

EDUCAUSE

REVIEW

The CIO Agenda for a Decade of Converging Curves (Plus Cliffs and Clouds)

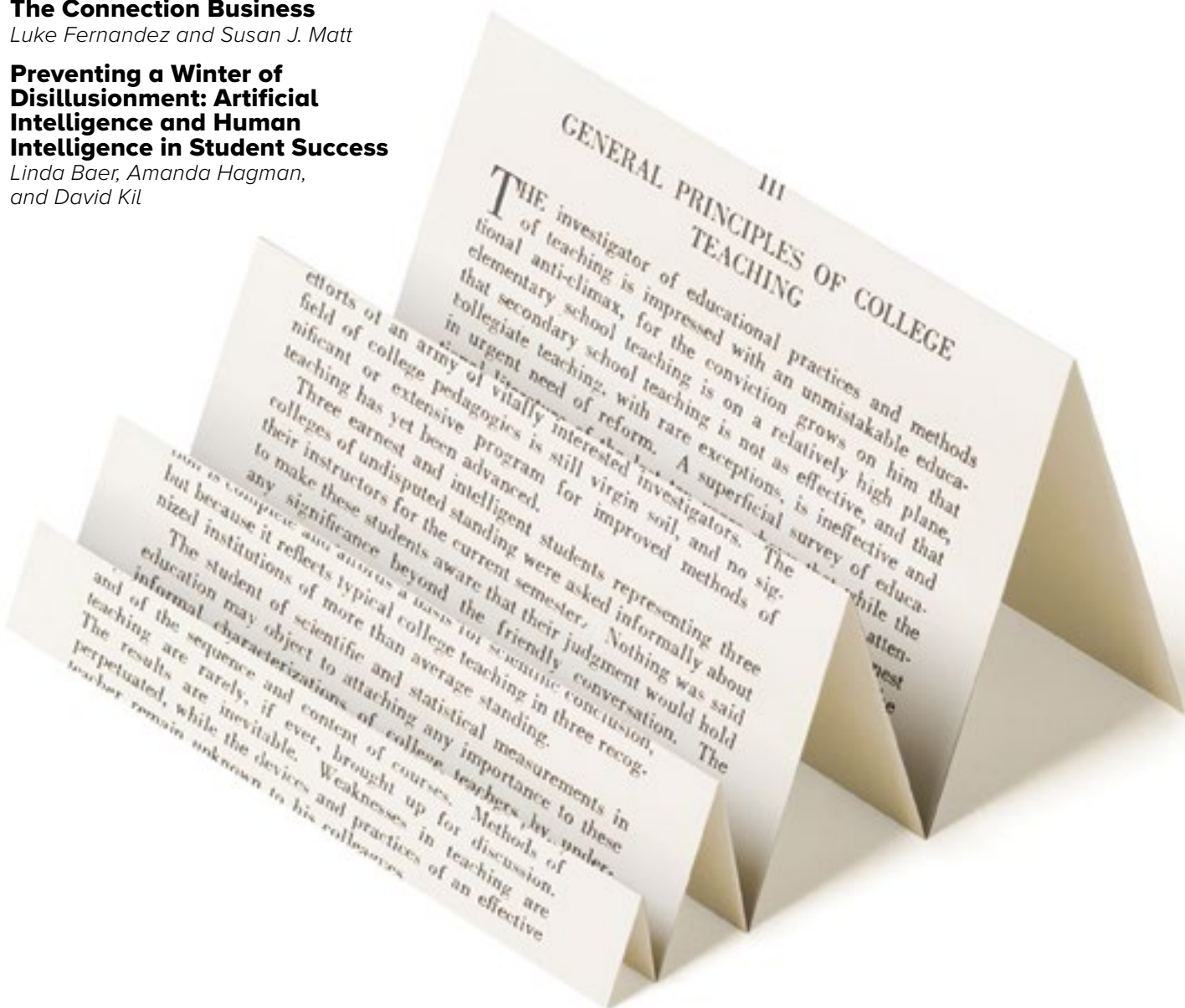
Brad Wheeler

The Connection Business

Luke Fernandez and Susan J. Matt

Preventing a Winter of Disillusionment: Artificial Intelligence and Human Intelligence in Student Success

Linda Baer, Amanda Hagman, and David Kil



The Horizon Report

Trends

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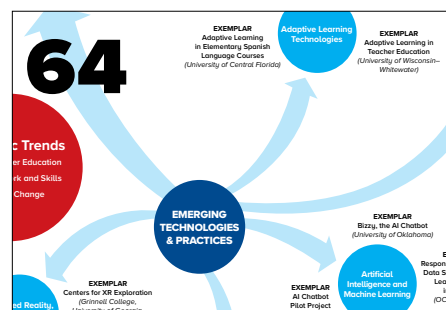
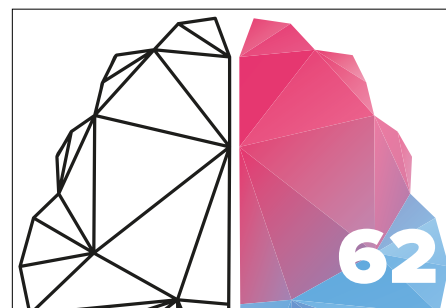
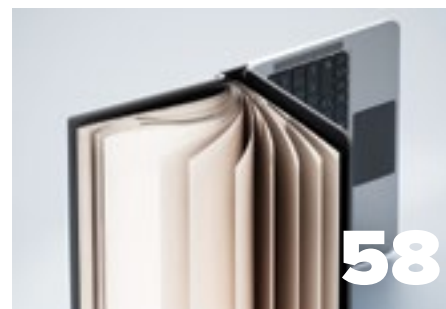
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Having It Both Ways in the New Decade

By John O'Brien

A

s I write, my mind is spinning from watching a promotional video announcing one of the latest robotic digital companions. Launched by Samsung at the CES 2020 meeting in January, “Ballie” is a small, brightly colored ball that rolled onto the stage to a round of applause. After that, Ballie mostly followed the Samsung CEO around on stage. It is in the beautifully crafted video accompanying the product launch where Ballie, doing household chores set to waltz music, shines. And in the press release, we learn that Ballie “understands you, supports you and reacts to your needs to be actively helpful around the house.”

OK, yes, Ballie is adorable. Who wouldn’t want, as *TechRadar* says, “a cute, subservient companion rolling through the house to check that everything’s in order”? Watching the promo video tweeted by Samsung, I decided that I absolutely do, in fact, need a rolling robot that will open the blinds to wake me up in the morning, adjust the thermostat, and tell the robot vacuum to clean up after the dog while I’m not home. But that’s not all. We’re told that Ballie will be a “a friend to your kids” and that this anthropomorphized ball of cuteness is “a camera that records and stores special moments.” This is when things started to turn chillier for me. What “special moments” will the freely roaming Ballie store? At one point in the video, Ballie quietly rolls up behind a young woman doing yoga—surely a private moment?

Ballie is just the latest harbinger of a new decade, one that will be dominated by a choice between privacy and convenience. I hope the choice will not be binary, but however this unfolds, we are going to wrestle with which is more important—and whether we have much say in the matter. As we consider this same dynamic in the smaller world of higher education, the question becomes an issue of how comfortable we are with using student data not only to enhance the student experience but also to help students succeed. In higher education, we are determined to have it both ways: we want analytics and technologies that deliver convenience and progress on goals like student success, but we also insist on respecting our students’ privacy and ensuring that their data is used appropriately.

A few members of our community have expressed their confusion about why **EDUCAUSE** has taken two seemingly contrary positions at the same time.

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Throughout the last year, I've been trying to have it both ways as well: I have been sharing my genuine enthusiasm for analytics and new technologies while simultaneously sharing my concern and sense of urgency about digital ethics. For example, at the same time that I was delivering keynote talks expressing the need for caution on digital ethics, I was working with EDUCAUSE partners at the Association of Institutional Research (AIR) and the National Association of College and University Business Officers (NACUBO) to draft a statement that would express our belief that the value of embracing institutional analytics is high.³

A few members of our community have expressed their confusion about why EDUCAUSE has taken two seemingly contrary positions at the same time. I agree: arguing both sides does seem paradoxical. Yes, we are taking the position that technologies hold great promise to solve institutional challenges. For EDUCAUSE, this belief in the power of technology innovation is at the heart of our promotion of the concept of digital transformation (Dx). And yes, we are simultaneously taking the position that caution, care, and thoughtfulness are needed when these innovations use student data. Once you get beyond the (intended) hyperbolic title of our joint statement, you'll quickly see that analytics isn't going to "save higher education" unless we incorporate analytics deliberately and self-critically at every step. As we stress in the joint statement, the "responsible use of data is a non-negotiable priority," and ill-conceived or misused new technologies or predictive algorithms can "reinforce pernicious discrimination and bias." Intentional or unintentional misuse of data can be avoided by matching technology investments with "an institution-wide program of awareness, transparency, and training."

This issue of *EDUCAUSE Review* includes an excerpt from the 2020 *EDUCAUSE Horizon Report*, an excellent example of our combined focus on both promotion of and caution about analytics. The 2019 *EDUCAUSE Horizon Report* noted concerns about privacy and the appropriate use of data, in the context of analytics technologies, virtual assistants, and artificial intelligence. It promoted "Advancing Digital Equity," for example, and pointed readers to New America's "Predictive Analytics in Higher Education: Five Guiding Practices for Ethical Use."⁴ Similarly, the *Horizon Report* for 2020 continues to underscore these themes, identifying "Equity and Fair Practices" as a social trend and "Analytics and Privacy Questions" as a technological trend demanding our thoughtful attention.

As Ballie and countless other devices that build on advances in artificial intelligence and machine learning roll onto the scene in the coming decade, the tensions between privacy and convenience will intensify, not diminish. As colleges and universities bring these technologies to campus, IT professionals will, as usual, have a difficult job to do. Without the luxury of being able to pick one or the other, we will need to balance our students' demands for the cool and the convenient with the larger demand for data privacy and the appropriate use of data. The good news is that no one is better trained to handle paradox. Since forever we have been tasked to "do more with less," and we've managed the impossible task of protecting information security in an environment that demands openness. Now we have another paradox to add to the mix. ■

Notes

1. "Samsung Electronics Declares 'Age of Experience' at CES 2020," press release, January 6, 2020.
2. David Lumb, "Samsung Ballie Is a Cute Rolling Robo-pal That Narcs on Your Messy Dog," *TechRadar*, January 7, 2020.
3. The statement is reprinted in the Leadership column in this issue of *EDUCAUSE Review*.
4. Manuela Ekowo and Iris Palmer, "Predictive Analytics in Higher Education: Five Guiding Practices for Ethical Use," New America report, March 6, 2016.

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Why IT Matters to Higher Education

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We Meant to Do That. Really.

When Susan Johnston, president and CEO of the National Association of College and University Business Officers (NACUBO), and Christine Keller, executive director and CEO of the Association for Institutional Research (AIR), and I got together in early 2019 to craft a statement to energize campus conversations about analytics, we weren't sure how this would all come together. Yet we were sure of one thing: we wanted to get people's attention. To that end, we wanted to avoid a title like "The Effectiveness of Analytics and Higher Education"—followed (of course) by a colon and more words. Our hope was to contribute a sense of urgency to the consideration of analytics.

In the end, we decided this was a job for hyperbole, and we settled on this: "Analytics Can Save Higher Education. Really."¹ We didn't foresee that in the following months, a number of powerful articles would be published, in both the higher education press and the mainstream press, around perils and concerns related to analytics, data tracking, and algorithmic solutions. In the light of these stories, our desire for hyperbole may have created the impression that we were shouting "Full speed ahead!" and "Damn the torpedoes!" precisely at a time when nuance and caution were called for.

Now that we've received some attention, let's point to where that attention should be directed in the coming months. We stand firm in our conviction that analytics is a crucial part of the future of higher education—though never, ever, should analytics be recklessly deployed at the expense of student and staff privacy. In fact, one of the six sections of the statement below bluntly reminds us all that "analytics has real impact on real people," stressing simply but clearly that "responsible use of data is a non-negotiable priority."

Our data shows that colleges and universities have not made enough progress in analytics to substantially strengthen higher education.² NACUBO, AIR, and EDUCAUSE stand firm in our conviction that the technologies we have before us hold the promise to considerably improve the odds that our students will thrive. We stand equally strong in the conviction that analytics and related technologies must be used with the care and caution that our community deserves. We can go carefully, *and* we can "go big." We must do both.

Notes

1. The joint statement was published online (changewithanalytics.com) in August 2019.
2. John O'Brien, "Analytics, Interrupted," *EDUCAUSE Review* 54, no. 2 (Spring 2019).

Analytics Can Save Higher Education. Really.

AIR, EDUCAUSE, NACUBO

The Association for Institutional Research (AIR), EDUCAUSE, and the National Association of College and University Business Officers (NACUBO) stand together with a strong sense of urgency to reaffirm higher education's commitment to the use of data and analytics to make better strategic decisions.

As the leaders of three national associations collectively serving nearly 2,500 institutions and representing over 80 percent of postsecondary students in the U.S. (22 million students), we believe higher education must re-energize its efforts and unleash the power of data and analytics across higher education to support students and institutions.

We strongly believe that using data to better understand our students and our own operations paves the way to developing new, innovative approaches for improved student recruiting, better student outcomes, greater institutional efficiency and cost-containment, and much more. Data are an institutional strategic asset and should be used as such.

With the change-making capacity of analytics, we should be moving aggressively forward to harness the power of these new tools

for the success of our institutions and our students. However, so far higher education has failed to follow talk with decisive action.

A renewed commitment by higher education's leaders to the use of analytics can help colleges and universities advance institutional goals, improve quality and efficiency, strengthen student outcomes, and enhance teaching, learning, and advising. The thoughtful application of the six principles that follow will accelerate the meaningful use of analytics and take advantage of the power of data to make the decisions and take the actions that just may save higher education. Really.

Go Big: Make an Institutional Commitment to Analytics

Make your approach to data analytics transformational and connected to the institutional mission for real results that matter to your students, faculty, and staff. Don't look for a one-size-fits all approach—each institution's mission, culture, organizational structure, and analytics maturity will dictate the specific next steps. However, the incremental approach used so often in higher education won't be enough. Tweaks won't deliver the change

we need in time to make a difference in the lives of the students enrolled in our institutions today.

Data analytics initiatives are most effective when they target clear, measurable outcomes, so determine which critical institutional goals call for this approach, and let these efforts lead the way to the broader use of analytics across the institution.

Analytics Is a Team Sport: Build Your Dream Team

Data analytics can be a catalyst to solve institutional problems, but not when silos stand in the way. Establish a team approach with an unrelenting expectation for collaboration across colleges, departments, and divisions of all kinds. Give faculty and staff leaders throughout the institution the broad latitude to clear the way for teamwork. Fundamentally, data must be recognized as an institutional strategic asset, not the property of individual offices. Analytic data and tools help senior administrators lead institutions effectively but must also be accessible for faculty and staff, empowering those on the front lines who are directly educating and supporting students.

Most effective data and analytics success stories include a foundational commitment with strong buy-in from the top. Recognizing that presidents and chancellors are critical to this comprehensive approach to data and analytics, we encourage all institutional leaders to provide the critical leadership that expands “pockets of excellence” into an institutional culture that embraces innovation, change, and continuous evaluation for improvement.

Prepare for Some Detours on the Road to Success

For analytics to have a measurable impact on decisions and behaviors at all levels of an institution, authentic and sustained change is necessary. Faculty, staff, and senior leaders will all need to see analytics as a long-term commitment, a core part of their day-to-day functions, and a driver for institutional decision making. This means each person on your campus—from the cabinet to the bursar’s office and from students to deans—will likely find some aspect of your analytics transformation jarring. Expectations must be managed: Aim high, but plan for setbacks, with the understanding that it is okay for some efforts to miss the mark. Learn from the mistakes and move on.

This balancing act will be a challenge demanding skillful leadership and intentional change management across the institution. However, despite the difficulties in the journey, the goals you are working toward—serving your students and strengthening your institution—are worth it.

Invest What You Can: You Can’t Afford Not To

Get ready to make substantial investments in time, talent, and money. The necessary investment goes far beyond buying technology. First, make sure the considerable data you already collect are available, shared, and used appropriately. Then, if you want to move hard-to-nudge needles like retention and graduation rates, you need to invest in a broader strategy to get the

appropriate information in the hands of faculty, staff, and students and to develop the data literacy skills needed to use the information to make smart decisions.

Helping students successfully achieve their academic goals is fundamental to mission, but it also can positively affect the bottom line. The math is compelling. According to rpk GROUP, technology-enabled initiatives like these may generate net revenue averaging \$1 million annually. Advancing analytics can be expensive, but the return on investment can also be sizable and extends to long-term reputational returns far beyond adding revenue that would otherwise have been lost when students leave early.

Analytics Has Real Impact on Real People: Avoid the Pitfalls

Responsible use of data is a non-negotiable priority. Inside and outside higher education, we’ve seen too many examples of the inappropriate sharing and use of data, while inadvertent data breaches have impacted literally billions of individuals. Moreover, sophisticated new technologies and predictive algorithms may reinforce pernicious discrimination and bias if not carefully applied with knowledge of the underlying methods and data. Critical to integrating the use of analytics into institutional culture is ongoing attention to the protection of sensitive data and a deep understanding of the assumptions underlying the analytic methodologies.

