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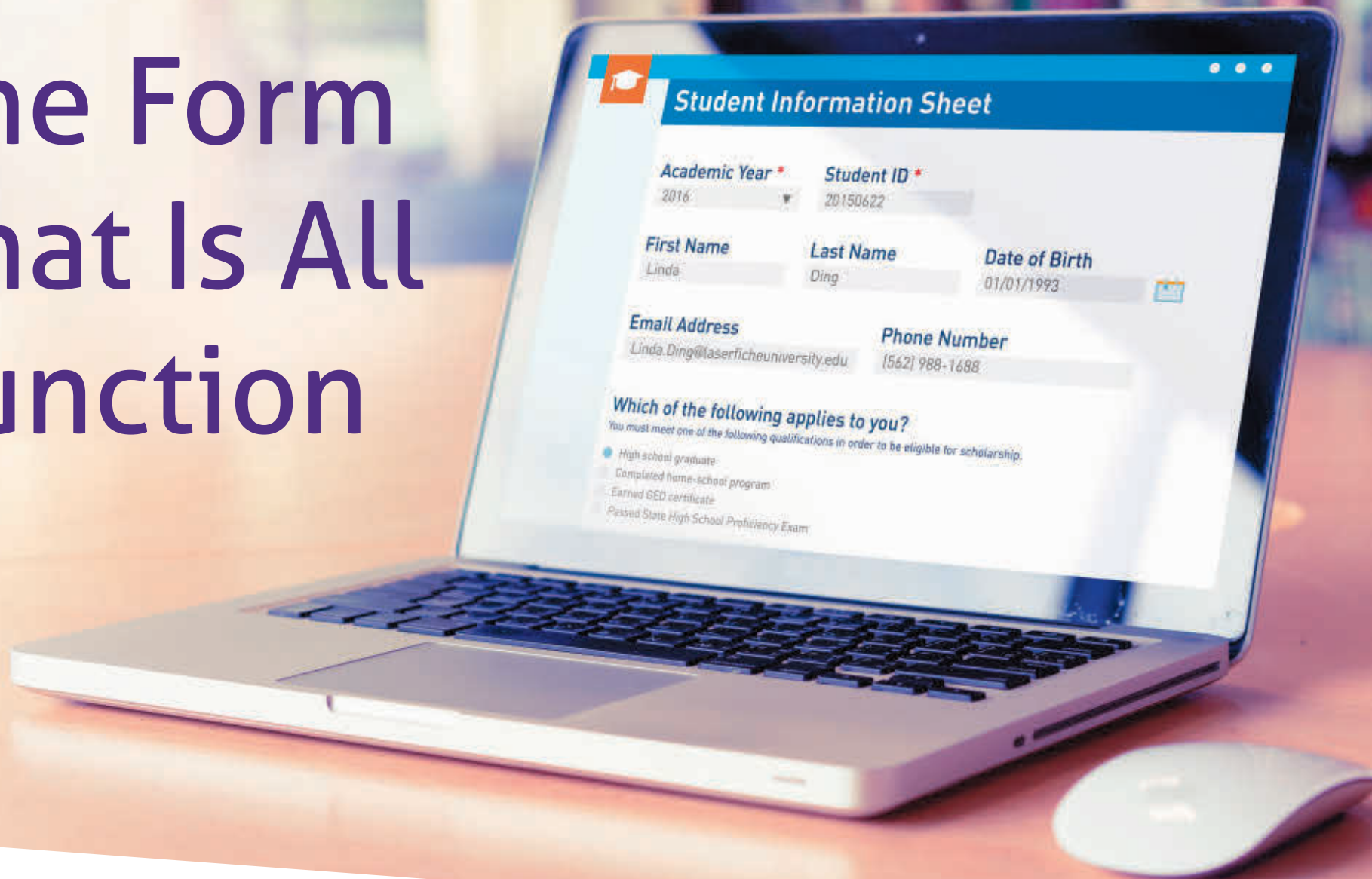
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April 14, 2017

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EDITOR'S NOTE

THIS SPECIAL REPORT on The Digital Campus looks at the promise — and the limits — of big data. Colleges have high expectations for big data: They want to use it to better track students and help them succeed, to find out what works in the classroom, to shape their student bodies, and more. Our coverage features some of the efforts underway to accomplish those goals.

