as described by Boyer.[56] This can include writing review articles as well as accessible books and essays aimed at nonspecialists. Research can also focus on pedagogy and learning—a field that has flourished recently. At the same time, we argue that faculty should be encouraged to take research or practice-oriented sabbaticals at R1 or R2 institutions, museums, archives, government labs, and partner industry labs, and at companies.

51 • http://www.deltacostproject.org/sites/default/files/products/DeltaCostAIR_Staffing_Brief_2_3_14.pdf

52 • https://nces.ed.gov/pubs2011/2011230.pdf

53 • Bacow, Lawrence S. "The political economy of cost control on a university campus." Clark Kerr Lecture, University of California a t Berkeley (2017).

54 • Wieman, Carl. "Improving how universities teach science." In Improving How Universities Teach Science. Harvard University Press, 2017.

55 • LeBlanc, Paul. Students First: Equity, Access, and Opportunity in Higher Education. Cambridge, MA, USA: Harvard Education Press, 2021.

56 • Boyer, Ernest L. *Scholarship Reconsidered: Priorities of the Professoriate.* Princeton University Press, 3175 Princeton Pike, Lawrenceville, NJ 08648, 1990.

Finally, we note that in some fields, research is becoming highly collaborative, multi-university, and multidisciplinary. We believe that faculty from the NEI can and should participate in such large projects where possible. Some R1 and R2 universities can house the key infrastructure—such as experimental facilities—but others can contribute intellectually rather than replicating the same equipment. Such an approach can also create further channels for the sabbaticals we have described, as well as create internship opportunities for students.

RETHINKING CURRICULUM DEVELOPMENT AND DELIVERY

Faculty at many institutions today spend a great deal of time developing classes and then delivering them. While this does enable a great deal of nuance and personalization, a better approach may be emerging for some fields. We believe that academia is on the cusp of a major change that fundamentally transforms this model.

There are two components to what we suggest: the use, where appropriate, of online courses licensed from other institutions in the form of "small private online courses" (SPOCs) and the wholesale adoption of the flipped classroom model from the very start. The term "SPOC" was coined during the creation of edX in contrast to Massive Open Online Courses (MOOCs). MOOCs run on platforms such as edX with open enrollment to anyone in the world. In a SPOC, the same online material as the MOOC is run on the cloud but specifically for a particular institution, with customized timing, and with "master access" to the course—which includes message boards, grades, etc.—handed to the instructor from the institution. The idea of the SPOC is inspired by what MIT is doing in its own residential programs.

Dozens of MIT courses use the Open edX engine to present material online to students, and to replace lecture time with more engaging pedagogy, effectively flipping the classroom. A SPOC makes it possible for other schools to benefit from curricula developed at institutions like MIT.

This has two benefits. First, R1 and R2 institutions can afford to invest in regular curriculum renewal. Second, the SPOC user can focus on the delivery of the content, particularly on approaches like deliberate practice, to enhance educational outcomes. The idea of using a SPOC can be generalized to any high-quality digital material. For example, although, as we have mentioned earlier, humanities education generally "flipped the classroom" decades ago, digital humanities education offers further avenues for innovation and engagement.[57]

Of course, care must be taken when using digital material. Students need to be motivated on the topic, and a social contract needs to be established at the beginning of the class. And during the course, the coaching and in-person elements must reinforce the back-and-forth between the online content and its absorption and application. In other words, we do not mean to imply that this approach is hands-off or easy to deploy; it takes expertise, dedication, and continuous improvement. It is also likely easier in some areas, like STEM or business, than in others such as, say, literature.

One aspect, and strength, of this approach is that faculty from the NEI can participate in the creation of the materials with the faculty at the SPOC provider. The development of online courses requires a great deal of resources and time. At MIT, we have found that the recruitment of teams who can help with course development is difficult.

We have already discussed the concept of faculty sabbaticals for research. NEI could also participate in the creation of the courses. We believe that this collaborative development of "educational commons" can balance efficiency with a multifaceted view of the topics.

57 • Iantorno, Luke A. "Introducing Digital Humanities Pedagogy." *CEA Critic* 76, no. 2 (2014): 140-146.

Over the last few years, MIT has run several SPOC experiments with other institutions. For example, institutions such as San Jose City College (SJCC) have worked with larger institutions such as MIT and UC Berkeley, whose SPOCs are locally supported by SJCC instructors for an SJCC student population.[58]

The SPOC essentially replaces the lecture and liberates resources to make the "guide on the side" truly possible. What we are essentially describing here is a "flipped university": a university that is built with the flipped classroom at the center, as opposed to a retrofit.

HOLISTIC CURRICULA

Traditionally, a Western liberal arts education includes natural sciences, humanities, arts and social sciences. Conversations about the reform of undergraduate education have often led to questions about the importance of the humanities, arts, and social sciences (HASS). The recent news regarding the doubling of the price of a HASS degree in Australia is an example. We reject this dichotomy as false and ironic, because employers have consistently expressed concerns about students' preparation in areas such as critical thinking, writing, and communication.[59,60]

In fact, MIT requires its students to complete at least eight HASS courses during an undergraduate degree. An MIT degree also requires students to take a set of courses in natural sciences: mathematics, physics, biology and chemistry. Now, more than ever, we consider this collective "core" essential to the preparation of students for the challenges they will face in coming years.

We believe fundamentally in the importance of a holistic education in which liberal arts are "baked in," because it enables students to live more fulfilling and successful lives. A student who studies the history and human dynamics of a technical field is, we believe, more likely to appreciate and understand the topic.