To avoid intentional or unintentional misuse of data, investments in analytic tools must be coupled with an institution-wide program of awareness, transparency, and training. As your institution develops comprehensive processes, protocols, and skills in the collection and use of data, hold vendor partners accountable at both the procurement and implementation stages. Invest time early on to make sure your policies keep up with your implementations, and clarify expectations for data use and protection and for data privacy.

Tick-Tock, Tick-Tock: The Time to Act Is Now

A sense of urgency is critical as institutions commit to using data analytics. This urgency needs to come from the institution’s leaders. You can honor higher education’s long tradition of moving carefully, but not be immobilized. The stakes are too high. It’s possible to move forward decisively while also listening, collaborating, and building buy-in along the way. For every semester we don’t do everything we can to ensure student success—including using analytics to increase student progress and completion—students leave our campuses without graduating, discouraged and more in debt than when they entered. For every year we fail to use data effectively to improve operations or to make better financial and business decisions, we threaten the financial sustainability of our institutions. Whether you are encouraged by the significant opportunities or driven by the need to solve critical problems, it’s time to take a big step forward. Now. ■

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The *Horizon* *Report* Trends

EDUCAUSE

III GENERAL PRINCIPLES OF COLLEGE TEACHING

THE investigator of educational practices and methods of teaching is impressed with an unmistakable educational anti-climax, for the conviction grows on him that elementary school teaching is on a relatively high plane, that secondary school teaching is not as effective, and that collegiate teaching, with rare exceptions, is ineffective and in urgent need of reform. A superficial survey of educational pedagogies is still virgin soil, and no significant program for improved methods of teaching has yet been advanced.

Three earnest and intelligent students representing three colleges of undisputed standing were asked informally about their instructors for the current semester. Nothing was said to make these students aware that their judgment would hold any significance beyond the friendly conversation. The results are rarely, if ever, brought up for discussion. The student of more than average teaching in three recognized institutions of scientific and statistical measurements in education may object to attaching any importance to these informal characterizations of college teachers by undergraduates. Weaknesses in teaching are perpetuated, while the devices and practices of an effective teacher remain unknown to his colleagues.

Anticipating the future is human nature.

As anyone who has tried meditation knows, staying in the present is surprisingly difficult because our minds spend so much time reflecting on the past or anticipating the future. Humans are planners, worriers, and dreamers, and those plans, worries, and dreams are rooted in our mental constructs of the future. For sixteen years, the *Horizon Report* has provided a construct of the future of educational technology in higher education, based on a structure of three time horizons.

Anticipating the future is risky.

As any science fiction reader or future-enthusiast knows, extricating present-state experience from visions of the future is very difficult.¹ The track record of predictions—whether about the stock market, the World Series, world events, or technology—is generally so poor that it’s a wonder anyone dares to make them. With technology in particular, we tend to overestimate its short-term impact and underestimate its long-term impact.² The *Horizon Report* has provided ample documentation of predictions, from educational technology experts, of the future impact of technology on teaching, learning, and creative inquiry. Unfortunately, its track record has been described as fair to middling.³ Why would EDUCAUSE bother to continue this publication if its level of accuracy is so low?

learning outcomes, level of risk in adoption, faculty receptiveness, issues of equity and inclusion, and required level of spending.

Anticipating the future is necessary. Today's decisions are always bets on what we think the future will be. The 2020 *EDUCAUSE Horizon Report™ | Teaching and Learning Edition* is not meant to be a fun, “cool” list of hyped technologies for the field to debate and debunk. It is meant to inform decision makers and help learners, instructors, and leaders think more deeply about the educational technology choices they are making and their reasons for doing so. And so, our final choice in reimagining the *Horizon Report* was to provide more-helpful, richer resources to assist the community in considering choices and formulating action plans. In addition to identifying trends and emerging technologies and practices, we offer scenarios for how the future could play out. Will higher education grow in size and importance? Will higher education as we know it fade away or even collapse entirely? Will it remain essentially the same, neither expanding nor contracting? Or will it transform and become almost unrecognizable from today's model of higher education? No one can say, but we have tried to paint those four scenarios to help readers think more expansively about the future of their institutions and our industry so that they can plan and act more thoughtfully today. Finally, the report includes a set of short essays, written from different regional and institutional perspectives, on the implications of the report findings.

Below we offer the first section of the 2020 *EDUCAUSE Horizon Report™ | Teaching and Learning Edition*: the fifteen social, technological, economic, higher education, and political trends that are shaping global higher education and teaching and learning. The full *Horizon Report* can be found online at <https://www.educause.edu/horizon-report-2020>.

Fifteen Trends

For the 2020 *Horizon Report*, we begin with a focus on bigger-picture developments around and within higher education. What can we say about the world in which teaching and learning technologies and practices are taking shape, as well as about the world that institutions, instructors, and learners are going to inhabit in the future? Teaching and learning doesn't take place in a vacuum, after all, and understanding the trajectories of such large-scale trends can only help decision makers and professionals build more responsive and sustainable environments and practices at their institutions.

In assuming ownership of the *Horizon Report*, EDUCAUSE recognized the challenges of anticipating the future. We have, in this first major revision of the report's methodology, structure, and content, striven to break the mold of the classic *Horizon Report* without losing its essential purpose. This recasting of the report recognizes that our thoughts about the future are rooted in the present and how it has changed from the past. The report begins with a scan of our current environment to identify the major trends that are shaping global higher education and teaching and learning. The Horizon Expert Panel named fifteen social, technological, economic, higher education, and political trends that signal departures from the past, that are influencing the present, and that will almost certainly help shape the future. For educational technologies, the report moves away from the time-to-adoption structure, which implied a prediction precision that the project was unable to achieve. In its place, the new report offers evidence, data, and scenarios. The report includes evidence for the trends, as well as panelists' quantitative ratings of factors that often temper actual adoption of emerging technologies and practices in higher education. These factors include impact on



Anticipating the future is necessary. Today's decisions are always bets on what we think the future will be.

To ensure that we identified a wide array of trends, we asked panelists to look across five categories: social, technological, economic, higher education, and political.

To help us explore these larger forces taking shape around higher education, we asked the Horizon Expert Panel to survey the landscape and identify the most influential trends shaping higher education teaching and learning. To ensure that we identified a wide array of trends, we asked panelists to look across five categories: social, technological, economic, higher education, and political. This section summarizes the trends the panelists voted as most important in each of these categories, as well as anticipated impacts of and evidence for each trend.

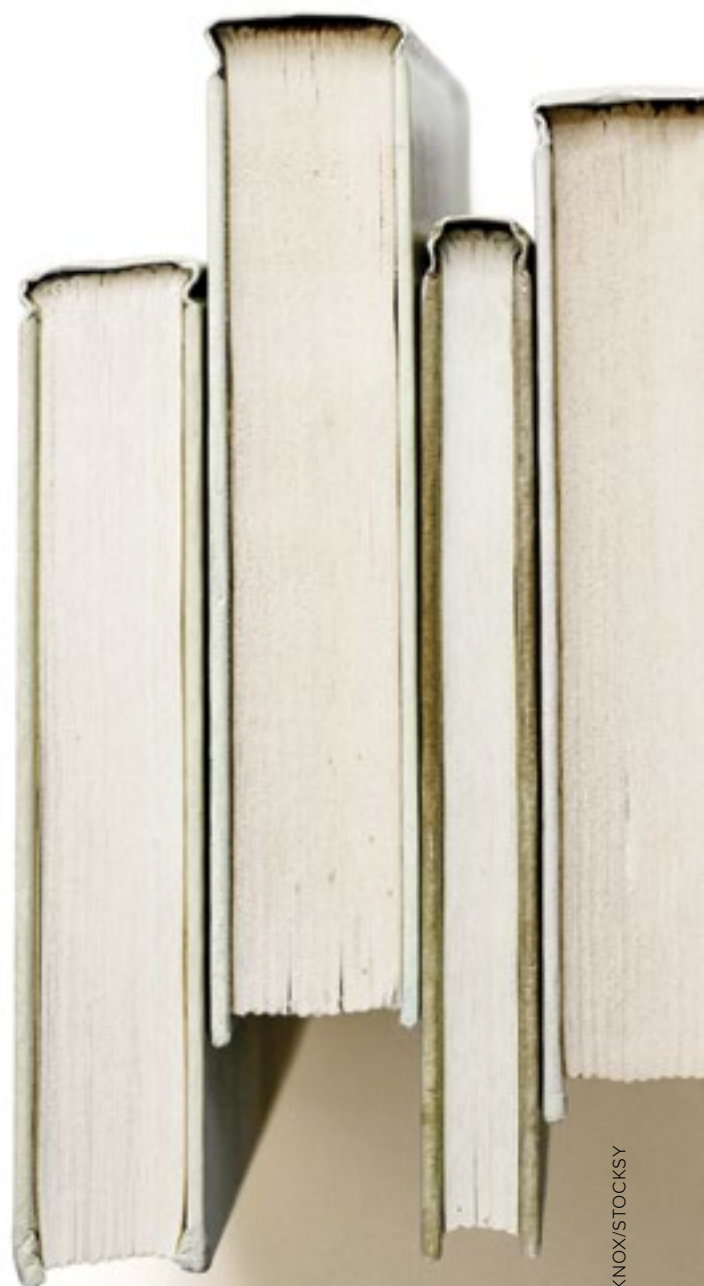
For each of the trends, there is far more complexity and variability across types of institutions and regions of the world than can be adequately captured in such a brief summary. Indeed, our expert panelists—35 percent of whom represented communities outside the United States, including Australia, China, Egypt, France, Taiwan, and the United Kingdom—routinely reflected on the ways in which trends affect institutions differently across global settings. Where possible, we've tried to account for that variability, though the reader will certainly bring additional experiences and contexts that would further broaden those considerations.

Social Trends

Teaching and learning is a human endeavor, conducted by people for the benefit of others. As such, global trends taking shape across societies and within communities—trends reflecting who we are and what we experience as persons, both individually and collectively—inevitably make their way into educational decisions and practices.

Well-Being and Mental Health

Impacts: Well-being and mental health initiatives at colleges and universities, including emerging technology and application solutions, need to support the increasing numbers of students who report experiencing



KELLY KNOX/STOCKSY



anxiety, depression, and related concerns. Faculty and administrators will need to navigate more frequent encounters with students seeking well-being and mental health help, since students who do not have effective intervention services or treatment available to them will likely be less successful in academic and social activities.

Evidence: The META app—an online platform focused on connecting students with therapists for video or phone therapy sessions—launches and provides a simple, fast counseling tool for college and university students. Institutions in New Zealand and parts of Australia are using the Ripple app from the Australian Childhood Trauma Group. The app focuses on students’ feelings and eating and sleeping patterns.

Demographic Changes

Impacts: Ongoing shifts in the demographics of global populations, including migration trends and patterns, are leading to a new outlook on how higher education must serve students in the future. Increasing numbers of nontraditional students and changes in the concept of the “typical” student will continue to force institutions to consider alternative approaches to higher education (e.g., campus housing programs and models, online education). Reflecting student migration patterns, international enrollments will continue to rise, such as with US student enrollments at Canadian institutions and Chinese student enrollments at Australian institutions.

Evidence: The fertility decline that many industrial nations around the world are experiencing suggests a new era in higher education, an era of at least a decade in which the number of students in each year’s prospective student pool is smaller than the last. The share of US Millennial women with a bachelor’s degree is higher than that of US Millennial men, a reversal from the Baby Boomers and the Silent Generation.

Equity and Fair Practices

Impacts: Equity and diversity goals and agendas are increasingly prevalent in higher education. In some instances, institutional performance goals related to equity of completion outcomes are tied to funding. Professional development among faculty, staff, and administrators can influence the ways in which curriculum is structured, pedagogy is delivered (e.g., culturally responsive), and service and support are rendered to students and the community.

Evidence: Last year Harvard University became embroiled in controversy over its race-conscious admissions policies. And in April 2019, a Pew study found that US college and university students are twice as likely as faculty to be black and four times as likely to be Hispanic.

Technological Trends

The educational experiences of instructors and learners are always scaffolded and enhanced by systems and tools, whether a paper gradebook and abacus or an online discussion forum and virtual reality lab. Those educational systems and tools often reflect wider technological advances taking hold in other industries and sectors of society, at the same time introducing both promise and risk for global higher education.

Artificial Intelligence

Impacts: Artificial intelligence (AI) is already being used as part of educational services and as part of curriculum design. Increasingly it will be used by human instructors for providing feedback on student work and for helping with other “virtual teaching assistant” applications. It may also have applications for refining language translation and for improving access for students with visual or hearing impairments.

Evidence: Amazon has introduced the Alexa Education Skill API. A public-school district in North Carolina is using Microsoft Translator to improve language options for both parents and students.

Next-Generation Digital Learning Environment

Impacts: The next generation digital learning environment (NGDLE) is creating a transformational shift in how institutions architect their learning ecosystems for learners and instructors. Institutions are increasingly requiring support of open standards in educational technology applications, which enable institutions to offer a more flexible learning experience to more students, both synchronously and asynchronously. The agility provided by such an architecture can afford learners and instructors alike the opportunity to “think outside the box” and reconceptualize their approaches to education.

Evidence: Use of the IMS Global LTI (Learning Tools Interoperability) standard is becoming widespread. The University of Wisconsin has adopted Blackboard Collaborate Ultra as its total learning architecture (TLA) in tandem with the Canvas LMS.

Analytics and Privacy Questions

Impacts: Higher education institutions continue to invest billions of dollars in analytics capabilities, and cost-benefit implications for student privacy will become an increasingly important consideration. Institutions will need to be more proactive in protecting student and employee data and must make careful decisions around partnerships and data exchanges with other organizations, vendors, and governments. Institutional relationships with technologies—and with platforms such as Facebook and Google—should reflect larger cultural preferences and tolerances for privacy.

Evidence: The European Union implemented the General Data Protection Regulation (GDPR) in 2018. China is launching a “social credit” system. Google estimates that its Google Apps for Education (GAFE) will reach 110 million users by 2020.

Economic Trends

Institutions of higher education are both products of and contributors to the economies, environments, and industries that compose the global landscape. In an increasingly connected, open, and scrutinizing world, institutions are expected to be wise and judicious stewards of the resources that enable them to exist and operate. They are also expected to contribute something of value to the larger world and to effectively generate the knowledge and skills that people need to work and live—all at a reasonable cost. Absent this perceived value, institutions of higher education in many countries will likely continue to see declines in funding from supporting governments and industries.

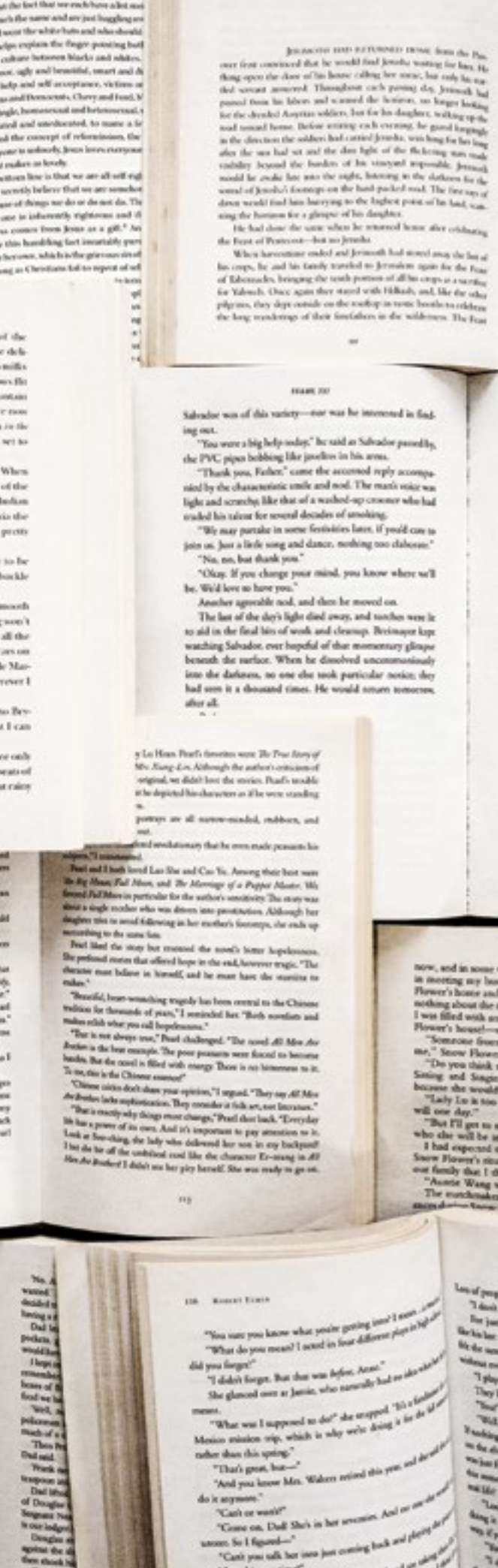
Cost of Higher Education

Impacts: The growth of the private education sector in countries such as Egypt, Germany, and France will see global levels of student debt continue to rise and will establish more “elite” forms of higher education. The rising cost of tuition, combined with decreased funding from public and other sources, will expand the US student debt crisis and lead to multiple long-term economic effects. Students’ independence in adulthood (e.g., purchasing a home, having children, contributing to the economy) will be impacted. Institutions need to demonstrate their value and/or adjust to economic realities with new business/funding models.