But it also includes a caveat from several data experts. All that data, they warn, is meaningless if colleges aren't using it to ask the right questions and to identify the most pressing problems — tasks that require human intervention.

Our coverage also examines the urgent threat to data security posed by hackers, the growing collaboration between colleges and private boot camps that offer technical skills, and the latest developments in the open-educational-resources movement, which is aimed at freely licensing textbooks and other learning materials to reduce costs.

Thanks to the writers, editors, and designers who worked on The Digital Campus. We hope you find it useful.

—CAROLYN MOONEY
SENIOR EDITOR, SPECIAL SECTIONS

If hackers get into a college's network, they can gather terabytes of research data or emails to sift for possible profit. "It might take years to look at it," says Mitchel Davis (right), chief information officer at Bowdoin College, "but they want to get hold of it." Steven Blanc, associate chief information officer, says, "security is not something that IT does, it's something the college does."

Keeping Up With the Growing Threat to Data Security

By **LEE GARDNER**

LAST FALL, Donald Trump theorized that the computer hacker who stole emails from the Democratic National Committee could have been "someone sitting on their bed that weighs 400 pounds." But the stereotypical rogue nerd isn't the threat that most concerns information-security officers on college campuses.

Their institutions are under constant attack, they say, by groups of criminal hackers who have professionalized, and industrialized, their efforts in the past few years. If the hackers find a tiny flaw in a college's data-security apparatus — an unsecured server, a careless user — they can infiltrate its network, Hoover up any and all data they come across, and peddle the choice bits on the dark market — those shadowy corners of the internet where people go to buy and sell illicit goods anonymously. There have been thefts of politically sensitive data, as when hackers published hundreds of emails and documents in 2009 that raised questions about climate scientists' impartiality, but al-

most all attacks have more mercenary motives.

It's an escalating battle that many colleges must fight with limited resources. And the stakes are high. A major breach can expose thousands of names and Social Security numbers, credit-card numbers, and other personal data that employees and students turn over to colleges all the time, leaving those affected vulnerable to identity theft. A breach at the University of California at Berkeley last year compromised the personal data of about 80,000 current and former employees and students.

An attack can also bring an institution's computer network crashing down: In 2015, Rutgers University was hit with several "denial of service" attacks, in which a hacker flooded the institution's network with data, temporarily crippling it. In the aftermath, the university budgeted about $3 million to improve its data security.

Colleges "have to be right every time" when it comes to securing data, says Brad Wheeler, vice president for information technology and

chief information officer at Indiana University. "The bad guys can try 10,000 times, or 50,000 times. As long as they get it right once, they get a win. It's a very, very asymmetrical game now."

Groups of criminal hackers, many of them based overseas, have upgraded their tools and methods. "They're using these almost weapons-grade hacking kits," Mr. Wheeler says.

But even familiar modes of attack have grown in sophistication. "Phishing," in which people receive an email designed to get them to give up passwords or financial information, has evolved past "a rich uncle in Nigeria who wants to wire you a million dollars," he says, and now uses messages that look very legitimate: "They're simple, they're short, they're often contextualized for something going on at the institution." Indiana delivered 442 million emails to its users last year, and its countermeasures killed 2.1 billion emails before they entered its system.

The rise of big data has also abetted hackers' efforts. A decade ago, a spreadsheet of Social

Security numbers was "the holy grail" for hackers, says Ronald D. Kraemer, vice president and chief information and digital officer at the University of Notre Dame. Data that can be used for identity theft or to tap financial resources remain the primary targets, but in the past few years, "the analytics tools that people have available to them to sort through data and to figure out what the hidden gems are have just advanced so much," he says. Personally identifiable information is still the most desirable, and lucrative, goal, but if hackers get into a college's network they can gather terabytes of research data or emails to sift for possible profit. Most of the nonpersonal data will contain little or no information that can be leveraged, but it doesn't matter.