Similarly, philosophical, sociological, literary, and artistic principles and approaches make for better, more creative, more ethical, and more successful students and employees. Steve Jobs, for example, was famously motivated by the course on calligraphy while at Reed College.[61]

The "baked in" approach opens up new possibilities that we will expand on in the next section. We quote two examples from MIT. First, Shankar Raman, Alvin Kibel, and Noel Jackson created a course titled: "**The Art of the Probable: Literature and Probability**," which uncovered connections, perhaps surprising today, interweaving the historical development of various models of mathematical probability, philosophy, poetry, and narrative.

Second, the Social and Ethical Responsibilities of Computing (**SERC**) initiative at MIT now publishes a peer-reviewed, open-access Case Studies series, drawing on the expertise of scholars from across the humanties, arts, and social sciences, in addition to computing and data sciences. These cases, as well as original in-class demos, homework assignments, and group projects designed by multidisciplinary teams, are now used across the undergraduate curriculum, including several courses on computation.[62,63]

58 • https://campus.edx.org/resources/online-campus-sjcc

59 • Börner, Katy, Olga Scrivner, Mike Gallant, Shutian Ma, Xiaozhong Liu, Keith Chewning, Lingfei Wu, and James A. Evans. "Skill discrepancies between research, education, and jobs reveal the critical need to supply soft skills for the data economy." *Proceedings of the National Academy of Sciences* 115, no. 50 (2018): 12630-12637.

60 • https://www.aplu.org/library/from-academia-to-the-workforce-executive-summary/file

61 • https://www.washingtonpost.com/news/arts-and-entertainment/wp/2016/03/08/the-trappist-monk-whose-calligraphy-inspired-steve-jobs-and-influenced-apples-designs/

62 • https://mit-serc.pubpub.org

63 • https://ocw.mit.edu/courses/res-tll-008-social-and-ethical-responsibilities-of-computing-serc-fall-2021/

THE DEGREE AS AN ASSEMBLY OF MICRO-CREDENTIALS

As discussed, the undergraduate degree is effectively an "all or nothing" monolith. Completing 100 percent of the degree requirements is celebrated, rightly, as success. But completing 90 percent of the credits is viewed as a failure to receive the degree.

We instead recommend rethinking the degree requirement as a series of modular "concentrations." In effect, this turns the degree transcripts into an amalgamation of minors and majors. Each micro-credential is self-contained in this approach, and enables students to achieve mastery of a field. A student who does not complete a degree may still have several micro-credentials under their belt.

MIT Open Learning has been experimenting with several such micro-credentials, beginning at the graduate level. These are not "MIT" credits in the traditional way; they are meant for students outside MIT. One is the MicroMasters.

First launched at MIT in 2015, there are now more than 50 MicroMasters from over 25 universities worldwide on edX. MIT has identified more than 150 partner universities that give credit for the MicroMasters if a student were to pursue a master's degree there. Most MicroMasters courses are offered as MOOCs, but they could, in principle, be offered as SPOCs as well.

In fact, inspired by that idea, MIT is currently testing a new micro-credential called the "xMinor" with several colleges. The idea of the xMinor is as follows: A "client" institution, which may not have the resources to develop course material in a particularly advanced or specialized topic, subscribes to a course sequence in the form of an xMinor from a "source institution."

The online courses effectively replace the "sage on the stage" at the client institution, and faculty members from the client institution act as "the guides on the side."

The local institution can also provide the hands-on element: access to libraries, labs, and other facilities. Upon completion of the course sequence, the student receives an xMinor certificate from the source institution *and* within the transcript of the client institution.

An undergraduate degree can be constructed from a specified number of micro-credentials—some foundational and some specialized. The reconstitution of a degree as a series of micro-credentials can also pave the way for a new form of continuing education. Students can continue to educate themselves upon graduation and receive micro-credentials that keep them current. This can be either from the NEI or from another institution.

These micro-credentials can be posted both on the living institutional transcript and on résumés and online platforms such as LinkedIn. In fact, to facilitate the authentication of these credentials, MIT and a consortium of universities are working on **digital credentials**.

Today, the transcript is a single document controlled by institutions. In the future, with digital credentials, substantive achievements can be referenced individually in their résumé. The university can verify the credentials that it provides, but the student can also accumulate other credentials—MOOCs, apprenticeships, and so on—to advance their career. This makes the transcript more compatible with a résumé.

TEAM TEACHING AND COURSE SEQUENCES

If the unit of measurement of teaching emphasized changes from courses to short sequences, several new possibilities open up.

- First, it is possible to design the sequence more holistically and with a combination of modules that provide more comprehensive coverage of the topic. Rather than three one-semester courses, say, the sequence can consist of six (or other number of) modules that together form a whole.
- Second, sequences are likely more amenable to team teaching with a focus on the whole experience.

- Third, sequences developed in this way can also systematize content development—videos, for example—and pedagogy.

MIT's first-year learning communities, such as the **Experimental Study Group (ESG)** and **Terrascope**, contain examples of team-teaching, and are directional examples of the values and aspirations we describe.[64,65]

Consider a micro-credential on artificial intelligence. It could consist of several modules:

- Fundamentals of Machine Learning
- Applications of Machine Learning
- History of AI, and Social and Ethical Questions It Poses
- Frontiers of AI
- Project Work in AI

This approach has several benefits.

First, it incorporates the highly important ethical, social, and societal questions that AI poses. Second, the sequence can yield a micro-credential in AI—say "Foundations of AI"—which is a key part of the bachelor's degree but also a stand-alone credential. Third, this credential can be team-taught by a faculty member focused on the math and computation, a faculty member focused on the application of AI, and a faculty member focused on the social and ethical issues of AI. Finally, the creation of these micro-credentials can pave the way for continuing education after the student has completed their degree.

Perhaps at a later stage in life, the graduate might be interested in taking the follow-on credential on advanced AI.

PEDAGOGY

We recommend that the NEI adopt modern pedagogical practices from the beginning. Existing structures in universities often make these approaches awkward retrofits:

Faculty and teaching assistants may not have the knowledge to implement these approaches, classrooms may not be designed to enable them, the incentive systems may not encourage them, and students themselves may not be aware of the benefits of these practices.