Evidence: The US Congress is seeking to pass the Employer Participation in Repayment Act, expanding

The educational experiences of instructors and learners are always scaffolded and enhanced by systems and tools, whether a paper gradebook and abacus or an online discussion forum and virtual reality lab.





employers' assistance with employee student debt. Institutional adoption of open educational resources (OER) continues to steadily rise.

Future of Work and Skills

Impacts: In order to stay relevant and sustainable, institutions will need to adjust their courses, curriculum, and degree programs to meet learners' needs, as well as the demands of new industries and an evolving workforce (e.g., automation, digital literacy, gig economy). Demand for lifelong learning and skills renewal will also increase. Industries will seek to partner with organizations outside institutions of traditional higher education for skills development and workforce recruitment.

Evidence: The World Economic Forum predicts that at least 133 million new jobs will be generated globally by 2022 as a result of the new division of labor between humans, machines, and algorithms. In the fall of 2019, Sheffield College in the United Kingdom opened the Liberty Steel Female Engineering Academy to address the disproportionate engineering skills gap among women.

Climate Change

Impacts: Sustainable living and learning will become a higher priority for higher education institutions as we continue to learn about the effects of climate change and explore strategies for mitigating those effects. More institutions will focus on online learning as a sustainable educational model as students and faculty become less willing or able to commute. Extreme global weather events and droughts will impact students' well-being and educational attainment, particularly in rural and/or under-resourced communities.

Evidence: A global group of colleges and universities is committing to becoming carbon-neutral by 2030. Institutions in California (e.g., UC Berkeley) are sometimes forced to operate on limited power due to widespread power outages, resulting in lost instruction days.

Higher Education Trends

Notions of what higher education should be, of what its ultimate purpose or goals should be, and of whom it is intended to serve seem to be constantly in flux in response to larger trends and shifts in human thinking and social, political, and economic relationships. Future models of higher education, as well as future

practices in teaching and learning, will need to adapt to these trends and fundamentally rethink what higher education is.

Changes in Student Population

Impacts: Global fertility rates have decreased 50 percent since 1960, potentially leading to fewer students and presenting fiscal challenges, especially for smaller and tuition-dependent institutions. Increased student diversity (in age, ethnicity, and other factors) requires institutional leaders to rethink how to achieve their teaching and learning missions and will demand a new emphasis on holistic student success.

Evidence: It has been predicted that US college enrollments will drop by as much as 10 percent by the late 2020s. Minority students today account for roughly half of all high school graduates in the United States.

Alternative Pathways to Education

Impacts: Institutions must rethink their degree pathways to accommodate a changing student demographic and employment landscape. Alternatives include

nano- and micro-degrees, competency-based programs, expanded online options, and portable and standards-based credentials, as well as increased collaboration and partnerships with other institutions. Advising programs will utilize integrated platforms and data.

Evidence: Southern New Hampshire University (SNHU) now awards college credit for Salesforce skills. Through aggregators such as EdX, institutions are offering an increasing number of low-cost master's degree programs.

Online Education

Impacts: Online education is increasingly seen as a scalable means to provide courses to an increasingly nontraditional student population. Faculty must be prepared to teach in online, blended, and face-to-face modes. Higher education institutions are moving to new models for online programs, such as assessment (competency) and crediting (microcredentials and digital badging). Institutions will increasingly engage with online program managers (OPMs) to jumpstart online programs.

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Evidence: California's Online Community College initiative gives students access to courses across its community college system. In Canada, fully online student enrollments have been increasing by roughly 10 percent annually over the past five years.

Political Trends

Across the world and within our own communities and homes, we seem to be living through a period of significant political transformation and are experiencing political divisiveness at unprecedented levels. As these political trends continue to take shape, they will undoubtedly have a lasting impact on models and practices of higher education teaching and learning. From policy agendas and legislative battles that target educational standards and funding, to the political discourses that are taking place on the ground at campuses and in classrooms, higher education will continue to influence and be a product of the political world around it.

Decrease in Higher Education Funding

Impacts: As public funding for higher education continues to decrease in the United States, institutions must pursue alternative business and funding models to sustain operations. Alternative approaches may include privatization of the industry, micro-credentialing, establishing partnerships with other industries or organizations, and other more sustainable models. Meanwhile, teaching, learning, and research practices will be increasingly driven by opportunities to secure funding.

Evidence: The University of Alaska budget was cut by 41 percent in 2019. Continued federal funding for Historically Black Colleges and Universities (HBCUs) and other Minority-Serving Institutions (MSIs) continues to be hotly contested in the US Congress.

Value of Higher Education

Impacts: A majority of adults in the United States believe the higher education industry is headed in the wrong direction, due either to the increasing cost of higher education or to the perceived social or political bent of higher education. Millennials tend to believe in the value of higher education, though they express concern over the cost. As overall enrollments continue to decline, institutions will be forced to identify alternative education or business models.

Evidence: In the 2018–19 academic year, college/university enrollments in the United States declined for

the eighth consecutive year, decreasing 1.7 percent in the spring of 2019 compared with the previous spring.

Political Polarization

Impacts: In some instances, heightening tensions between political worldviews have been leading to increasingly heated debates on campuses and, in other cases, to self-censorship among faculty and students who feel uncomfortable speaking up on potentially divisive issues. In the United States, legislation that could impact and benefit higher education will become more difficult to pass through an intensely polarized Congress and entrenched political positions.

Evidence: The Wisconsin Legislature has proposed new free-speech guidelines for the University of Wisconsin system focused on protecting the “expressive rights of others.” In 2017 Georgetown University launched its Free Speech Tracker to monitor threats to political, social, and intellectual expression.

Conclusion

We hope the 2020 *EDUCAUSE Horizon Report* will enable you to learn, plan, and act. In the months after its release, community members will no doubt talk and write about how it differs from the *Horizon Report* in previous years. While that lens on the past is interesting, we care more about looking ahead: how does the new *Horizon Report* help you today as you think about what tomorrow will bring? Let us know. We will be listening. And learning from you. ■

Notes

EDUCAUSE Horizon Report is a trademark of EDUCAUSE.

1. See John O'Brien, “Back to the Future of EdTech: A Meditation,” *EDUCAUSE Review* 52, no. 2 (March/April 2017).
2. This observation seems to be part of technologists' collective consciousness; it has been attributed to many people, from Arthur C. Clarke to Bill Gates, but its actual origin remains elusive. See “People Tend to Overestimate,” *Quote Investigator* (website), January 3, 2019.
3. For two opinions about the value of the *Horizon Report's* predictions, see Audrey Watters, “The 100 Worst Ed-Tech Debacles of the Decade,” *Hack Education* (blog), December 31, 2019, and Stephen Downes, “Horizon Report Preview 2019,” *Stephen Downes* (website), February 28, 2019.

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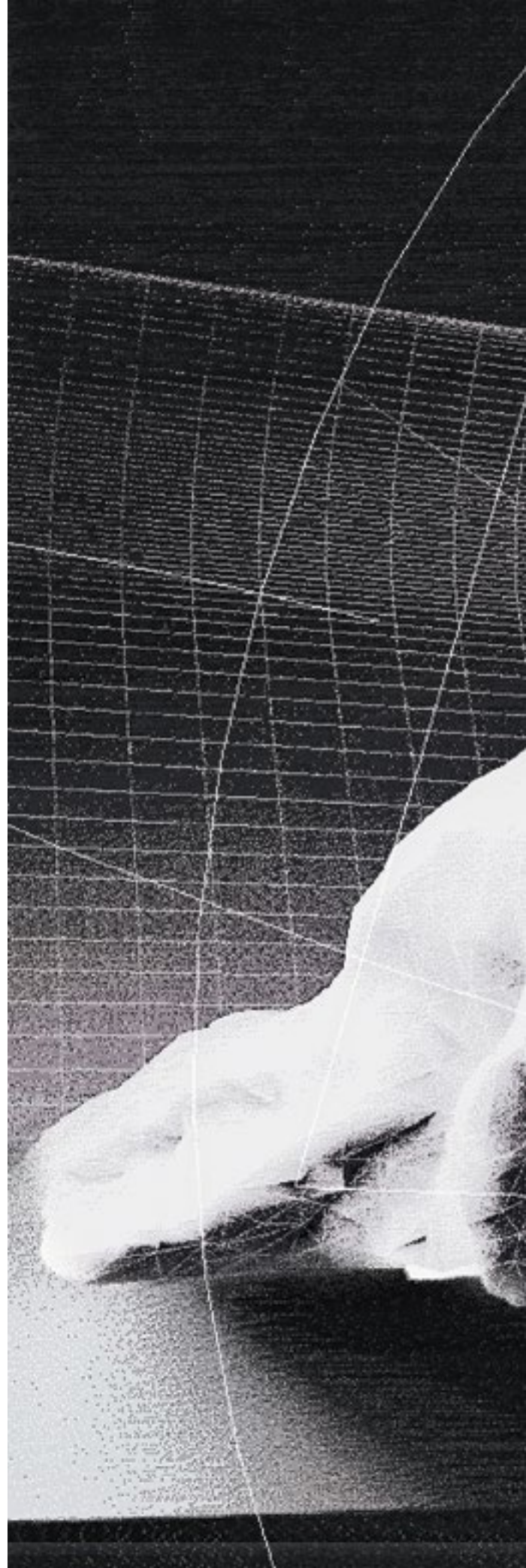
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THE CIO AGENDA FOR A DECADE OF CONVERGING CURVES (PLUS CLIFFS AND CLOUDS)

By Brad Wheeler

Illustrations by John Karborn





The decade that began on January 1, 2020, signals the convergence of clear and foreseeable contextual, economic, and technological trends that will affect each of the 4,298 colleges and universities that compose the US higher education industry.¹

The effects of these trends—both in terms of bold new opportunities and in terms of potential existential challenges—will differ among types of institutions and within types, yet all will be affected in some way.

For those of us in higher education information technology, these trends should spur a broad rethinking of institutional approaches for, and uses of, technology in what will very likely be an increasingly competitive decade. This is an opportunity to advance innovation in what we do, and to realign some of how we do it, if we are to best enable, protect, and extend the noble mission of education, research, and service that has long defined the purpose of the academy.

Trends as Converging Curves

The trends include contextual, economic, and technological shifts that manifest in nonlinear ways as accelerating or decelerating curves when graphed over time. Some curves put pressure on institutional leaders to react; other curves severely constrain the range of possible actions. Some curves have already been widely discussed; other curves have received limited attention. At least ten curves are converging in ways that will present opportunities, pressures, and constraints in relatively short periods of time.

Contextual

1. *Evolving Demands for the Institutional Mission.* Colleges and universities are navigating shifting public, governmental, student, and parent perceptions regarding the purpose and role of higher education. Should higher education focus more on skills for a first job or more on a broader education for an evolving career? For public institutions, many states are emphasizing higher education as a means of workforce development while states compete to attract and retain employers.² States are also increasing the use of performance-based funding models that tie funding to graduation rates, degrees in certain STEM disciplines, and gainful employment indicators. Likewise, public funding increases often are not going directly to institutions; rather, tuition assistance is being made available through institutions to students from lower-income households for use at any in-state institution. This further empowers students as shoppers in a competitive market.
2. *Diminishing Public Trust.* Overall, we are seeing a decline in the public's trust in many types of institutions—not only higher education but also religion, government, law enforcement, and some social organizations.³ Notable factors for this decline regarding higher education include the 2019 “Varsity Blues” admissions scandal, perceptions that the price of higher education is outpacing its value, burgeoning student debt, increased social unrest on campus, lowered opinions of the relevance of the curriculum, and the view that students are being coddled as “snowflakes.”⁴
3. *Shifting Student Demographics.* Nathan D. Grawe's widely referenced book *Demographics and the Demand for Higher Education* (2018) aptly illustrates how we will see a large decline in the number of 18-year-olds later in this decade due to fewer children being born during the last major recession—the result of what the economic forecaster Harry Dent has dubbed “the demographic cliff.”⁵ Grawe's work also outlines how these

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shifts in “traditional” students (those ages 18 to 21) will vary by regions of the country and will have varied effects on different types of institutions. Likewise, the number of international undergraduate students in US institutions declined in 2019 for the first time in twelve years, and international graduate student enrollment fell for the second year in a row.⁶ Counter to these trends, there are accelerating opportunities with nontraditional students who seek educational experiences other than residential, four-year undergraduate degrees.

Economic

4. *Accelerating Discounting.* The growth in discounting—the gap between published tuition prices and actual revenue received (“net tuition”) via *internally funded* scholarships—favorably reduces the cost of attendance for some students. Yet the practice has the doubly insidious effect that higher published prices fuel negative public perceptions of rising costs to students whereas in reality, discounting reduces the net tuition available to fund the internal work of teaching and student services.⁷
5. *Changing Financial Outlook.* In 2018, Moody's Investor Service downgraded the higher education sector to “negative outlook” for financial stability. Analysts cited factors such as costs growing faster than revenue, discounting, and shifting demographics.⁸ In late 2019, Moody's raised its outlook to “stable” but with many caveats that drew distinctions regarding the likely effects of the curves on varied types of institutions. S&P Global Ratings again reported a negative outlook for the third consecutive year.⁹ These ratings could mean higher interest and operational costs for those institutions that borrow to finance construction or other large initiatives. Thus, many colleges and universities are increasingly turning to public-private partnerships to outsource and thus avoid using their own capital.¹⁰
6. *Expanding Substitutes.* Coding camps, corporate training, and degrees from





mega online institutions are offering learners in every location more alternatives for acquiring an education and developing job skills.¹¹ These increasingly convenient forms of education extend new opportunities for nontraditional students who benefit from a favorable price and a shorter time to completion. Some employers are developing direct, employer-paid education benefits for these services.

Technological

7. *Growing Cloud Subscriptions.* Software-as-a-Service (SaaS) and Infrastructure-as-a-Service (IaaS) continue to add to recurring costs every year. Collectively, these rent-your-own computing services can represent a faster pace to a solution, but as a bundled software, hardware, and maintenance solution, they can also increase the risk of longer-term supplier lock-in if pricing or service goes awry. The relative ease of acquiring cloud services has also unleashed a proliferation of student, faculty, and departmental subscriptions; greater institutional data fragmentation among bundled providers; service duplication; and higher switching costs among suppliers. Annual price increases that outpace inflation are already rampant, and many of the advanced uses of machine learning and artificial intelligence will increasingly be bundled in these subscription services.

8. *Rising Expectations for Constituents' Journeys.* Colleges and universities are playing catch-up with consumers' internet-optimized customer experiences. Students, faculty, staff, parents, and alumni—collectively, higher education's "constituents"—often encounter fragmented campus services based on a functional specialization by department (e.g., Admissions, Registrar, Bursar, Housing, Advising, Alumni) rather than services that are designed for constituents.¹² Higher education leaders need to rethink how our institutions are organized in order to

modernize constituents' journeys that achieve desirable outcomes.¹³

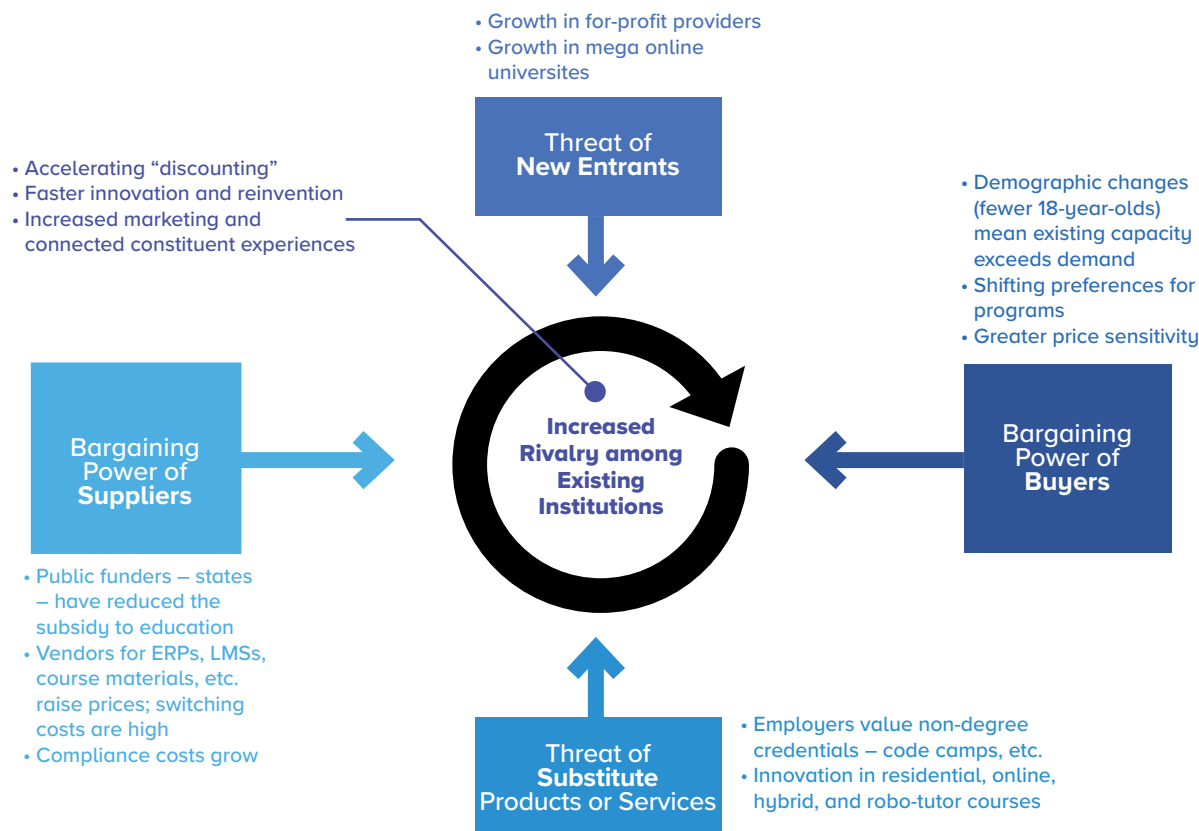
9. *Atrophying Staff Skills.* The acceleration of cloud-based IT services and optimized constituent journeys reveals a skills gap for many institutions. A wave of Baby Boomer retirements will accelerate the need to both replace and reskill the IT workforce in cloud-based systems that have a greater reliance on configuration and integration through APIs. Conversely, some systems are likely to remain on-premises or even expand, and local skills to evolve and integrate those types of systems may become rarer.

10. *Escalating Cyber Risks and Privacy Regulation.* There is no foreseeable end to the escalating cyber risks and evolving digital privacy expectations that colleges and universities must address.¹⁴ The increased automation of attacks, ransomware, and even assaults by possible state actors already require growing investments in and recurring costs for mitigation efforts including cybersecurity, policy, audit, privacy practices, and cyber resilience.¹⁵

As those of us in higher education confront these curves, our institutional instincts are to methodically diagnose and react to each of these trends in compartmentalized ways—for example, those in the Admissions Office study changes in student demand and discounting, the CFO worries about overall costs to trim budgets, the CIO investigates trends in vendor software platforms or technical cybersecurity. Committee members spend months or years assessing which varied incremental options may work best as each trend begins to manifest as a problem. The convergence of the curves, however, presents a new kind of challenge to these instincts. It requires bolder, faster, more integrated, and more holistic leadership actions in shorter periods of time. Why?

■ *Competition for targeted students will continue to increase very quickly as the supply of higher education (i.e.,*

Figure 1. Porter's Five Forces Model Applied to Higher Education



Source: Adapted from Michael E. Porter, "How Competitive Forces Shape Strategy," *Harvard Business Review* (March 1979).

capacity in seats and enrollments) grows while the demand for higher education (i.e., from traditional students) begins to diminish for some institutions. Aggressive discounting and larger marketing expenditures will accelerate to prop up enrollment numbers, and each of these trends will further reduce the funds available for the institutional mission. Across higher education, innovation in programs and experiences will give students—both traditional and nontraditional—more options to shop residential, blended, and online programs for the best match to their interests in perceived quality, reputation, and net price.

- *The capital budget for making major investments will be further strained* as institutions face a competing set of urgent investments. These will include (a) modernized or new facilities to appeal for both faculty and student recruiting; (b) innova-

tive educational offerings for new courses, certificates, and degrees; (c) brand-building marketing campaigns; and (d) major IT system replacement efforts or process reengineering. Downgraded credit ratings for some colleges and universities will make borrowing more expensive and will add recurring costs to already strained operating budgets.

- *The operating budget will be further squeezed through converging curves* as they limit institutional abilities to raise prices, compress net tuition, and accelerate costs in personnel, compliance, and technology. Previous reliance on one-time funding sources (including grants and philanthropy) may fail to meet the increased ongoing financial needs.

The work required to respond to these interrelated and converging curves takes time. In many cases, the desired effects of

even very bold actions may not materialize for years.

The "Five Forces" View of Higher Education

One very useful framework for illustrating how multiple forces and trends converge to affect an industry, such as higher education, is Michael Porter's Five Forces Model.¹⁶ In short, weaker forces enable institutions to easily generate more revenue than their real costs over time. Stronger forces make this difficult or impossible unless institutions achieve a major change in their ability to generate revenue or to operate more efficiently—often much, much more efficiently. Figure 1 shows an adapted version of Porter's model for higher education.

For some institutions, these forces reveal vast opportunities that are consistent with their mission to expand their educational and research offerings to increase revenue while concurrently achieving greater efficiency in costs. If executed well, that approach can have quite favorable results,

and the larger public universities with strong brands are well positioned to do this. For other institutions, higher cost operations relative to an ability to garner revenue from any source may put their very existence as an independent institution at risk. Robert Witt and Kevin Coyne recently observed: “For the vast majority of private nonprofit colleges, the only route to survival—in any form—will be through the college’s own internal actions to improve its value and efficiency. Those who fail this test will not merge into another institution—they will simply cease to exist.”¹⁷

Likewise, Grawe also advocated for an urgency of leadership action ahead of these curves: “The challenges facing higher education are multiple, and most of them will be made more difficult as prospective-student pools shrink in the next decade. Before the brunt of the birth dearth is upon us, now is the time to address the cracks already visible in our practices and financial models. By attending to non-demographic threats, we may just find that the demographic stresses are reduced.”¹⁸

As we consider the convergence of these curves and their potential effects, it may feel jarring to view the noble mission of higher education through the economic crassness of a competitive industry. Yet the economic forces that are now converging were unleashed more than a decade ago when the financing of higher education shifted from a historically subsidized public good to an increasingly private good with the attendant behaviors of a marketplace.¹⁹

The CIO’s Agenda

These converging curves present opportunities for CIOs and their partners to help reshape their institutions for the decade ahead. In response to increased competition, the change agenda for almost all institutions will be to grow revenue, reduce costs, or both, and each of these actions is highly reliant on improved IT-enabled capabilities. For many CIOs, their institutions need them to work as change agents who assertively reach across the campus to help lead rapid transformation.

The “Proactive with Purpose” Agenda

CIOs who have already established deeper trust and credibility with other campus leaders and important committees have a great opportunity to draw on that trust to drive a “Proactive with Purpose” agenda. This includes three sequenced initiatives:

1. *Aggressively integrate data, and transform it into information for decision support.* Decision makers at all levels need more integrated views of disparate institutional data that is presented in the form of actionable insights. These insights can help make the case for institutional change and improve allocation of scarce resources.²⁰ Many institutions are awash in data in insulated repositories and reports, yet drawing meaning from that data as contextualized information with internal and external trends is often highly laborious, if not impossible. Departmental views that were often created for narrow managerial purposes are an inadequate basis for strategic decision support to plan for and address the converging curves. CIO leadership can rapidly improve the quality of information.²¹
2. *Clarify and accelerate the pace of IT governance and funding simplification.* Leaders at many institutions may have the information and may know what to do, but the IT governance processes regarding who has input rights and who has decision rights for recurring IT decisions may be unclear, bureaucratic, or dysfunctional.²² As the need for IT services has evolved over forty years, most institutions need to realign the flow of IT funding to better match the services that should be efficiently funded and operated as common-good services for everyone, or institutions need to decide which services will benefit from the additional overhead costs of charge-back models to ration use or allocate precise costs. In short, IT governance with broad input rights in the form of deep relationships across an institution and very narrow decision rights as responsibilities of the CIO and

As we consider the convergence of these curves and their potential effects, it may feel jarring to view the noble mission of higher education through the economic crassness of a competitive industry.

a few other leaders is best suited to the hastening pace of the decade ahead.

3. *Adapt business processes to dramatically improve constituents' journeys and operational efficiency for a future-ready mindset.* The view of the CIO spans many departments. The CIO is uniquely positioned to help lead both improved journeys for constituents and essential operational efficiency. To be effective change agents, CIOs will need to broaden and deepen their understanding of how process improvements can contribute to effectiveness and efficiency. This work spans areas including brand building, marketing, student recruitment, student success, faculty and staff human resources processes, finance, procurement, compliance, alumni engagement. In a 2017 research brief, Peter Weill and Stephanie L. Woerner illustrate the paths that institutions can take to evolve from the traditional "Silos and Spaghetti" quadrant to the

"Future-Ready" quadrant. They also outline the problems that arise when either an efficiency or a constituent-facing effectiveness agenda is pursued in isolation.²³ The greatest efficacy over time is through a concurrent, incremental plan that targets both improving operational efficiency and reengineering constituent-facing experiences (see figure 2).

The "Reactive Reality" Agenda

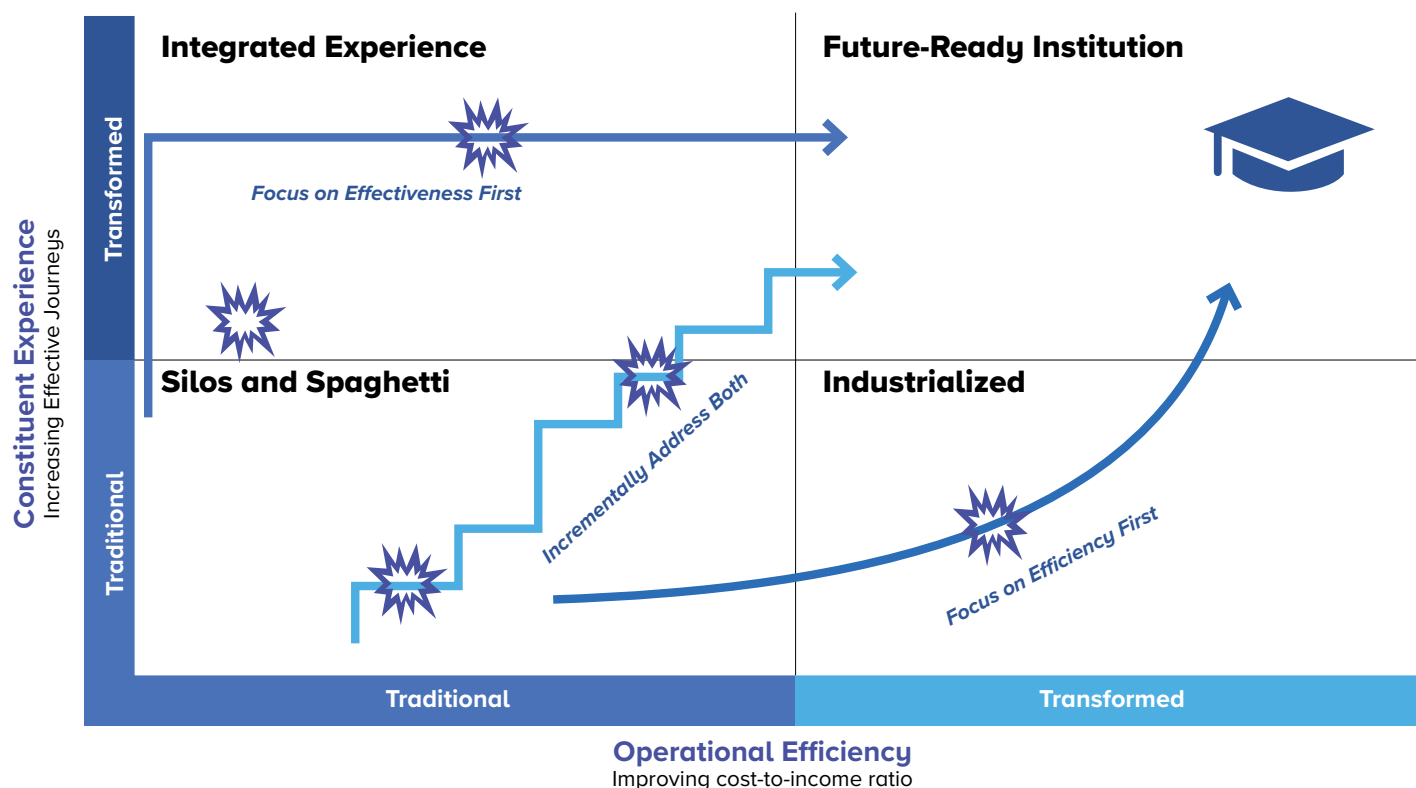
All CIOs find limits in some areas of their institution. Culture, resources, or personality factors may be the cause, but the reality is that the range of possible CIO actions is very constrained. For these situations, CIOs need a "Reactive Reality" agenda, in which narrower, achievable actions can still contribute to navigating the curves:

1. *Work through others who are leading change initiatives.* When the breadth of the CIO's vision across an institution cannot be translated into direct institutional

action, the best step is to work with and through others who are leading changes. Assess if there are opportunities to make those efforts achieve more than their initial plans for both efficiency and constituents' experiences.

2. *Stop or slow the proliferation of duplicate systems and data fragmentation.* When an institution's weak IT governance approach to systems and processes proliferates duplication and data fragmentation, CIOs can sometimes slow or stop that compounding dysfunction. Tactics include focusing greater attention on already selected and deployed solutions, rallying varied groups to ally and align on a direction, and working with the Procurement Office to invoke a CIO approval step for cloud-service contracts.
3. *Know the costs for central IT services and the IT costs for the institution as a whole.* Knowing the full costs of IT services helps the CIO make wiser decisions for in- or outsourcing and for opportunities

Figure 2. Pathways to a Future-Ready Institution



Source: Adapted from Peter Weill and Stephanie L. Woerner, "Future Ready? Pick Your Pathway for Digital Business Transformation," MIT CISR Research Briefing 17, no. 9 (September 2017).

to consolidate for efficiency. Lightweight, activity-based costing exercises for central IT services can yield a world of insight to get beyond political squabbles. Don't avoid these foundational efforts due to the size of the undertaking; start with basic measures, and enhance them over time to provide insights for campus budgetary discussions. Likewise, work with the Finance and Human Resources Offices to appropriately code other IT costs across the institution to reveal full IT spending. Some institutions may be underinvesting in information technology relative to the opportunities of the converging curves whereas others may be spending too much or inefficiently.

4. *Steer cost-cutting exercises toward improving processes.* As budgets tighten, reach out to partners to improve a process or constituent journey even if the immediate pressure is only for trimming budgets. Initial process-improvement goals are often modestly incremental in their aspiration, but CIOs can press for increased automation to reduce costs through disintermediation of entire processes that are no longer valuable.
5. *Seek a better deal through economies of scale.* The efficiencies in real economies of scale occur when aggregating highly common units of some system or service. Larger institutions can often achieve efficiencies through internal aggregation, and smaller institutions may seek to do so through partnerships. There are no economies of scale in the attempted aggregation of dissimilar units, so standardizing processes and configurations is often an important antecedent to seeking real efficiencies.

All Agendas

All agendas must include an accelerated institutional shift to a cyber-resilient mindset that goes beyond our historically successful approaches to cybersecurity. The unending risks of vulnerable technology, human error, and increasingly sophisticated nefarious actors all over the world mean



that institutions of all kinds face potentially debilitating risks at an unprecedented pace and scale. Cyber-resilience means getting all of the basics right in technology practices, policy, and behavior and also being able to continue operating during a major cyber event.²⁴ For many institutions, cyber risks have remained systemically unaddressed; mitigating those risks requires paying new upfront and recurring operational costs in a planned way, rather than a reactionary way to a major incident. Likewise, the troves of institutional data being gathered via numerous sources—from Wi-Fi logs to emerging tracking apps—will require new policies and compliance as privacy concerns grow in the societal and legal domains.²⁵

Questions for Institutional Leaders and Boards

The efficacy of any CIO agenda to help navigate the decade ahead can be increased

or impeded by the actions of other institutional leaders and also governing boards. These groups should assess if an institution's IT structure and strategy are best positioned to help achieve institutional goals. Many colleges and universities enter the decade with a baseline of inflexible legacy software systems and processes that are departmentally optimized rather than constituent-journey optimized—the “Silos and Spaghetti” quadrant of figure 2. They face mounting cyber risks and a growing operational budget for critical IT services, without an aspirational goal that targets a strategic purpose. As noted by Weill and Woerner, the path to future-ready institutions is not easy. Also difficult to achieve is cultural change in the operations of institutions as they seek to innovate in academic programs, find new delivery methods for both residential and online components, and grow research efforts (for research

institutions). In most cases, the lead time for substantial change is one to three years.

Boards and campus leaders should work with their CIO—and with the aid of consultants when necessary—to ask and answer the following questions:

- Are our choices for information technology—including its costs and efficacy—aligned with the institutional strategy and needs for the next five years?
- Do we have a clear understanding of our total IT footprint for the institution, encompassing all schools and departments, in terms of costs and risks?
- How did our IT spending change over the last decade and over the most recent five years, what did we learn, and what do we wish we might have done differently?
- Do we have the right IT roles and leadership for the decade ahead?
- Do we have sufficient scale in our IT systems to operate at efficient costs?