A de novo NEI can be built from the ground up, informed, but not constrained, by history. We have already described changes to faculty incentives, the use of online modalities, and the team-teaching approach with the student at the center. In addition, we recommend that faculty be explicitly trained in the ethos of the new university and the science of learning.

The goal of the NEI faculty member's teaching should be redefined to be the mentoring expert—the guide on the side—with the objective of transforming individual students' abilities to achieve their full potential. A focus on deliberate practice and deeper mastery should be encouraged. Projects and outside-world case studies will encourage deeper learning, while also preparing students for their cooperative education (co-ops) (as detailed below). The coaching should also develop generosity, kindness, and social aptitude.

In addition, we encourage a pedagogical focus on grit and resilience—principles that have been documented to improve student retention and to reduce dropouts, especially amongst the underrepresented.[66]

64 • Established in 1969, the Experimental Study Group has retained its name though it is very much a permanent part of MIT's offerings. Quoting from the ESG website: "The program was created as an alternative to the highly structured instructional methods (lectures and recitation sections) that were the standard in the late 1960s at MIT. Students were allowed a great deal of flexibility in the pace and content of their studies at ESG. Independent work was encouraged, as was close staff-student interaction. Students were encouraged to learn at their own pace, gain self-awareness, learn to cooperate with others, and, most of all, be actively involved in their learning." Other first-year learning communities are listed **here**. The 2014 **Future of MIT Education Task Force** recommended expanding this program significantly.

65 • **Terrascope** offers first-year students the opportunity to take on big, global problems, which they call "the mission." The community offers a vibrant team experience, a novel curriculum, intense academic advising, field trips, and extra-curricular activities.

66 • https://www.nytimes.com/2014/05/18/magazine/who-gets-to-graduate.html

A MORE EQUITABLE AND HOLISTIC APPROACH TO FACULTY

American academia has two classes of faculty: tenure-track faculty and non-tenure-track faculty (NTTF). According to the American Association of Public Universities, by 2011, more than 50 percent of all teaching staff were part-time non-tenure-track, and an additional 19 percent were full-time non-tenure-track.[67] These numbers are increasing as colleges grapple with cost and other issues.

There has been much concern about the fairness and effectiveness of the reliance on NTTF in academia. Non-tenure-track faculty typically receive significantly lower salaries than their tenure-track or tenured counterparts—in the range of a half or an even smaller fraction—and fewer or no benefits.[68] NTTF often do not receive the support necessary to perform their teaching assignments well. They are frequently hired with limited preparation time, and with limited choice as to which classes they can teach, and must often resort to outdated, inherited syllabi.[69]

The logistics are difficult, too. For example, many temporary faculty are not assigned offices, and since part-time faculty are often paid per class per semester, they often work several jobs. This makes scheduling teacher-student meetings difficult, and training and professional development for NTTF remains patchy. Best practices do exist, but are not widely implemented.[70]

We offer a more egalitarian alternative that breaks with the past and removes the current divide between tenured/tenure-track faculty and NTTF. We propose that all faculty be offered similar contracts.

Promotions and titles will be much more closely tied to educational performance—quality, commitment, outcomes, and innovation—than to research outcomes. The faculty member's role will be to work within team-teaching groups, to focus on learning and on scholarship as we have described it, and to be the guide on the side. Finally, many universities only pay tenure-track faculty for nine months of the year. We propose to make the salaries annual. This also works better with the trimester model which we describe later.

A NEW KIND OF FACULTY

At MIT, the MITx Digital Learning Lab consists of an extraordinary group of dedicated lecturers and teachers who bring many of the skills necessary to the new faculty roles we have described. They hold PhDs in the topics they teach, and are passionate about teaching, experts in digital technology, deeply immersed in modern pedagogy, and practiced in creating modern learning environments.

Recalling a term coined by the Nobel Laureate Herbert Simon, they are true "learning engineers."

COOPERATIVE EDUCATION (CO-OPS)

We propose cooperative education as a central element of the NEI.

Cooperative education (or "co-op") programs, which enhance classroom-based education with work experience, were first developed by Herman Schneider at the University of Cincinnati in 1906. While a professor at Lehigh University, Schneider had noted that classroom education itself could not fully convey what the workplace

67 • https://www.aaup.org/sites/default/files/Faculty_Trends_0.pdf

68 • Curtis, John W., and Saranna Thornton. "The annual report on the economic status of the profession 2012-13." *American Association of University Professors* 99, no. 2 (2013): 4-86.

69 • Kezar, Adrianna, Elizabeth Holcombe, and Daniel Maxey. "Rethinking faculty models/roles: An emerging consensus about future directions for the professoriate." *TIAA Institute* (2016).

70 • Kezar, Adrianna, and Sean Gehrke. "Creating a high-quality place to teach, learn, and work." *Peer Review* 15, no. 3 (2013): 8.

could.[71] More than a century later, the "skills gap" echoes that observation.

Today, several well-known institutions run extensive co-op programs, including Northeastern University, Drexel University, and the University of Waterloo. The latter runs the largest co-op program in North America with more than 20,000 students in 120 programs placed for three semesters in local workplaces.[72] Co-ops are not limited to STEM or business programs. Antioch College adapted cooperative education to their liberal arts curricula in 1921.[73]Interestingly, General Motors established a college around its co-op program; formerly called the General Motors Institute of Technology, it is today known as Kettering University.

Co-ops differ from internship programs in several key respects. First, co-ops are assigned through the university rather than independently; second, they generally receive academic credit; and third, they are often paid. The more than 100-year history of co-ops has shown that they are valued by students and employers alike, and that they help students acquire a number of skills necessary for success, including self-direction, professional preparedness, an implicit understanding of the workplace, and insights around the material learned in the classroom.[74]

But co-ops require careful design, mentoring, and monitoring, as well as extensive partnerships with external entities—companies, universities, governments, international entities, non-governmental organizations (NGOs), museums, and so on.