Many of the changes for the decade ahead require navigating institutional politics, authority, and change-tolerance culture. Each of these may require exceptional support from board members and campus leaders if urgency is required.

All institutional leaders should also assess where the curves provide new opportunities. Colleges and universities may have prime opportunities to grow in some or all aspects of their educational offerings, being constrained only by the pace at which they can add internal capacity in faculty, housing, and services. Other institutions may see niche areas where their excellence can help command strong interest from students and also low discounting. Still others may find opportunities for cost efficiencies through internal consolidation or even multi-institutional mergers.²⁶

“Act Decisively”

Depending on one’s point of view, colleges and universities have proven to be either remarkably adaptive to changes over the centuries or stubbornly recalcitrant to

adapt. The longevity of colleges and universities affirms that institutions have been adaptive, yet the decade ahead portends the challenge of converging curves that will test the faculty, administrative leaders, and governing boards in unprecedented ways. Some institutions will grow, some will merge, and others will exit.

Grawe adds a timely insight for the early years ahead: “In a recent conversation about potential threats to higher education, W. Joseph King, president of Lyon College and an author of *How to Run a College*, made an astute observation about today’s environment. When you see the lowest birthrate ever recorded, he said, the challenges of demographic change are simply a reality that all colleges are going to need to face. ‘But,’ he added, ‘it’s not just the demographics.’ In other words, as important as demographic forces will be in coming years, colleges must act decisively to control the many things that are within their power.”²⁷

The role of the CIO as an essential leader and partner has never been more important or more urgent as institutions adapt to the converging curves. Effective uses of information technology will be part of almost every action, and opportunities abound to help higher education institutions recruit and retain students, operate more efficiently, and innovate in our core mission of education and research. ■

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The Connection Business



By Luke Fernandez
and Susan J. Matt

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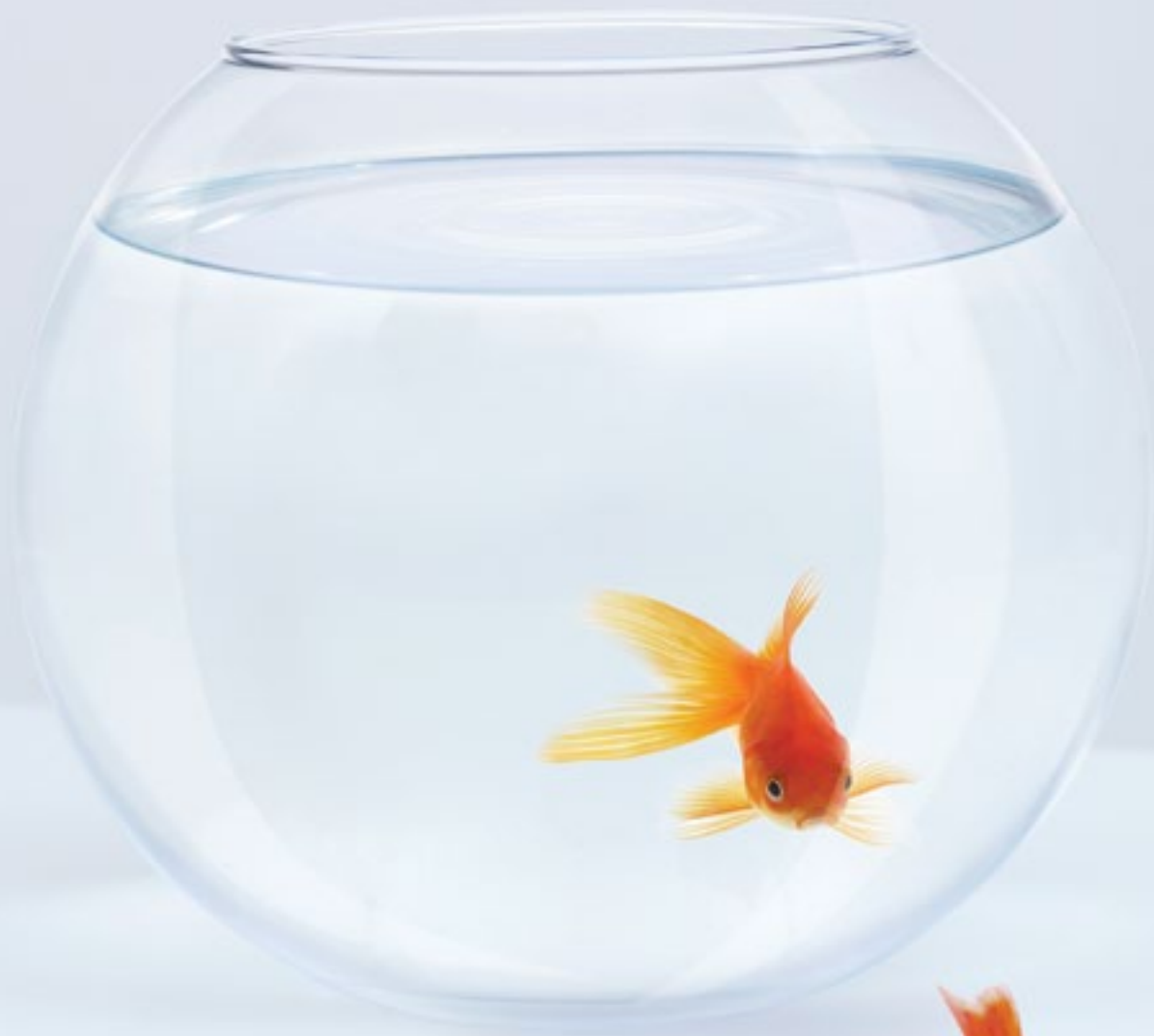
early a decade ago, in August 2010, a post appeared on the EDUCAUSE CIO Constituent Group listserv titled “Classroom Internet ‘Kill Switch.’” The writer had been asked by faculty whether there might be a way to equip classrooms with a device that would allow them to disable wireless access to the internet. With such a switch, professors would no longer have to police students who had become distracted by Facebook, online games, and other entertainments. The query was, for the most part, dismissed by those who responded on the listserv. They noted that the goal of technology is to *connect* people, not to disconnect. If students were distracted, the fault wasn’t due to the technology so much as to the instructors.

We were puzzled by the reaction to the initial post. Giving faculty the option to turn classrooms into Faraday cages that would block off the internet seemed (to us) like a good idea.¹ After all, back in 1845 Henry David Thoreau had done something similar. Tired of the hustle and bustle of his family’s pencil-manufacturing business, Thoreau built a small one-room cabin on the side of Walden Pond and lived there for more than two years. Having removed himself from the distractions of everyday life, he was able to write and philosophize; his time away allowed him to begin work on essays and books like “Civil Disobedience” and *Walden*, which have become centerpieces in the American literary canon.

If it was good for Thoreau, why shouldn’t we extend a bit of that privileged remove to today’s students? Wouldn’t spending a little time off the proverbial grid be helpful? We wondered why disconnection was no longer seen as a virtue. What historical events might explain the change? And was there anything in Thoreau’s technological asceticism worth recovering?

These questions ultimately impelled us to research and write *Bored, Lonely, Angry, Stupid: Changing Feelings about Technology, from the Telegraph to Twitter* (2019).² As we discovered, people’s attitudes about technology and disconnection have changed dramatically. Today, we have far less tolerance for boredom and empty moments than did earlier generations. We regard and manage attention differently. Many of us can no longer abide being alone. These changes are creating a new sense of self in the 21st century. Many today regard their emotions and desires as timeless and natural. And many justify their technological choices by suggesting that those choices serve innate psychological needs such as alleviating boredom and loneliness. But it turns out that these needs and emotions are much more contingent than we often realize. We change. Our feelings change. And as we change, so too does our understanding of which technologies are best able to cater to our shifting needs and desires.





For instance, consider the experience of having nothing “exciting” to do. Today, we might think of ourselves as bored and try to end the feeling as soon as possible. Certainly our students seem eager to avoid boredom, turning to their phones whenever an empty moment presents itself. Constant connectivity allows them to do so. This is a departure from the past: in the 19th-century, Americans did not necessarily expect that everything would be exciting or that every moment would be full of sensory stimulation. Empty time sometimes hung heavy, but few worried about it. People sometimes described tasks or days as monotonous or tedious, but they were relatively unconcerned about the emotional effects of such dullness. In fact, the word *boredom*—denoting an internal psychological state of understimulation—did not even exist until the mid-nineteenth century. Only after it entered the language did boredom become an inner problem in need of a solution.

Just as earlier generations did not expect constant entertainment and stimulation, neither did they expect constant socializing with hundreds, perhaps thousands, of friends. As the Unitarian minister William Rounseville Alger explained in 1867: “There is more loneliness in life than there is communion. The solitudes of the world out-measure its societies.” Like Thoreau, many people at the time found that being disconnected, alone, and on one’s own brought benefits and opportunities for insight. They often termed this *solitude*. Some even believed that solitude ultimately made one more sociable. Alger, for instance, noted: “One of the most valuable uses of solitude is to prepare us for society. He who studies, when alone, to understand himself, and to improve himself . . . takes the surest means to commend himself to his fellow-men. He employs the best method both for giving and securing pleasure when he shall return from his retirement to mingle with others again.”³

When 19th-century men and women did seek social connection, they typically looked for it with their neighbors, family, and friends. Unlike many of us in the 21st century, they did not believe their loneliness would end by being in touch with strangers from across the nation or the globe. Little wonder, then, that they did not initially see much use for the telegraph or telephone; in fact, many resisted these new devices and looked for the Victorian equivalent to the “kill switch.” For instance, journalists and other observers reported on recurring sabotage to telecommunications systems in the United States. There were numerous accounts of men and women chopping down telegraph and telephone poles and wires, which they considered to be

Today we flee boredom, fear loneliness, and believe our brains are infinitely powerful. Those changes have implications for how we see ourselves. They shape how we train our students and what they expect from life.

noisy, unsightly invaders that brought few benefits. In fact, some believed that telegraph wires might be harmful to both body and spirit. Rumors circulated that the wires transmitted disease and were responsible for the cholera epidemic of 1849. Meanwhile, preachers claimed the telegraph was defying God’s will, since it seemed to give humans supernatural powers of communication. In later years, although most people had embraced both the telegram and the phone call, many remained skeptical that the new wires and poles could “cure” aloneness.

The rise of radio in the 1920s and 1930s sparked similar debates. While cultural critics recognized that radio was popular because it brought entertainment into the home, they suggested that its constant noise diminished individuals’ capacities to sit by themselves in quiet. By 1942, a reporter noted that Americans had become so dependent on the radio that they could no longer accept or appreciate solitude. She wrote: “I’ve nothing against radios. Indeed, I . . . have installed them myself in various parts of my home, including my car.” However, she added: “I am very much against our hysterical need of constant noise and diversion as a means of escape from solitude.” She explained: “Solitude is not a blight nor a nightmare. It is a normal and necessary part of our human experience, and no character can become . . . poised without large amounts of it.”⁴

In the early days of radio, such attitudes were often shared by college and university leaders. The *New York Times* surveyed educators in 1930 about their campus policies toward radios. Yale University leaders discouraged radios on campus, as Clarence Mendell, dean of Yale College, explained: “We have, at Yale, no central radio for broadcasting to the student body, nor do we encourage private sets. I believe that life is already too complicated and noisy for the best results without introducing any further disruptions.” Lieutenant Colonel S. Whipple, of the United States Military Academy, explained that his institution prohibited radios in students’ rooms, believing they were “a hindrance to the concentrated study required.”⁵

This fear that students might be overwhelmed by too much information reflected another key assumption that shaped both higher education and the larger social world. Through the early twentieth century, physicians and psychologists believed that humans had finite storage capacity in their brains and inherent limits on how much information they could take in. In 1881, for example, the neurologist George Beard critiqued the educational system of his day and declared that the brain “is an organ of very feeble capacity. . . . The brain can hold but little.”⁶ He therefore warned



educators against trying to pack too much into their students' heads. Like Beard, other physicians, philosophers, educators, and psychologists filled scientific journals with accounts of students and businessmen suffering from dangerous illnesses that they labeled as cerebral hyperaemia, neurasthenia, and mental fatigue—all the consequence of studying too hard and of using too much brainpower to pay attention to the torrent of information rushing over telegraph wires, railroad tracks, and telephone lines. They believed the brain possessed natural limits that should not be transgressed—for the brain was, after all, a finite organ.

Exceeding these natural limits could have fatal consequences. According to medical experts, excessive brain work caused “the decomposition of brain substance,”⁷ distended blood vessels, intense head pains, fainting, vertigo, even death. Doctors filled scientific journals with accounts of “mental workers” who had collapsed, had strokes, or died after concentrating too hard. The cure was mental rest. Patients must limit the amount of information they took in, retreat from the world of work and thought, and avoid any mental exertion. Even a game of chess might endanger those suffering from mental strain. Humans needed mental recesses, empty moments when they were disconnected from the world of work and excitement.

These views shaped how men and women conceived of themselves and their abilities. They believed there were limits on experience and on themselves.



They did not expect or even want constant connection, unlimited friends, unceasing entertainment, infinite information. Nor did they believe their brains could handle such a deluge. Humans were finite.

These attitudes have changed dramatically. Today we flee boredom, fear loneliness, and believe our brains are infinitely powerful. Those changes have implications for how we see ourselves. They shape how we train our students and what they expect from life. These changes also explain why it is so hard for many today to see disconnection as desirable or even possible.

As noted earlier, one key change was in how people regarded boredom. As labor became more industrialized and a growing number of workers toiled on assembly lines, complaints of boredom multiplied. By the 1930s, psychotherapists suggested that individuals had a right to expect diversion from the world around them. By the 1950s, psychologists were labeling boredom a pathology, and by 1986, they had developed a “boredom proneness scale” to measure the condition.⁸ Whereas people in the 19th century had expected and endured dullness, in the 20th century they came to fear it as a psychological malady and tried to avoid it at all costs.

The invention of laptops, smartphones, podcasts, video games, and social media aided the flight from boredom, as users tried to fill every waking moment with some kind of activity. By 2014, the *Onion*, in its typically satirical style, reported: “Citizens are loudly calling for a device or program capable of keeping

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them captivated as they move their eyes from a computer screen to a smartphone screen, arguing that a new source of video and audio stimulation is vital to alleviating the excruciating boredom that currently accompanies this prolonged transition.”⁹

In our own research, we found that the need for constant entertainment was widespread among the students we interviewed. H., a student at Grinnell College, told us boredom felt “dangerous” to her. She believed that her smartphone, and technology in general, had accustomed her to constant entertainment. As a result, she noted: “Boredom has to immediately be filled in with something. I think that’s a product of technology. Always having something at your fingertips. It’s like, if you’re bored, fix it fast.”

Just as boredom changed, so too did the experience of loneliness. In the 18th and 19th centuries, people regarded loneliness as an expected, though not always pleasurable, part of the human condition. By the 20th century, this view was shifting. Many were coming to see near-constant connection as necessary for a good life and were starting to regard loneliness as a problem. Telecommunications companies helped promote this view, promising that they could eliminate the problem. In 1912, the Nebraska Bell telephone company advertised that a phone “banishes loneliness.” Phonograph and radio companies made similar promises. “Buy an Edison Phonograph and you will never be lonesome,” assured a 1905 ad.

To be disconnected from others risked social stigma. The pressure to connect only increased.

Advertisers were joined by self-help writers who also denigrated aloneness. In the 1930s, success advisors like Dale Carnegie told readers they should worry about being alone and should try to have as many friends as possible. Those who were sociable and outgoing would succeed in life. If they failed, it was a result of their own personalities and their inability to connect in a meaningful—and profitable—way with others. By the mid-20th century, this attitude was so widespread that a new word entered the American language: *loner*. It was a pejorative term, a label for someone who stood outside the bustle of social life, who didn’t try hard enough to be sociable. To be disconnected from others risked social stigma.

The pressure to connect only increased. By the 1970s, the sociologist Robert Weiss had declared that a “loneliness industry” seemed to be both publicizing and profiting from the feeling.¹⁰ An array of psychologists had taken up the study of loneliness, creating new anxieties about social disconnection. They developed a loneliness scale, offered self-help cures to encourage outgoing behavior, and celebrated gregarious sociability as a sign of psychological adjustment. Telecommunications companies also refined their advertising messages during this era, with Bell Telephone encouraging Americans to “reach out and touch someone.”

In the 21st century, technology companies have celebrated connection even further, and loneliness has come to appear all the more worrisome. Facebook



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Co-Founder and CEO Mark Zuckerberg, for instance, has promoted online connection as a “human right,” and Facebook Vice President Andrew Bosworth, has stated: “The ugly truth is that we believe in connecting people so deeply that anything that allows us to connect more people more often is *de facto* good.”¹¹ Whereas people in the 19th century were sometimes ambivalent about being connected, saw its downsides as well as its upsides, and believed sociability should be calibrated, in the 21st century we fear being disconnected even momentarily. Doing so runs afoul of prevailing social norms.