Two other features can be added to co-op programs. The first is professional and leadership education to prepare students for the work experience. MIT's **Undergraduate Practice Opportunities Program (UPOP)** is an example of a one-year program, with an intensive one-week workshop, in which students learn professional skills, including leadership, teamwork, planning, and critical thinking. This can help make the co-op more valuable.

Second, co-ops need to be managed so that mentors at the company are partners in helping the student to develop. This will take mentor orientation and training—something on which MIT's UPOP puts particular emphasis.[75]

Third, the availability of online courses makes it possible for students to take and receive credit for courses while at the co-op site. Clearly, this would only apply to courses that can be taught effectively online, and the load would have to be commensurate with the job responsibilities.

We recommend that the NEI incorporate a significant co-op component into the degree. The co-ops would be done in partnership with companies and would be paid. Online courses that students complete while on a co-op would be charged very modest fees.

The benefits of co-ops to students in terms of learning, maturing, employability, and employment are likely to be significant. The reversal of net cashflow during co-ops will also go a long way toward reducing the financial burden on students.

71 • Sovilla, E. Sam. "Co-op's 90-Year Odyssey," *75th CED Anniversary Magazine*, American Society for Engineering Education, 7, no. 5 (1998): 18-23.

72 • "The world's largest co-op program." *Ontario Universities.* Council of Ontario Universities. Retrieved 20 January 2019.

73 • Keen, Cheryl, and Adam Howard. "Experiential learning in Antioch College's work-based learning program as a vehicle for social and emotional development for gifted college students." *Journal of Secondary Gifted Education* 13, no. 3 (2002): 130-140.

74 • https://www.ijwil.org/files/APJCE_08_1_67_76.pdf

75 • The culture of mentorship should not be taken for granted. Students can end up doing uninteresting work in a co-op, which can be disheartening. Apprenticeship programs in Europe have developed a mentorship culture which will need to be developed. Vazsonyi, Alexander T., and J. Blake Snider. "Mentoring, competencies, and adjustment in adolescents: American part-time employment and European apprenticeships." *International Journal of Behavioral Development 32*, no. 1 (2008): 46-55.

ACADEMIC CALENDAR

The prevalent academic calendars are the annual system, the semester system, and the quarter system. There is an alternative that some of us find attractive: the trimester system.

A semester system can be transformed into a trimester system by shortening the regular terms and lengthening the summer term to an equal length. The trimester system is used in higher education in some universities in Australia and Canada, including at the University of Waterloo. Having three equal semesters a year is a relatively small change, but creates a great deal of flexibility in arranging the academic calendar.

Some of the authors of this document were involved in developing such a system at the Singapore University of Technology and Design (SUTD). The compromise in a trimester system is to reduce the term length to 12 or 13 weeks, and to allocate the balance to breaks.

We recommend adopting the trimester system for the NEI.

The advantage of a trimester layout is that summers, during which students often do internships outside the university program, can be incorporated into the university curriculum. This effectively increases the interaction time between the university and the student to 11 terms rather than eight, and enables a more integrated co-op approach.

Furthermore, co-ops can be longer—up to two trimesters—ensuring a more in-depth work experience. One disadvantage is that each term is slightly shorter than in the regular semester. However, this disadvantage can be mitigated by thinking of content not as a single course but rather as a course sequence, as discussed earlier. Students can also do online courses during the co-op.[76]

76 • This was suggested by then MIT students Drew Bent and Gabriel Ginorio during a seminar on redesigning MIT

EXTERNAL PARTNERSHIPS

Making co-ops central to the design of the NEI necessitates the formation of partnerships with external entities. The University of Waterloo, for example, claims **more than 7,000 partners**. As described earlier, we recommend that partnerships include a range of entities beyond for-profit companies.

Students should be able to do co-ops with governments, including city, state, federal, and international; with NGOs, libraries, galleries, museums, and archives; and with labs such as US national labs. In addition, we recommend that the NEI partner with R1 and R2 universities. This will be particularly valuable to NEI faculty, who can do research during sabbaticals at partner universities.

VISITING FACULTY AND FELLOWS

One of the benefits of building the NEI around partnerships is the possibility of "reverse sabbaticals"—visiting appointments from partner entities to the NEI. Faculty from partner universities can take standard sabbaticals at the NEI, participate in team-teaching projects, help with curricular reviews and seminars, and do research.

There is also a significant opportunity to draw visitors from other partner entities. For example, the curators at museums can bring a deeply enriching experience to students. In fact, curators from the MIT Museum teach **several popular classes** at MIT. These relationships can lead to projects that can integrate across fields. An example is **The Met x Microsoft x MIT project**. Visitors can also come from companies, such as Microsoft, which have prestigious Technical Fellows programs. A data scientist from Microsoft or an economist from The World Bank, for example, can add a great deal to a student's experience while also benefiting from the renewal offered by a sabbatical.

EXTRACURRICULAR ACTIVITIES

There is little doubt that extracurricular activities are an important and effective aspect of student life from both wellness and growth perspectives.[77]

An entrepreneurship club, a solar vehicle team, a soccer club, or a Shakespeare ensemble can provide students with creative outlets and avenues to learn new topics, as well as ways in which to exercise leadership and relieve stress. Yet, it is our observation that extracurriculars and recreational amenities are caught in a contradiction. On the one hand, many such programs are underfunded and have little structure, often leading to inconsistent and varied student experiences. On the other hand, there is a sense that colleges are overdoing their extracurriculars and amenities to compete.[78,79,80]

We believe that effective extracurricular opportunities can be developed and administered relatively affordably when there is intent, planning, and thought. In fact, we were able to participate in such a design process during the establishment of the Singapore University of Technology and Design (SUTD).[81,82,83]

Balancing the initiative and agency of students with supervision and guidance from experts—a form of scaffolding—is difficult to strike, but it can be achieved with careful design and shared leadership and governance. Moreover, we believe that faculty must make a commitment to the community in the way that faculty assigned as heads of house at dormitories do at institutions such as MIT.