College and university students surely feel this imperative in their own lives, particularly online. In 2014, the Pew Research Center reported that the average number of Facebook friends per adult user was 338 and that the median number was 200. Of users who were ages 18 to 29, 27 percent had more than 500 friends.¹² Alta, a radiology major at Weber State University, told us that she knew people so eager to appear popular that they had “friends on their Facebook that they don’t even know just so that they can have the numbers. . . . I think there’s too much importance on it now.” While she said that she was not obsessed with the number of friends she had, she added that she nevertheless felt the need to be constantly connected: “When I leave the house now and I don’t have my phone, I feel naked. Like, where is it? I have to have it on me at all times. . . . Just because what if someone calls or what if someone texts and I’m not there to respond? I don’t love that feeling but . . . it’s with me all the time. . . . So walking away from it is very nerve-racking.” The fear of missing out on social life and the worry that one doesn’t have enough friends reflect contemporary expectations for constant connection and intolerance of solitude.

That people think they can process dozens (or hundreds) of social media updates, respond to scores of texts, and still manage their homelife is symptomatic of the new view of the brain. Unlike those in the 19th century, who believed that they had to limit the amount of information coming their way because their brains had finite capacity, people in the 21st century believe their brains can handle it all. This faith that they can manage the data deluge drives the multitasking we so often see today.

The early-20th-century philosopher William James played a crucial—if unwitting—role in promoting the idea of infinite brainpower when he declared: “Few men live at their maximum of energy.”¹³ He maintained that with training, people could do more. From this statement emerged the idea that humans were underutilizing their brains and that they might have

Most of the students we interviewed for our research found it difficult to disconnect. Though today that may seem natural, their need to be hyper-connected is actually the result of technological and cultural changes that have reconfigured our sense of self.

excess capacity still to use. James hadn’t quantified how much brainpower people wasted, but others did. In 1936, Lowell Thomas’s preface to Dale Carnegie’s *How to Win Friends and Influence People* claimed that individuals used only 10 percent of their mental power, attributing the idea to James. Carnegie’s book, a “bible” for anyone pursuing success, reassured readers that their minds could do ever more; there were no limits on their abilities or aspirations. This new vision of the power of the brain spread during the twentieth century, and though unfounded,¹⁴ it continues to shape how we conceive of our mental powers—even when they are degraded by distraction. Today many people believe that their brains have untapped capacity and that, with the right apps and drugs, they can take in more information. A 2013 Harris Interactive poll found that 65 percent of those surveyed believe they are using only 10 percent of their brain.¹⁵

When smartphones, laptops, and tablets emerged on the market, they reinforced the belief that it was possible to multitask and seemed to offer a way to use our alleged untapped mental powers. Unlike those in the 19th century, who believed that they should control the amount of information they took in and that they should sometimes disconnect so as not to surpass their natural limits, today we believe that we can absorb it all. Will, a student at Grinnell College, offered a sense of this optimistic attitude: “I have at my desk my laptop screen and . . . a second monitor screen. . . . Whether I am typing up a paper or . . . just relaxing . . . both screens are active at the same time. . . . I’ll have my paper up here, and on the other screen there’ll be like 50 tabs open. . . . All the time, I’m multitasking with the two screens. . . . I have the ability to search a billion things at the same time.” When he wasn’t multitasking, he felt bored, convinced that his brain wasn’t “doing anything.”

Will is not a lone case. Most of the students we interviewed for our research found it difficult to disconnect. Though today that may seem natural, their need to be hyperconnected is actually the result of technological and cultural changes that have reconfigured our sense of self. In the past, many people accepted loneliness, boredom, and limited knowledge as part of the natural order of the world. Today, that acceptance of limits has largely disappeared.

When higher education IT leaders make policy choices about which technology solutions to implement and which to dispense with, we often justify those choices by arguing that they cater to a specific need or desire of our students. We turn the choices into an ergonomic argument: our students have a

particular set of feelings and needs, so we should deploy technologies that fit those needs. But as we have seen, those needs are not completely innate. They have been—and continue to be—reshaped and amplified over many years by cultural forces and business imperatives, including the loneliness industry and the entertainment industry, which have economic incentives to paint empty moments and aloneness in a negative light. When those of us in higher education information technology make policy, let's keep this history in mind. Even though we are in the connection business, perhaps we should reconsider our 19th-century ancestors' thoughts on the virtues of occasional disconnection. ■



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Artificial
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and Human
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in Student
Success

By Linda Baer, Amanda Hagman, and David Kil

Illustrations by Edmon de Haro

Student success, in its various forms, is a top issue in higher education. Over the last decade, colleges and universities have worked to consolidate mountains of data into insights that can empower academic professionals to influence student success. Yet this cannot be accomplished using only human intelligence (HI). To facilitate an impact on student success, many institutions have employed artificial intelligence (AI) to help process and analyze data. AI, embedded in data systems, can allow institutions to better gather high-value data, monitor and uncover predictive risk indicators, and proactively respond to student behavior to promote student success.

Despite the high capabilities of these systems, they cannot be sustained outside professional HI, which gives meaning and direction to data insights. By providing enhanced information, AI helps humans to focus on insights relevant for student success impact and to proactively support student success. The promises of AI—that is, predictive models that create early alerts or evaluative tools to estimate the impact of interventions on student success—are possible only when HI and AI work together.

In “Student Success: 3 Big Questions,” Kathe Pelletier focused on what student success means, how it is measured, and whether or not student success is a mission-critical component of higher education institutions.¹ These are important foundational questions for improving student success. Next steps must address how leaders can build smarter student success models that scale and achieve sustainable results. This cannot be done without increasing the synergy between AI and HI.

Linking smart machines with human insight creates student success models that maximize outcomes while minimizing risk. As Diana Oblinger explains: “Machine learning allows computers to ‘consume’

information such as medical records, financial data, purchases, and social media and then develop predictions or recommendations. . . . These machines can create their own guidelines and discover patterns invisible to humans.” She quotes Garry Kasparov, the former world chess champion, who observed: “Humans are not being replaced by AI, we are being promoted. Machine-generated insights add to ours, extending our intelligence in the way a telescope extends our vision. Think of AI as ‘augmented intelligence.’ Our increasingly intelligent machines are making us smarter.”²

Research on what contributes to student success and the growing focus on data and analytics set the stage for improving the ability to increase student retention and completion. We know more about student behavior and the activities that lead to success or risk. AI brings results to decision makers in real time. Predictive models allow discernment about which factors contribute to individual students’ progress and momentum. By combining student segments with learning life cycles, higher education professionals can align learner, time, and interventions into a model to maximize student success and decrease risk.



New technologies support the data mining, reporting, evaluation, and action by decision makers. As Heath Yates and Craig Chamberlain have noted, machine learning allows the modeling and extracting of useful information from data: “Adopting a machine learning–centric data-science approach as a tool for administrators and faculty could be a game changer for higher education.”³ Creating space for a synergistic relationship between HI and AI will be transformative.

But we face an obstacle: a winter of disillusionment. This can happen when AI hype leads to disappointment and criticism due to little-to-no tangible benefits. In fact, two AI winters have already occurred, in the 1970s and again in the 1980s.⁴ How can we prevent another such winter related to student success? Doing so requires that we become successful at improving student success, measured in a scientifically rigorous manner, by maximizing the symbiosis between HI and AI.

Defining AI and HI for Higher Education Objectives

Data science is a discipline of constructing an intelligent system that ingests data from multiple sources, performs data transformations, and deploys various machine learning algorithms in an attempt to make the system adapt and become more intelligent over time in solving business problems. Data science has greatly benefitted higher education by federating formerly siloed data, transforming the data into a useful state, and analyzing the data to identify insights that were previously hidden from view or took too much time to be of use for active students. Insights from data science efforts have included robust descriptions of student populations, predictive models, and even analyses to estimate the causal inference between institutional operations and key outcomes of student success.

AI refers to a system’s ability to interpret data correctly, learn from it, and achieve specific business goals through the judicious use of collected knowledge over time. Machine learning consists of a set of

Higher education professionals have access to far more data than they can interpret and utilize to influence student success. Fortunately, AI can assist HI in processing and organizing insights that historically have been hidden from view.

statistical and deep-learning algorithms that facilitate meaningful learning from data. AI uses automated logic and reasoning to streamline vast quantities of digital data and automatically improve knowledge over time.

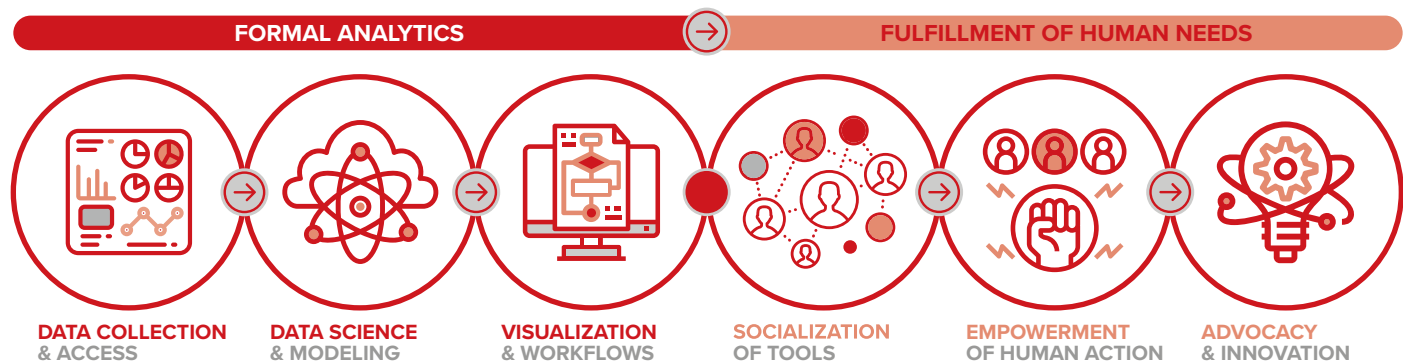
Unfortunately, AI, due to its dependence on learning from data, cannot think outside the box, meaning that making open-set decisions based on new patterns in data can be very challenging without HI. For example, mortgage-backed security pricing algorithms blew up in 2008 because they were trained on the previous three years of data—a time when home prices had been rising.⁵ Furthermore, intentional intervention design can benefit from (1) human creativity in integrating knowledge from descriptive, predictive, prescriptive, and impact analytics, and (2)

deep understanding of behavioral science, which is often missing in quantitative institutional data. That is, while AI is good at chewing through a large volume of data to find patterns and make predictions, piecing everything together for coordinated actions and student success outcomes still requires HI. This is the essence of the synergy between AI and HI.

Since the beginning of time, logic and reasoning have been the hallmarks of HI: people analyze and interpret the perceived variables within their environment. Unfortunately, the number of perceived variables has exploded with the accumulation of digital data. Colleges and universities are awash in data from students’ participation in almost every aspect of campus life. Higher education professionals have access to far more data than they can interpret and utilize to influence student success. Fortunately, AI can assist HI in processing and organizing insights that historically have been hidden from view. Working together, AI and HI can leverage insights from data to directly influence student success and institutional functions.

A useful model for understanding the relationship between AI and HI is “The Lifecycle of Sustainable Analytics” (see figure 1).⁶ This integrated model acknowledges the necessity of AI and HI to solve 21st-century problems in higher education. The model makes a distinction between the steps in formal analytics (data collection, data science, and visualization) and the steps in the fulfillment of human needs through analytics (socialization, empowerment, and advocacy). Any data initiative must be socialized to cover not only the how of using AI insights but also the why and when of using these insights. Higher education professionals must understand how AI promotes them and complements their work so that they can feel empowered to incorporate AI technologies into their daily actions. Finally, professionals must see how the insights can be used to advocate and innovate in their work. Finding a harmony between AI and HI is necessary for the success and sustainability of data science initiatives.

Figure 1. The Lifecycle of Sustainable Analytics



Source: Mitchell Colver, "The Lifecycle of Sustainable Analytics: From Data Collection to Change Management," unpublished paper, Office of Student Analytics, Utah State University (Logan, UT, 2018). Reprinted with permission.

Lessons from Health Care

As higher education adopts AI methods to assist HI in the immense task of student success, we can learn from fields that pioneered AI methods to tackle complex problems. An early leader of AI in industry was the health-care system. For example, in 2004 one health-care company built a patient-risk predictive model that outperformed the industry-standard model by over 20 percent. The company then developed a lifestyle coaching program that incorporated salient behavioral science and patient-activation principles. The company ran a pilot program on the diabetic population, measured outcomes, and found statistically significant positive results. Everyone was happy, and the company decided to expand the program to all patients.⁷

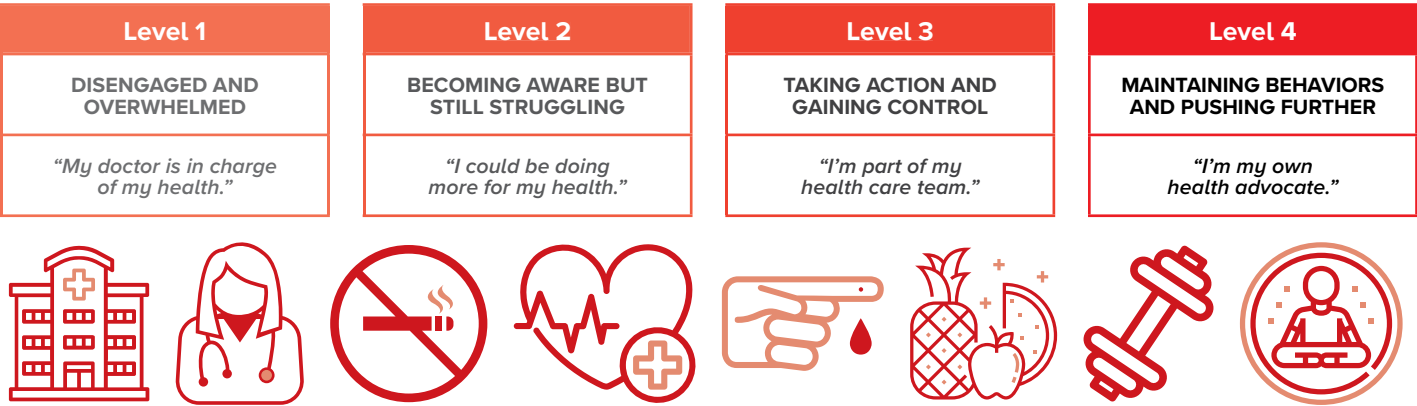
When the company measured outcomes again, however, they were very surprised to find negative outcomes: feedback from health coaches indicated that the patients who received outreach were much sicker than the initial pilot population. Instead of giving up, the company decided to dig deeper. Drill-down impact analysis showed that although some patient segments, such as those with diabetes or cardiovascular diseases, benefited from lifestyle coaching, patients with far more serious conditions and comorbidities did worse. Analysis of patient-coach interaction data, along with coach-level impact analysis, soon revealed that there was no one-size-fits-all intervention program.

These findings, along with strong encouragement from the company’s executive team, led to a new, portfolio-driven

approach to patient care, with programs catering to specific needs of various patient segments (see figure 2). Furthermore, the company measured the impact of all patient-care programs monthly, reviewing the results and discussing opportunities for performance and process improvement in a monthly steering committee meeting attended by all senior executives, clinical-program owners, and data scientists. This is a clear example of HI-AI synergy that led to a systemwide improvement in outcomes.

Implications for higher education from the health-care example are fascinating. First of all, making predictions is less important than knowing how to create a portfolio of programs personalized to population segments with specific needs. Predictions can help academic professionals focus on

Figure 2. A Portfolio-Driven Approach to Patient-Care Optimization



Source: Linda Baer, Amanda Hagman, and Dave Kil, "What Leaders Need to Know about Scaling Student Success Programs," WCET 31st Annual Meeting, Denver, CO, November 5, 2019. Reprinted with permission.



the right students, but knowing *how* to help them is the key here. Thus an important lesson learned from health care is to transform the AI and HI relationship from risk prediction to impact prediction. Impact predictions analyze how institutional programming is influencing student success across multiple student segments. Quantifying the impact of student initiatives allows the higher education institution to build a portfolio of student services. Drilling down into evaluations of the programs reveals what works and for whom and in which operational settings. In this process, higher education professionals will become equipped to prescribe programming that can promote student success with existing resources. Campuses use a number of interventions to influence student success, but it is very difficult to improve without rigorously measuring their efficacy for continuous learning and portfolio optimization (i.e., resource allocation optimization given that everyone operates under a finite amount of resources).

Learning from pioneering health-care companies, higher education must foster the working relationship between AI and HI. Although many higher education institutions have adopted AI analytic systems, a report jointly produced by AIR, EDUCAUSE, and NACUBO calls for a much stronger approach to the use of analytics in student success. It concludes: “With the change-making capacity of analytics, we should be moving aggressively forward to harness the power of these new tools for the success of our institutions and our students. However, so far higher education has failed to follow talk with decisive action.”⁸

Some colleges and universities have indeed reaped benefits in terms of student retention, but others have been underwhelmed with the productivity of AI systems on their campuses. A major problem may stem from the belief that transformative changes should flow spontaneously from AI analytic insights, but this ignores the key role played by the HI of higher education professionals.

One example is the low prioritization of professional development at some institutions that have adopted sophisticated AI systems.⁹ HI must be trained on how to take insights from AI systems and innovate practice to improve student success.

In short, the goal of AI in higher education is to help design and execute intentional interventions in order to maximize the probability of student success. This moves HI away from a focus on repetitive and uninspiring work and toward tasks that inspire and reward us. Of particular interest here is the Fogg behavior model, which talks about aligning core motivators, simplicity factors, and behavior triggers to increase the likelihood of humans performing targeted behavior.¹⁰ AI simplifies what we need to know about students and existing programs so that we can put together an action plan with confidence of its utility. Such intentional intervention design work appeals to our core motivators, giving us pleasure in seeing the fruits of our creative and mission-driven work. Furthermore, understanding the right behavioral triggers for students to comply with carefully designed calls to action can lead to a virtuous cycle of higher compliance and better outcomes. That is, having an evidence-based intervention recommendation adds to simplicity and appeals to core motivators, leading to improved odds of designing intentional interventions and impact success.

The building blocks for this transition between prediction and impact must include AI and HI working together toward the following:

1. Understand who is at risk, why, and what can move the needle on student success
2. Organize existing data and evaluate the need for improved data-capturing
3. Audit current programming and initiatives using impact analyses to discover what is working and for whom
4. Match at-risk students with programs shown to influence student success for similar students
5. Create evidence-based student success

knowledge with learning lifecycle management and continuous evaluation as programs are adjusted to reflect intervention insights

6. Develop an action plan from evidence-based intervention data and evaluate results¹¹

Leveraging the benefits of AI and HI initiatives requires the above building blocks. Jonathan Zittrain has explored the pernicious nature of intellectual debt associated with AI when we do not know how something works; failing to consistently train HI to understand and leverage insights from AI systems creates this intellectual debt.¹² At Utah State University, the Center for Student Analytics has taken on the task of empowering professionals to utilize insights from AI as a way to innovate university practices for improving student success. This has been accomplished by fostering a positive relationship between HI and AI and by helping professionals to see how these modern tools promote their current practices. The Center for Student Analytics at Utah State University has also established professional training as an institutional priority. Instead of receiving mere point-and-click training, professionals discover how to leverage insights from analytics into daily practices. They also learn about professional intentionality and the ethics of using big data in higher education. Dedicating resources to the empowerment of university professionals with modern technology has proven a boon to the culture of innovation within the institution.

Combined HI and AI in Action

What does combining AI and HI mean for student success models? Currently, smarter student success is possible by balancing AI and HI. Thanks to improved insights from AI, HI can concentrate on which actions and interventions provide the most impact for students.

Grinnell College has leveraged this balance between AI and HI by addressing the science of intervention to provide faculty and staff with information on its

effectiveness. In “Blending Human Intelligence and Analytics for Student Success,” Randall J. Stiles and Kaitlin Wilcox state: “Colleges and universities have long relied on human-intelligence networks made up of faculty, professional advisors, other administrators, and students themselves to find the best balance of challenge and support for individualized learning and to monitor student progress.” Staff at Grinnell have integrated learning analytics with HI networks “so that alerts, predictive models, and outreach to students might be improved.”¹³ This blending was based on the work of Thomas H. Davenport and Julia Kirby, who talk about *augmentation*, defined as “starting with what minds and machines do individually today and figuring out how that work could be deepened rather than diminished by a collaboration between the two. The intent is never to have less work for those expensive, high-maintenance humans. It is always to allow them to do more valuable work.”¹⁴

This cultural shift toward a balance between HI and AI can be seen in an example at Utah State University. A program designed to promote new freshmen’s integration into campus life was in jeopardy of losing funding. In the program, students attending academic and co-curricular programming accumulated points toward earning a monetary reward and a reception with executive-level university professionals. An impact evaluation revealed significant gains in student persistence for students who participated. Specifically, students who participated in the program were 2.7 percent more likely to persist than similar students who did not participate. This gain in persistence was associated with retaining an additional 38 students each year. The program was especially helpful for students who were most at risk of leaving the university.¹⁵

Given these insights—that (1) the program was effective and (2) it was influential for students at risk of leaving the university—the orphaned program was adopted by the Student Affairs Office. Unfortunately, while in transition, the program lost a large portion of its funding. In response

Without HI, the AI technologies will fall short of our expectation of improved student success. Colleges and universities need to expand their capacities in data technologies in tandem with expanding their human capacities to ingest, incorporate, and innovate.

to the decreased funding, university professionals reflected on their experience with the program (HI) and investigated the data (AI). In a facilitated discussion with the data team, university professionals added their contextual insights (HI) to the data. One HI insight revealed that many students were very eager to receive the monetary reward. Staff thus decided to keep the monetary reward for participation but cut the reception with university executives.

The following semester, the program was evaluated again with an impact analysis. Interestingly, the removal of the reception resulted in a reduced impact, from the 2.7 percent increase in persistence to a 1.1 percent increase in persistence. In other words, this programmatic change shifted from retaining 38 students a year to only 14. While anecdotal evidence from the first round of evaluation suggested the monetary reward was the largest motivator, losing the reception hurt the program. Unfortunately, the programmatic budget was not changed. Instead, university professionals worked within their constraints

to identify no- or low-cost alternatives to the reception. They were able to pull together enough resources for several raffle drawings for meal plans, parking passes, and other university goodies. The impact of this change is not yet known, but the program is on track for an evaluation this spring. Regardless, one thing is clear: the university has established a cadence to quickly evaluate the impact of its programmatic changes. This symbiosis of AI and HI opens countless avenues for accountability, innovation, and advocacy for university programming.

Utah State University has also undertaken the task of evaluating existing student initiatives across campus using impact analyses with a common outcome of persistence. The sweeping project has given rise to a better description of how services are influencing student persistence. It is also uncovering insights about which students are benefitting from which initiatives. Through this process, students can be prescriptively matched to the initiatives that support their individual needs and success. The most current example of this effort is the *Student Analytics Look Book*, a student-facing document that highlights analytical insights derived from predictive modeling and impact analyses of student initiatives.¹⁶ Promoting these insights through a *Look Book* to students and university professionals democratizes insights for the betterment of the student experience.

Given the above examples of HI-AI synergy, the desired output of AI systems is the knowledge base on how to improve business outcomes. As an analogy, the core mission of many precision medicine companies and nonprofit health organizations is to build the evidence-based treatment efficacy knowledge base as a function of a patient's clinical condition, treatment history, and molecular profile.¹⁷ In What Works Clearinghouse (WWC), only twelve interventions in postsecondary education meet WWC guidelines for being a proven high-impact practice (as of November 13, 2019). Furthermore, these interventions have so many moving parts

that scaling and replicating them at other institutions is very difficult, as well as very expensive, to implement. In addition, most colleges and universities are not consistently evaluating their implementation of the twelve WWC high-impact practices with impact analyses on a regular basis.¹⁸ In short, there is a strong moral imperative that we build the evidence-based student success knowledge base systematically in a scalable, cost-effective manner by fusing the most salient attributes from AI and HI.

Conclusions and Future Directions

David Watson recently lamented that while AI has been conceptualized in anthropomorphic terms, its true abilities have been vastly overstated, robbing us of our own autonomy.¹⁹ Instead, as we have argued above, a balanced investment in AI technologies and HI capital can take AI tools to the next level. Without HI, the AI technologies will fall short of our expectation of improved student success. Colleges and universities need to expand their capacities in data technologies in tandem with expanding their human capacities to ingest, incorporate, and innovate.

Higher education has the power to prevent another AI winter of disillusionment related to student success. To ensure that the use of AI leads to tangible student success outcomes, we must champion the symbiosis between human intelligence and artificial intelligence. ■

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Whatever It Takes

Students who attend community colleges are juggling a lot in their lives. More two-year and AA¹ students work full time, are married or in a domestic partnership, have children, and are financially independent than are their peers at four-year schools.² With so many responsibilities on top of the work of being a student, many community college students today may feel like they need superhero-sized endurance to manage it all.

In the *ECAR Study of Community College Students and Information Technology, 2019*, the EDUCAUSE Center for Analysis and Research examined topics related to the technology experiences of community college students, including their learning environment preferences. While about half of our sample reported that they prefer blended environments, some two-year and AA students told us they favor courses that met mostly or completely online. So, who are these students, and what could be influencing their preferences for environments that are heavily or fully online?

To answer this question, we developed a statistical model that looked at the impact of four demographic variables that are significantly correlated to learning environment preferences: gender, whether or not a student has dependents, marital/relationship status, and employment status. In the logistic regression model, each of these independent variables was a significant predictor of preferences for mostly-to-fully online courses.³ Based on the results of the model, we generated probabilities that students would prefer mostly-to-fully online courses for *every possible combination* of demographic predictors (see figure 1).

We found that women, students with dependents, students who are married or in a domestic partnership, and those who work are significantly more likely to prefer mostly-to-fully online courses than do their counterparts. Students with dependents are nearly twice as likely to prefer mostly-to-fully online courses, while women and students who are married or in domestic partnerships are about 1.5 times more likely to have the same preferences.

The results for these individual variables provide insight into how one particular factor—like gender

or marital status—is related to a student's learning environment preferences. However, the lives of students are not defined by a single variable but are considerably more complex. That is, the specific combinations of any of these demographic factors are likely to reveal the more nuanced ways student preferences for online environments are based on their lived experiences. To provide a comprehensive picture of how gender, dependents, marital/relationship status, and employment status relate to learning environment preference, we generated 16 probabilities, or one probability for each of the possible combinations of the four independent variables that were found to significantly predict learning environment preferences (see figure 2).

When all four key demographic factors were considered, we found that those who are most likely to prefer primarily to completely online courses are married, working women with dependents. The group that was second most likely to prefer online learning environments is married women who have dependents and who do not work, followed closely by single, working women with dependents. While the female students in our study could be caring for parents, siblings, or other family members, studies suggest that these dependents are far more likely to be the children of these students. In fact, students with dependent children represent 30 percent of the total community college student population,⁴ and single mothers are growing as a share of the overall college population.⁵

Married, working mothers may prefer mostly-to-fully online courses because they must simultaneously balance the pressures of going to school and having a job and a family. Research has shown that the practical conveniences of online courses often drive learning environment preferences for community college students⁶ and that these online learning environments are often chosen for practical reasons versus the belief that students will learn more than they would in a face-to-face course.⁷ And married, stay-at-home mothers may favor online learning environments for similar reasons.

Although women who are married or in domestic relationships have partners to help with at-home responsibilities, national statistics show that

The responsibilities of family life (especially with children) are factors that shift the preferences of community college learners from mostly **face-to-face learning environments to mostly online ones.**

women still shoulder more of the household work and spend more time providing primary care to children than men.⁸ Single, working mothers may also prefer online environments out of sheer necessity, as they must manage the demands of employment, coursework, and caring for children—all without the support of an at-home partner. In the absence of the ability to teleport, time travel, or clone themselves, courses that are primarily or completely online offer the flexibility that many mothers critically need, as these online learning environments allow them to work toward their degree or certificate whenever or wherever they are able without (or with fewer) interruptions to their work and home schedules.

Single men with no dependents (whether or not they are employed) prefer online learning environments less than women do. The groups that our model predicted to have the next lowest preferences for online learning are married, unemployed men with no dependents; single, unemployed women with no dependents; and married, working men with no dependents. The responsibilities of family life (especially with children) are factors that shift the preferences of community college learners from mostly face-to-face learning environments to mostly online ones.

To help improve the learning outcomes of students with dependent children, higher education IT units should consider leveraging analytics to better understand the needs of these students and identify potentially effective solutions. Offering students the opportunity to voluntarily share information about their dependents (such as the dependents' ages, the number of hours students spend each day or week caring for their dependents, and the financial responsibility associated with dependent care) in student service portals can provide institutions with deeper insights into the lives of this population.⁹ These additional data points can help institutions make decisions about the types of courses that best meet students' needs, track students' progress, and identify the kinds of resources that can be offered to support parents. Educating students about their learning environment options through orientation and training also arms them with information that can help them choose course environments that work best for them. Online student success tools such as self-service referral systems to campus and community resources (e.g., family and women's centers, counseling services, and childcare services) can be leveraged to share information with parents. IT units, faculty, and staff can also advocate for increasing access to

affordable, quality childcare and other campus services that serve the parents of children who are working hard, stretching themselves thin, and doing whatever it takes to make a better life for themselves and their families. ■

Notes

Thanks to Kate Roesch, data visualization specialist for the EDUCAUSE Center for Analysis and Research, for her vision in creating the figures for these data.

1. Community colleges were defined as institutions that (1) have the Carnegie class of AA, and (2) are two-year institutions. In this study, two institutions met one or the other, but not both, of those criteria but were included after verifying their community college status.
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Figure 1. Predicted Probabilities of Individual Demographic Preferences for Mostly-to-Fully Online Courses

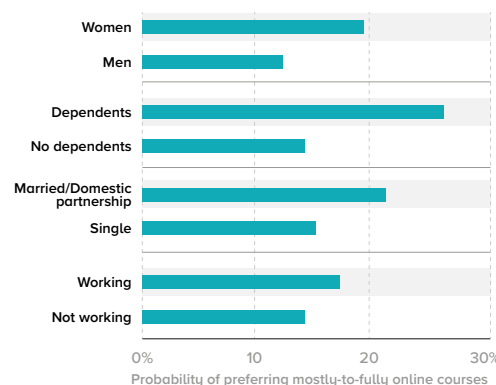
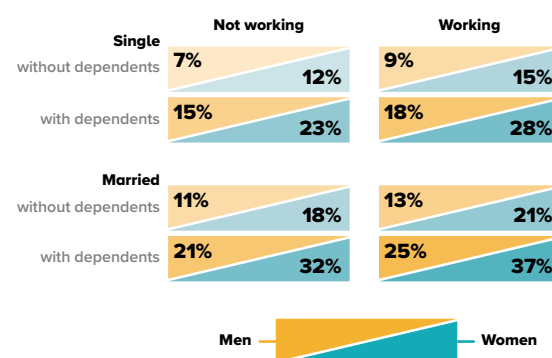


Figure 2. Predicted Probabilities of Combined Demographic Preferences for Mostly-to-Fully Online Courses





From Transactional to Transformational: Research Libraries and Data Partnerships

The “Implementing Effective Data Practices” conference provided an opportunity for fresh thinking on how the scientific community and the library community might partner for better data management and stewardship.

The Association of Research Libraries (ARL) is an institutional membership organization whose vision is for research libraries to be collaborative partners supporting the full lifecycle of scholarly creation and inquiry.

While this involves stewardship of information in all formats (past, present, and future), it is the explosive growth of digital scientific research data that arguably presents the greatest complexity and opportunity for libraries. The data “supply chain”—from collection, analysis, curation, publication/deposit, and reuse—involves a mix of public and private funding, open-source and proprietary software, computational and storage needs, commercial and nonprofit interests, law, public policy, institutional policy, and a high degree of disciplinary domain variation.

In December 2019, the National Science Foundation (NSF) sponsored an invitational conference led by the library community (ARL and the California Digital Library), in partnership with the Association of American Universities (AAU) and the Association of Public and Land-grant Universities (APLU). “Implementing Effective Data Practices: a Conference on Collaborative Research Support” addressed both the complexity and the opportunity of managing digital data within and across institutions. Attendees of the workshop-style meeting included US federal agency representatives, private funding organizations, IT professionals, vice-chancellors for research, professional societies, domain repository managers, tool builders, and data librarians. The goal was to draft, with multi-stakeholder input, guidelines for institutions to implement two particular data practices recommended by the NSF in 2019: (1) assign persistent identifiers, or PIDs, to data sets, and (2) make Data Management Plans (DMPs) machine-readable.¹

The value proposition for both PIDs and

machine-readable DMPs has been well-articulated by groups such as FORCE11 and the Research Data Alliance.² PIDs facilitate discovery, disambiguation, credit for data sharing, interlinking research outputs, and reproducibility. Machine-readable DMPs—which would replace the existing PDF attached to a grant proposal—will improve communication and progress reporting to funders, assist with institutional communication and planning for computing and storage needs, and enable risk identification with respect to privacy or other secure data requirements. Where the conference advanced collective thinking, and laid the groundwork for collective action, was in distinguishing between these data practices as compliance-driven transactions and the partnerships necessary to sustain the practices as essential to scientific methods and infrastructure.

A PID, for example, is simply a unique string of numbers assigned to an entity such as a person or organization or to digital assets such as data sets. PIDs for data are typically created as a service when a data set is deposited in a repository, and they are persistent only when they are maintained by a registry that commits to pointing to the entity in perpetuity. Through small-group discussion and design work, conference attendees drew the important distinction between using a PID and sustaining the infrastructure needed to maintain the integrity of the links. That work is accomplished by organizations like DataCite, Crossref, and ORCID, which register identifiers and maintain this critical metadata. This higher level of commitment to PIDs comes with a higher payoff: the possibility of a scholarly knowledge graph linking preregistration plans, data, code, samples, and reagents (for example) and research outputs (e.g., journal articles). Such a knowledge graph will make science more inclusive and more interdisciplinary and will enable new kinds of discovery. A strong partnership between the scientific community and the library



community is necessary to achieve this vision and its full potential.