FACILITIES AND INFRASTRUCTURE

Running a university, as we noted earlier, is like running a small city. The typical university has work-related and residential buildings; libraries; labs; eating, sports, and medical facilities; roads; grounds; transportation; and security. A high-level document such as this white paper cannot be expected to anticipate all the questions that will likely arise during the actual implementation of a new university. However, several new models for delivering services have emerged over the years, ranging from outsourcing[84] to shared services.[85] Libraries are of special interest in education and scholarship, particularly in the face of digitization. MIT recently published a report on the future of libraries which addresses the important functions that libraries will serve in the years ahead—in community, in discovery, in dissemination, and in the education mission.[86]

Furthermore, given the deficit in funding of public libraries,[87] there may be an opportunity for new institutions to take on a constructive role in sharing services and costs for the public good rather than erecting standalone "walled

77 • Kuh, G.D. "The Other Curriculum: Out-of-Class Experiences Associated with Student Learning and Personal Development," *The Journal of Higher Education* 66, no. 2 (2012): 123-155.

78 • Hurst, William. "End the extracurricular arms race." *Inside Higher Ed* (April 11, 2016).

79 • https://www.insidehighered.com/news/2015/06/15/are-lazy-rivers-and-climbing-walls-driving-cost-college

80 • McClure, Kevin. "Examining the 'Amenities Arms Race' in Higher Education: Shifting from Rhetoric to Research." *College Student Affairs Journal* 37, no. 2 (2019): 128-142.

81 • Fisher, Dara R., Aikaterini Bagiati, and Sanjay E. Sarma. "Fostering 21st century skills in engineering undergraduates through co-curricular involvement." In *2014 ASEE Annual Conference & Exposition* (2014): 24-623.

82 • Fisher, Dara R., Aikaterini Bagiati, and Sanjay Sarma. "Developing professional skills in undergraduate engineering students through cocurricular involvement." *Journal of Student Affairs Research and Practice* 54, no. 3 (2017): 286-302.

83 • Fisher, Dara R., Aikaterini Bagiati, and Sanjay Sarma. "Student ambassadors: developing an older student cohort." In *Proceedings of the 40th SEFI Annual Conference*, 2012.

84 • Phipps, Ronald, and Jamie Merisotis. "Is outsourcing part of the solution to the higher education cost dilemma?" *Institute for Higher Education Policy* (2005).

85 • Miskon, Suraya, Wasana Bandara, Erwin Fielt, and Guy Gable. "An exploration of shared services types in higher education." In *Proceedings of the 17th Americas Conference on Information Systems, Association for Information Systems*, (2011): 1-10.

86 • https://future-of-libraries.mit.edu

87 • https://www.nytimes.com/2021/05/02/opinion/letters/libraries-funding.html

gardens." While terms such as "outsourcing" have caused understandable concern, our idea here is to partner with, and strengthen, existing institutions rather than further diluting them through replication.

We encourage the ultimate designers of the NEI to explore the pros and cons of alternative models. The idea is to learn from the experiences of existing institutions and to focus on new best practices, rather than simply existing systems. The focus of the leadership should be on the core mission, quality, and cost. There is now documented experience in many innovative practices related to university infrastructure—simply replicating traditional practices from existing universities should not be the default.[88,89,90]

88 • http://www.dailynebraskan.com/news/colleges-experience-mixed-results-in-health-center-outsourcing/article_652e77b4-091c-11e2-95a6-001a4bcf6878.html

89 • See MIT's use of a third-party developer for its new dormitory. https://news.mit.edu/2021/two-new-student-residences-open-their-doors-0216

90 • Geronimo, V.A. and C.U. Aragon. "Resource sharing in university libraries: A tool for information interchange." *Library Collections, Acquisitions, and Technical Services* 29, no. 4 (2005): 425-432.

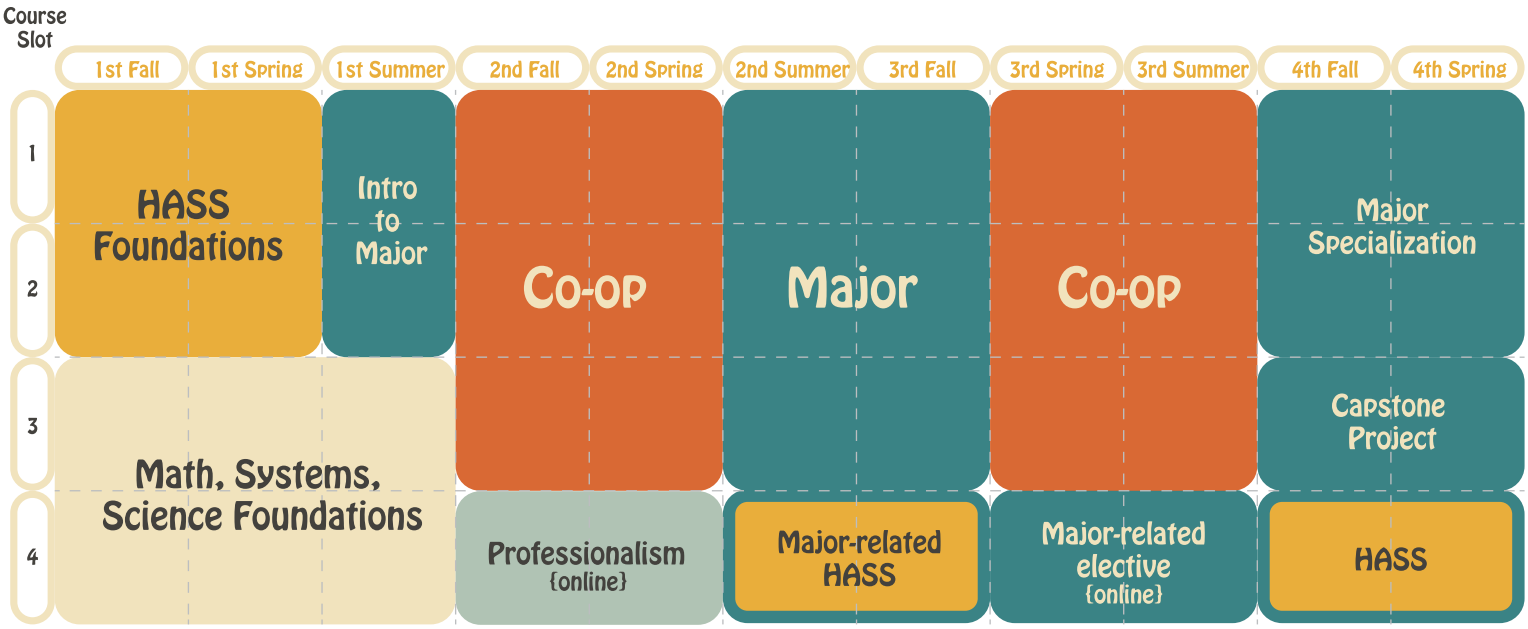


Figure 1: Curricular Structure

CURRICULUM

We base our curriculum on a few principles.

- First, less is more. In other words, we believe that focusing on proficiency in key concepts, rather than on overloading the curriculum, will help students in the long term.
- Second, as described earlier, we arrange the curriculum into blocks, each of which yields a micro-credential on its own.
- Third, we incorporate online education and co-ops from the very beginning.
- Fourth, whereas the traditional school may offer vast choice, we suggest instead modest choice of courses in the regular curriculum, but freedom within the courses through project work.

This is borne out by evidence that shows that excess choice can lead to students losing their way.[91]

Of course, in our model, at least some of the courses can be taken online, which opens up enormous choice for the students because they could, in principle, take courses from any number of platforms so long as they are approved by the institutional advisor. However, this choice has low marginal cost to the institution, and the curricular structure must "scaffold" the explorations that students undertake.

Figure 1 shows the type of curricular structure that we propose. Boxes are thought of as course sequences. This drawing shows four course slots a trimester. Accreditation considerations will dictate the precise curriculum. A separate accommodation will be needed for students who go "off track" due to personal circumstances or poor performance. One option will be to use co-op terms to get back on track.

91 • https://hechingerreport.org/some-colleges-start-to-confront-a-surprising-reason-students-fail-too-many-choices/

COMMUNITY, CULTURE, AND VALUES

Academic communities are generally, and rightly, considered exceptional environments for free enquiry, for progress, for personal and professional growth, and for reaching toward excellence. Community, therefore, is at the heart of higher education.

Like most communities, universities are not without tensions, but overcoming these tensions must be a part of every institution's mission. Academia has several distinct populations—students, staff, and faculty (tenure-track as well as non-tenure-track)—each with different roles, responsibilities, and expectations. This fact, combined with historic and systemic inequities in US society, results in real and perceived experiences of discrimination, power dynamics, hierarchy, and inequity in academia.[92,93,94]

Well-understood concepts such as imposter syndrome[95] and stereotype threat[96] amplify such dynamics. Of particular concern are students themselves (because they are young adults), and all members of underrepresented groups (because they are more likely to feel, or be, marginalized).

Our aspiration is for the NEI to be an inclusive and diverse community, with a culture that values mutual respect, equity, fairness, growth, and a continuous pursuit of improvement. We believe that such a community will naturally have better outcomes.[97]

Many of the design ideas we have described in this document will, we believe, help create a more nurturing and equitable culture. First, there is substantial evidence that a shared sense of mission enables better teamwork and a more coordinated culture.[98] The NEI has a clear education-focused mission and avoids mixed objectives (i.e., "Is research or teaching more important?"), some of which are quite prevalent in academia.

Team teaching will help alleviate another persistent tension: competitive dynamics between fields (i.e., "My field is more important than your field").

We also believe that students and faculty must be much more engaged in the university community of the NEI—especially through clubs, teams, and social events to further enhance the sense of community. There is much research that describes the "other curriculum": the learning, the personal bonds, and the resiliency that students form amongst themselves.[99]

Given that students will be on campus less in the NEI than in traditional universities, a more intentional approach to building a sense of *esprit de corps* within the cohort will be needed.

But getting started is not easy; our work in Singapore gives us some experience in "seeding" a cohort culture with visiting students from partner institutions.[100]

92 • Dupree, Cydney H., and C. Malik Boykin. "Racial inequality in academia: Systemic origins, modern challenges, and policy recommendations." *Policy Insights from the Behavioral and Brain Sciences* 8, no. 1 (2021): 11-18.

93 • Winchester, Hilary P.M., and Lynette Browning. "Gender equality in academia: A critical reflection." *Journal of Higher Education Policy and Management* 37, no. 3 (2015): 269-281.

94 • Young, Kathryn, Myron Anderson, and Saran Stewart. "Hierarchical microaggressions in higher education." *Journal of Diversity in Higher Education* 8, no. 1 (2015): 61.

95 • Bravata, Dena M., Divya K. Madhusudhan, Michael Boroff, and Kevin O. Cokley. "Commentary: Prevalence, Predictors, and Treatment of Imposter Syndrome: A Systematic Review." *Journal of Mental Health & Clinical Psychology* 4, no. 3 (2020).