Similarly, DMPs have been part of grant proposals to the NSF, the National Institutes of Health, and other funding agencies for more than a decade. DMPs prompt researchers to consider critical elements that will make data sharable and reusable—including where the data will be stored, under what licensing terms, when it will be shared, and how it will be described. Working groups within the Research Data Alliance have developed recommendations on how best to move beyond DMPs as static PDFs toward machine-actionable “living” data and output management plans. Next-generation DMPs like these can trigger business and communication processes between researchers, their institutional support services, and their funders. While libraries have long provided guidance to researchers on the creation of DMPs, this conference addressed the kind of structural issues that are necessary for the DMP to become an instrument of collaboration among the many institutional entities that provide researcher support across the data lifecycle. These issues include *timing* (what if DMPs were in draft form for proposal submission and in completed form when awarded?), *accessibility* (what if DMPs for awarded grants circulated automatically among all key units of a college/university?), and *integration*

(what if data management practices were included in regular grant progress reports?).

The “Implementing Effective Data Practices” conference provided an opportunity for fresh thinking on how the scientific community and the library community might partner for better data management, better stewardship, and better compliance with funders’ requirements, all without increasing researchers’ administrative burden. Next steps are for ARL, working with the conference committee, to draft guidelines and facilitate widespread consultations among research offices, high-performance computing and other research-support entities, and disciplinary, publishing, and public policy communities. Finally, ARL, AAU, and APLU will continue to collaborate to improve the sharing of and public access to data. ■

Notes

1. National Science Foundation, “Dear Colleague Letter: Effective Practices for Data” (NSF 19-069), May 20, 2019.
2. Stephanie Simms, Sarah Jones, Daniel Mietchen, and Tomasz Miksa, “Machine-Actionable Data Management Plans (maDMPs),” *Research Ideas and Outcomes* 3 (April 5, 2017).

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The Post-Learning Era in Higher Education: Human + Machine

“We’ll think nothing is happening and all of the sudden, before we know it, computers will be smarter than us.”

— Douglas Hofstadter, quoted in Melanie Mitchell,
Artificial Intelligence: A Guide for Thinking Humans (2019)

A critical question confronts those of us in the modern higher education system, particularly CIOs, faculty, and learning designers: What remains for people to learn when technology is able to outperform us, cognitively, on many basic knowledge tasks? Learning has long been viewed as the exclusive domain of biological entities. Even when statements are made that an organization or society can learn, the central point of reference remains the *people* in the organization or society. This assumption is starting to change, however, and the implications will be dramatic for how knowledge is created and shared, and how we seek to develop the next generation.

Artificial intelligence (AI), for all its recent hype, has been a domain of research since the seminal Dartmouth Summer Research Project on Artificial Intelligence workshop in 1956. The ensuing 64 years were marked by bold proclamations, hype, disappointment, and over the last decade, surprising advancements. AI is not a future technology with a future impact: it is here and now, present in our mobile phones and our daily lives. AI processing is used for photos taken with newer smartphones. A simple purchase at a restaurant involves a network of fraud-detection algorithms. AI is increasingly evident in discussions regarding the future of education. AI touches everything.

The use of algorithms to provide a perfect picture or to determine a fraudulent credit card purchase doesn’t threaten our concept of our own humanity. Instead, these are the direct outcomes of a data-rich world in which we rely on technology to solve problems caused by other technologies. Nervousness sets in when machines begin to exhibit capabilities that encroach on our uniquely human cognition. For example, in domains that would generally have been thought to be exclusively human just a few decades ago (e.g., image detection, language, and game play), tasks are now completed at superior levels by AI.¹ Human cognition, it appears, is continually acquiescing its superiority to artificial cognition.



KKGAS/STOCKSY

The vision of AI to advance beyond human cognitive performance was common in the earliest proclamations of what AI might offer humanity. In 1958, Herbert A. Simon and Allen Newell stated: “Within ten years a digital computer will be the world’s chess champion.”² (This did happen, but in 1997—a full forty years later.) Meanwhile Alan Turing, in the early 1950s, suggested that computers could readily “outstrip our feeble powers” and at “some stage therefore we should have to expect the machines to take control.”³

The enthusiastic hype and overpromising remain prominent in public AI conversation today. There is no shortage of opinions, from both scientists and hypesters, about AI’s long-term impact on humanity. The camps are sharply divided. One—including Bill Gates, Elon Musk, and Stephen Hawking—posits AI as worrisome and potentially species-altering or contributing to a catastrophic event. Others—such as Mark Zuckerberg, Demis Hassabis, and Ray Kurzweil—see limited downsides.⁴ Considering the extreme and disparate viewpoints among experts in the field, we should not expect accurate forecasts or even consensus about the longer-term development of AI and how it may intersect with, and impact, humans.

While debate remains unresolved regarding AI ending or augmenting humanity, dramatic short-term impacts on learning (and, as a result, on colleges and universities) can be anticipated. Once a machine learning model has mastered a task, though often within very bounded and domain-specific settings, it is capable of vastly

outperforming humans. As Stuart J. Russell has stated: “As soon as machines can read, then a machine can basically read all the books ever written; and no human can read even a tiny fraction of all the books that have ever been written.”⁵ An acquired capability can be rapidly scaled, which is a pronounced departure from learning in biological systems; in the latter case, learning can be readily transferred to new domains but cannot scale almost infinitely.

Clearly, we are being shaped by the machine. As Alan Kay has noted: “In normal science you’re given a world and your job is to find out the rules. In computer science, you give the computer the rules and it creates the world.”⁶ Humans are meeting AI halfway by allowing our learning and our actions to be made routine and heavily structured. Metrics drive the pedagogy. Greater use of personalized learning technologies will likely only advance our receptivity to being nudged and shaped to better fit the algorithms presented to us. With the automation and technification of all aspects of modern life, the desire to find uniquely human domains, untouched by routine and forced structure, is understandable.

While humans are wired to learn—we cannot *not* learn—we are in an age when our learning needs are more networked and less individual. AI is a node with growing presence in that network. Our learning peers are not exclusively human; they are also algorithms and automated agents. In anticipation of an emerging environment in which technologies are cognitive partners, humanity enters into something that could be best described as *post-learning*. Essentially, this is the point at which traditional learning activities that define modern education are better performed technologically and we, as educators, begin to explore a broader range of knowledge activities that are likely to remain outside of the domain of AI. These include activities such as sensemaking, wayfinding, creativity, and meaning making. The logic that underpins this assertion is as follows:

1. Historically, humans have created institutions, such as libraries and academies, that reflect what is possible with the information technologies that are available.
2. As information quantity increased, additional systems were developed to capture information and share it with the next generation via classification schemes (e.g., Linnaean, encyclopedias) and more institutions were created to disseminate that information (e.g., colleges and universities, corporate settings).
3. With innovations in information generation and global connectivity, existing mechanisms for sharing the scope of human knowledge with the next generation became inadequate.
4. In response, data science and analytics have developed to organize and gain insight into this new scope of information, building on advanced computational capabilities.
5. While analytics have enlarged the scope of humans’ ability to understand large quantities of information, a secondary and more significant trend is emerging and is beginning to overlap with human cognition: AI.

6. AI, in learning settings, increases the sophistication of what is possible cognitively, outperforming humans in many learning tasks. This raises questions about how to balance human and artificial cognition and about which domains of human cognition can (and cannot) be duplicated by technology.
7. If machines can outlearn humans and, increasingly, do not have the challenge of passing information on to the next generation, we need to consider our relationship with data and with learning—essentially, our entrance to a “post-learning era.”
8. In a post-learning era, educators make decisions around what is sensible for humans to do and what is sensible for technology to do. Conceivably, human knowledge work will focus on learning adjacent activities such as sensemaking, wayfinding, meaning making, and related creative and cultural activities that remain uniquely human.

Returning to our original question: What is left for humans to learn when AI “outlearns” us? Essentially, colleges and universities move from *learning* to *beingness* (or in Ronald Barnett’s words, from *epistemology* to *ontology*)⁷ as the key focus. Global connectivity, allowing access to an unending stream of information, is changing daily life. After the initial enthusiasm of Web 2.0 and the “read-write web” gave way to large-scale social media platforms, it quickly became clear that technology had created a context in which more technology, in this case, AI, was needed to track misinformation, security threats, and a range of challenges created by information abundance. While society grapples with the role of AI in these settings, higher education institutions face a different type of existential threat as artificial cognition matches and exceeds human cognition in many areas. Re-centering curriculum and teaching practices on the skills and mindsets that are needed to flourish in a complex and contradictory world is an important first step to better understanding long-term roles where we take agency over how we are shaped and remade cognitively. The return to less-technified and more-holistic teaching and learning practices holds promise for how higher education advances society and knowledge. ■

Notes

1. The Electronic Frontier Foundation tracks AI progress. See “AI Progress Measurement” (website), accessed 1/17/20.
2. Herbert A. Simon and Allen Newell, “Heuristic Problem Solving: The Next Advance in Operations Research,” *Operations Research* 6, no. 1 (January-February 1958).
3. Alan Turing, “Intelligent Machinery: A Heretical Theory,” lecture given to 51 Society, Manchester, UK, 1951.
4. Maureen Dowd, “Elon Musk’s Billion-Dollar Crusade to Stop the A.I. Apocalypse,” *Vanity Fair*, March 26, 2017.
5. Stuart J. Russell, quoted in Martin Ford, *Architects of Intelligence: The Truth about IA from the People Building It* (Birmingham, UK: Packt Publishing, 2018), p. 49.
6. Kevin Kelly with Steven Levy, “Kay + Hillis,” *Wired*, January 1, 1994.
7. Ronald Barnett, “Supercomplexity and the Curriculum,” *Studies in Higher Education* 25, no. 3 (2000).

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The New Library User: Machine Learning

Librarians need to prepare college and university graduates to be informed citizens and to develop fulfilling and useful professional lives in a world infused with big data, machine learning, and artificial intelligence.

I became a librarian in 1992. Mosaic, the first popular Graphical User Interface to the World Wide Web, was introduced a year later. It sometimes feels as though my entire career has been an effort to understand and deal with the impact of the web on my profession and on the information lives of the faculty and students I serve. There have been other significant technological developments since then, of course: the dominance of search engines such as Google and the concomitant development of discovery services; the move to mobile and wireless; the migration of the journal literature from print to digital; and users' shifting expectations of service as a result of online shopping and social media. But none of these have felt as paradigm-shifting as the transition from the print and internet library of the 1980s to the web-based, web-infused library of today. I used to have to explain to library users that a URL is like a library call number. Now I have to explain that a call number is like a URL.

As I find myself in the "final quarter" of my career, as described by Theresa Rowe in a 2018 *Viewpoints* column,¹ librarians are on the cusp of a change that will be at least as significant as the move to the web. If, during this final quarter, I am able to focus on the kind of "intentional" change that Rowe advocates in her column, I hope it be this: to help my colleagues in the academic libraries and the institutions they serve—places that have given me such a rewarding and fulfilling career—prepare to understand and deal with the impact of the rise of big data, and machine learning, and artificial intelligence.² Increasingly in our daily lives, with services such as Google Maps and Google Translate, we find ourselves aided by or collaborating with (or monitored and exploited by) systems imbued with artificial intelligence and machine learning. These kinds of collaborations are occurring in librarianship as well. For instance, using statistical analytics generated from data gathered from the full range of system users, Ex Libris's Data Analysis Recommendation Assistant (DARA) recommends specific process improvements to library customers.

The impact of big data, machine learning, and

artificial intelligence on libraries falls into three buckets: assisting users (both machine and human); making collections accessible; and preserving data sets and the products of research.

Assisting Users (Both Machine and Human)

Librarians have always envisaged the *human* user of their services. Three of S. R. Ranganathan's "five laws" of library science explicitly mention the reader, but he clearly meant the human reader, the only reader available to him and the Indian librarians he sought to educate and train in the 1930s.³ Today we need to welcome another set of users into the library. These machine learning, algorithmic, analytic users will be collaborating with human users, crunching and filtering the data and presenting the information needed by the human users. Human users will also be seeking access to the rich data that enables them to train algorithms and to conduct research using these sophisticated statistical techniques. Our librarians and staff who work directly with faculty and students in the classroom and beyond need to be prepared to help users find the data sets—that is, the training data—they are looking for. The library online platforms need to be designed so that machine users can gain unmediated access, where appropriate, to the data resources they and their human collaborators seek.

Perhaps even more significant for librarians' direct service with users will be the impact of artificial intelligence on users' expectations. Over the past decades, consumers' experiences with online shopping, search engines, and e-books changed their expectations of library services. Libraries responded with faster acquisitions, speedier interlibrary loan, single search-box discovery services, and one-click access to full text. Another shift in expectations is ahead. Students may wonder why they can't just ask Alexa or Siri to select and retrieve what they need, or they may balk at being asked to do basic evaluation and selection work that in other realms of their information lives is being handled by their intelligent digital assistants.

Making Collections Accessible

As librarians license access to content from vendors, we need to ensure that contracts do not preclude our users from conducting text and data-mining research, algorithmically based research, and machine learning. At the moment, many vendors write contracts that assume large-scale automated crawling and other techniques are an *a priori* misuse of their services. Concerned with reaping value from data science and machine learning techniques, they seek to control these rights. On behalf of our users, librarians need to press vendors for access to platforms and data within controlled environments; ideally, however, the content and platforms we license should be computationally accessible.

As we continue to build our own digital libraries, we also need to envision the machine user alongside the human user and to consider our own digital libraries to be “Collections as Data.”⁴ Like the commercial providers of information resources, academic librarians and other information professionals should think carefully about how openly accessible they want to make, or are able to make, these resources. This is important both ethically and legally. They also need to determine how comfortable they are with providing the raw materials from which others will reap value.

Another challenge will be the impact of machine learning on cataloging and description. Librarians have realized huge efficiencies by moving the description process, and collaborating, online. Examples of this are the shared cataloging within OCLC’s WorldCat and shelf-ready acquisitions from companies such as GOBI Library Solutions. However, behind all this online collaboration are human catalogers. Especially in archival description, we are beginning to see interesting efforts to automate portions of this descriptive work.⁵ As these efforts develop, the role of catalogers and processing archivists will continue to change, in terms of both the expertise we require of technical services staff and the work they do.

Preserving Data Sets and the Products of Research

All this access to collections as data and informed assistance from librarians able to work equally with machine and human users will result in additional scholarly production. Collections as data quickly come full circle to data as collections. We now have decades of experience in determining what from our digital lives and work should be preserved and made

accessible for the long term. The same issues will need to be addressed for the products of computational use and analysis of these large data sets. Should we sustain both technical and intellectual access over the long term, and if so, how? How do we address the ethical and legal rights not only of the users of these data sets and the creators of scholarship but also of those represented in the data sets? How do we support the replication of studies and the auditing of data sets, especially those used as training data in machine learning systems, for bias?

Are You Ready?

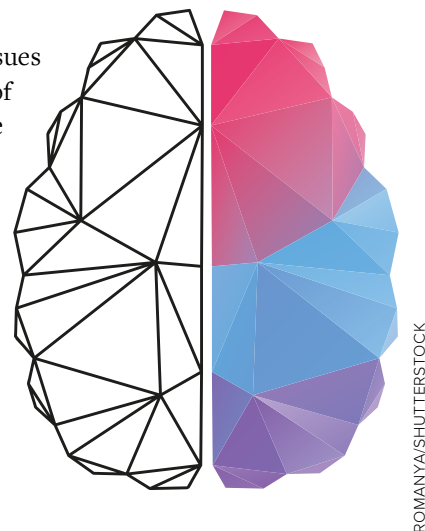
In the migration of libraries to the web, much of the early work was done by research universities. Today much of the engagement with data science, machine learning, and artificial intelligence is also happening at those institutions.⁶ However, libraries at smaller institutions and those more focused on teaching cannot avoid this looming structural change both in the profession and in the information experiences of library users. Vendors are already incorporating artificial intelligence and machine learning into their platforms, services, and products. Librarians must become informed customers and users of those platforms, services, and products. Perhaps most importantly, librarians need to prepare college and university graduates to be informed citizens and to develop fulfilling and useful professional lives in a world infused with big data, machine learning, and artificial intelligence.

Notes

1. Theresa Rowe, “The Final Quarter: Leadership and Legacy,” *EDUCAUSE Review* 53, no. 6 (November/December 2018).
2. I also hope to use my privileged position to focus on diversifying my profession, but that is a topic for another column. However, the two issues are related. We must ensure that incorporating artificial intelligence and machine learning into librarianship does not reinforce existing bias and privilege.
3. S. R. Ranganathan, *The Five Laws of Library Science* (London: Edward Goldston, 1931).
4. Always Already Computational: Collections as Data, “Santa Barbara Statement on Collections as Data” (March 3, 2017).
5. For example, the National Endowment for the Humanities awarded a grant (HAA-256249-17) to Carnegie Mellon University to develop image-identification tools and techniques to expedite description and improve access to the Charles “Teenie” Harris Archive of African American Life in Pittsburgh, a large photographic collection.
6. For example, Stanford University and the National Library of Norway have co-sponsored the first two Fantastic Futures conferences.

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