96 • Steele, C.M., and J. Aronson. (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology,* 69, no. 5, 797-811

97 • Hong, Lu, and Scott E. Page. "Groups of diverse problem solvers can outperform groups of high-ability problem solvers." *Proceedings of the National Academy of Sciences* 101, no. 46 (2004): 16385-16389.

98 • Marshall, John, and Matthew Adamic. "The story is the message: shaping corporate culture." *Journal of Business Strategy* (2010).

99 • Kuh, George D. "The other curriculum: Out-of-class experiences associated with student learning and personal development." *The Journal of Higher Education* 66, no. 2 (1995): 123-155.

100 • Fisher, Dara R., Aikaterini Bagiati, and Sanjay Sarma. "Student ambassadors: developing an older student cohort." In *Proceedings of the 40th SEFI Conference,* 2012.

Now, consider student performance and dropout rates, particularly among women and students from underrepresented backgrounds.

We have argued that the use of digital material liberates faculty time for more in-person engagement. This opens the door to techniques that can address underlying issues such as the imposter syndrome and stereotype threat through known techniques, including encouraging a growth mindset,[101] by building trust between faculty and students,[102] and through coaching, feedback, and reframing.[103]

In addition, better pedagogy enables more success, which intrinsically leads to better outcomes.[104] Role models are known to positively impact underrepresented groups.[105] Of course, much digital content must be inclusive to begin with, and this is an effort we are currently undertaking at MIT.[106]

Universities have struggled to increase the diversity of the faculty in many fields. While diversity in hiring should be a key focus of the NEI, the availability of industry fellows offers an additional lever for recruiting faculty from diverse backgrounds, enabling a more representative faculty body. Finally, exposure to work, connecting curricula to practical value in the real world, and, particularly, participation in projects which enable communal good, have shown promise in increasing retention among students who might otherwise fall victim to implicit biases and the stereotype threat.

Models, such as at Harvey Mudd, can be studied and replicated.[107] Of course, all these measures require training of faculty and staff, which is central to the operation of the NEI.

Since the NEI's mission is clear and specific, unlike at many educational institutions, our goal is to develop extensive training and onboarding programs for staff and faculty to ensure a culture and a community which supports the values of the institution.

101 • Dweck, Carol S. *Mindset: The new psychology of success.* Random House Digital, Inc., 2008.

102 • Cook-Sather, Alison. "Creating brave spaces within and through student-faculty pedagogical partnerships." *Teaching and Learning Together in Higher Education* 1, no. 18 (2016): 1.

103 • https://www.apa.org/gradpsych/2013/11/fraud

104 • Robinson, Cheska. "Growth mindset in the classroom." *Science Scope* 41, no. 2 (2017): 18.

105 • Bettinger, Eric P., and Bridget Terry Long. "Do faculty serve as role models? The impact of instructor gender on female students." *American Economic Review* 95, no. 2 (2005): 152-157.

106 • https://openlearning.mit.edu/events/open-learning-talks-open-education-cultural-collection-and-curation-focus-hbcus

107 • Corbett, Christianne, and Catherine Hill. *Solving the Equation: The Variables for Women's Success in Engineering and Computing*. American Association of University Women. 1111 Sixteenth Street NW, Washington, DC 20036, 2015.

Impact

The ideas presented in this document can, we believe, address two seemingly contradictory goals: effectiveness and affordability of undergraduate degrees.

EFFECTIVENESS

On the effectiveness side, we have presented structural, pedagogical, and curricular ideas including: a much more studio-like educational approach that enshrines flipped classrooms; interdisciplinary curricula that are team-taught; micro-credentials to encapsulate incremental milestones in learning; exposure to the workplace through co-ops; more project-based learning; more access to instructional staff; a greater focus on community; and affordable access to amenities and to extracurricular activities.

In doing so, we have also described a different staffing model in which faculty are treated more equally, where the focus on learning outcomes is paramount, where external visiting faculty are encouraged, and where permanent faculty can participate in research and sabbaticals in academia and in industry. The model we have presented is based on partnerships with existing large R1 and R2 educational institutions, and on cooperation and sharing in facilities, curriculum development, and online delivery in a mutually constructive way.

AFFORDABILITY

On the affordability side, we have focused on four components of institutional expenses: research, teaching, administration, and infrastructure.

- First, by reproportioning effort on teaching rather than research, we propose to tame research costs.
- Second, by focusing on more productive and effective teaching approaches, we propose to improve the "bang for the buck" in teaching.
- Third, by keeping the focus on a single, clear mission, we anticipate a reduction in administrative costs; shared services across many campuses can further reduce these costs.
- And fourth, we propose a leaner approach to facilities, thereby reducing infrastructure-related expenses. We believe that these changes will significantly reduce the expenses of the NEI.

From the perspective of the student, there are two additional reductions in expenses. First, since a significant amount of time will be spent in co-ops, students can be earning money rather than spending it during those periods. We argue that the online courses students take during co-ops will be very low cost if not free—helping students make progress toward their degrees while also earning, and gaining exposure to work and work opportunities. Second, for many students, co-ops can be located near their families.

This can lead to a form of low-residency education and reduced living expenses. We recognize that this will not always be the case and, for equity, we will need to support students who cannot avail themselves of home residency.

It is difficult to state precisely how much less expensive an undergraduate education can be under these circumstances, because actual costs will depend on scale, implementation, execution, the state of the economy, the strength and breadth of university and corporate partnerships, and the initial investments into such an effort. For example, if a large investment were made to develop the online infrastructure, to train faculty, to line up employers and co-op partners, to create shared offices that take on regulatory matters, and so on, and if a large number of campuses participated in such a shared effort, we might see the cost of education to the student drop by more than 50 percent.

However, this will take a concerted effort, commitment, and leadership—essentially an educational moonshot. But the time, we believe, for such a moonshot is now.

Conclusion

We have presented some ideas for an undergraduate education focused institution. We have considered a number of the structural elements of higher education, the current realities of academia, and possible leverage points based on a more singular, as opposed to diffuse, mission. We believe that the leeway offered by these structural changes, along with the potential innovations we have described, make it possible to develop a radically different value proposition for students in terms of effectiveness, outcomes, and affordability.

In 1991, colleagues at MIT wrote the groundbreaking book, *The Machine That Changed the World*.[108] They documented the ways in which the Japanese car company, Toyota, had achieved three seemingly contradictory goals: quality, innovation, and cost.

The techniques, which were later collectively called "lean principles," were remarkable because they turned apparent disadvantages, such as shortage of space and lack of capital (in post-war Japan), into advantages, such as improved quality, more innovation, and greater user-centricity.

Today, lean principles are used in a variety of industries ranging from government to construction to entrepreneurship. In many respects, the ideas we are describing can be thought of as lean principles applied to undergraduate education.[109] However, our hope is that the outcomes for all involved could be far from lean: enriching even further the US educational landscape to fit different populations and new learning opportunities at a moment when the national need is great.

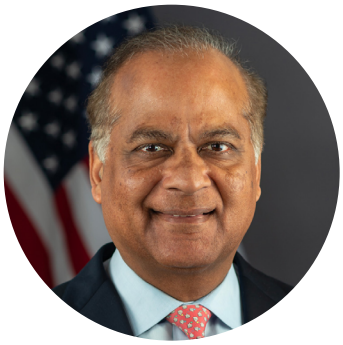
108 • Womack, James P., Daniel T. Jones, Daniel Roos, and D.S. Carpenter. *The Machine That Changed the World: Ibased on the Massachusetts Institute of Technology $5 million five-year study on the future of the automobile].* Rawson Associates, 1991.

109 • Balzer, William K., David E. Francis, Timothy C. Krehbiel, and Nicholas Shea. "A review and perspective on Lean in higher education." *Quality Assurance in Education* 24, no. 4 (2016): 442-462.

Author Bios

Sanjay Sarma is a professor of Mechanical Engineering and was until recently the Vice president for Open Learning (VPOL) at MIT. In his role as VPOL, Professor Sarma oversaw MIT's activities online education including Massive Open Online Courses, new credentials, online professional education and research in learning science. Between 2010 and 2012, Sarma lead the MIT team that helped establish the Singapore University for Technology and Design. Sarma's research spans RFID, IoT, automotive and clean energy technologies, and he serves on the boards of Aclara Resources (TSE:ARA), GS1 US and Cleanlab. He was founder of OATSystems, which was acquired by Checkpoint Systems in 2008 (NYSE:CKP). Sarma is the author of several books and over 200 academic papers.

David Kaiser is Germeshausen Professor of the History of Science and Professor of Physics at MIT. He also served as an inaugural associate dean for MIT's new cross-campus initiative in Social and Ethical Responsibilities of Computing. Kaiser is the author of several award-winning books about modern physics, including *Drawing Theories Apart: The Dispersion of Feynman Diagrams in Postwar Physics* (2005), *How the Hippies Saved Physics: Science, Counterculture, and the Quantum Revival* (2011), and *Quantum Legacies: Dispatches from an Uncertain World* (2022). A Fellow of the American Physical Society, Kaiser has received MIT's highest awards for excellence in teaching.



S.P. Kothari is Gordon Y Billard Professor of Accounting and Finance at MIT's Sloan School of Management. He has senior executive experience in government, academia, and industry with expertise in strategic and policy issues, securities regulation, and corporate governance. Most recently, he was Chief Economist and Director of the Division of Economic and Risk Analysis at the US Securities and Exchange Commission. Previously, Kothari was deputy dean of MIT Sloan School of Management, global head of equity research for Barclays Global Investors; and director of Bombay Stock Exchange; currently he is a director of Velan Studios and EbixCash. Kothari was awarded India's Padma Shri and Honorary Doctorates from London Business School, University of Cyprus, and University of Technology, Sydney.

Diana E. Henderson, the Arthur J. Conner Professor of Literature at MIT, has authored *Collaborations with the Past: Reshaping Shakespeare Across Time and Media* and *Passion Made Public: Elizabethan Lyric, Gender, and Performance* and edited or co-edited twelve Shakespeare-related essay collections, including *Shakespeare and Digital Pedagogy.* She works as a professional dramaturg, produced a documentary based on MIT's participation with the Compagnia de' Colombari Merchant in Venice, and is PI for the MITx course "Global Shakespeares: Re-Creating The Merchant of Venice." From 2006-2015 she served as MIT's Dean for Curriculum and Faculty Support, and has been awarded the Baker Prize and a MacVicar Faculty Fellowship for her undergraduate teaching.

Daniel Jackson is professor of computer science at MIT, associate director of CSAIL, and a MacVicar teaching fellow. For his research in software, he won the ACM SIGSOFT Impact Award, the ACM SIGSOFT Outstanding Research Award and was made an ACM Fellow. He is the lead designer of the Alloy modeling language, and author of Software Abstractions. He chaired a National Academies study on software dependability, and has collaborated on software projects with NASA on air-traffic control, with Massachusetts General Hospital on proton therapy, and with Toyota on autonomous cars. His most recent book, *Essence of Software*, offers a fresh approach to software design, and shows how thinking about software in terms of concepts and their relationships can lead to more usable and effective software.

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About J-WEL

The Abdul Latif Jameel World Education Lab (J-WEL) was launched as a joint initiative between MIT and Community Jameel, an independent, global organization advancing science to help communities thrive in a rapidly changing world. The lab was named in honor of the late Abdul Latif Jameel, the founder of Abdul Latif Jameel, and father of MIT alumnus and founder and chairman of Community Jameel, Mohammed Jameel KBE.

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