"They just slurp it all up," says Mitchel W. Davis, chief information officer and senior vice president at Bowdoin College. "It might take years to look at it, but they want to get hold of it."

Large, relatively open computer networks with thousands of users help universities to perform their expansive missions, but they also make it difficult to defend against intrusion. Data security at a college over all is only as good as the security of each server, and of each individual user.

Big attacks often start small. "Someone will hack a school, lab, or departmental-level server. Then they'll look around sideways," Mr. Wheeler says. "Then they'll escalate their privileges on that server. Then they'll start working up the food chain," probing for deeper access, and more and more valuable information.

A T INDIANA, Mr. Wheeler and his staff have spent several years working on reducing potential intrusion points. About four years ago, a self-audit at Indiana revealed about 1,600 computer servers that Mr. Wheeler's office didn't even know about. Back then, only about 65 percent of servers on campus were contained within the university's central data center, where they could be monitored by the best security the institution had on hand. Now about 90 percent are. "If we have fewer things to attack, and fewer things that we can focus more professional energy on securing them, we're going to be better off than otherwise," he says.

Many institutions are being more cautious about the information they keep on their networks. When it comes to data, Mr. Kraemer says, "if we have to have it, we encrypt it. If we don't have to have it, we get rid of it. An organization becomes less of a target if you don't have tens of thousands of Social Security numbers sitting in an unsecure system."

More colleges are also moving toward requiring multifactor authentication, where a password and some additional information or item are required to gain access to its system. If you're a hacker trying to get past it, "just stealing a password doesn't help anymore," Mr. Kraemer says.

Notre Dame recently made multifactor authentication mandatory for all faculty, staff, and students, a move that involved a management as well as a technical challenge. Mr. Kraemer and his staff spent months talking to various groups on the campus about the security value of multifactor authentication,

explaining that it would protect not only the university but also individuals from theft and fraud. Most people are already used to using multifactor authentication for accessing bank machines (a bank card and a PIN), he says. It seems like an unaccustomed step for computer access, but it shields their research and their finances.

Indeed, getting everyone on campus to keep computer security in mind can be as good as some technical backstop, and more affordable. When Bowdoin rolled out multifactor authentication about a year ago, the goal was not just to sell the new program, according to Steven A. Blanc, vice president and associate chief information officer. It was important to impart the idea that "security is not something that IT does, it's something the college does," he says.

T HERE'S NO reason to believe that hackers will become less skilled, or less persistent, in the future, so colleges will probably continue to face escalating data-security challenges.

The advent of cloud computing has afforded colleges new options for protecting their data, but it also creates potential new threats to security. Storing data in the cloud has helped institutions fend off ransomware attacks, in which malicious software allows hackers to hold data on a machine hostage. "If your data actually exists in multiple places, you can get back your data without having to go through the ransom process," says Mr. Kraemer. But unless handled carefully, passing data back and forth between a university's systems and the cloud is one of many processes hackers can exploit to compromise security. "Very few IT organizations in higher education have a clear understanding of what it takes to secure something that's now part of your system but outside of your organization," Mr. Davis says.

Hiring data-security personnel with the necessary skills and experience has become increasingly difficult for colleges. Many institutions have started cybersecurity programs that are turning out graduates as fast as they can, but universities themselves are often looking for more senior employees.

"We're looking for people who are seasoned in dealing with difficult situations," says Darren Lacey, chief information-security officer and director of IT compliance at the Johns Hopkins University and Johns Hopkins Medicine. "It can be difficult for people to get into the field, even though there's a shortage of people once you're in."

The shortage has driven up salaries for top information-security staff as well. A chief information-security officer at a typical college 10 years ago might have started at $75,000, Mr. Davis says. "Now? Double that."

Despite scarce personnel and limited resources, Mr. Lacey thinks colleges do a good job over all at data security. Data-security professionals in higher education can communicate with peers at other institutions through a membership organization known as Ren-Isac, the Research and Education Networking Information Sharing and Analysis Center. Such networking helps keep even the smallest institutions up on the latest threats and protective tactics.

Mr. Wheeler worries, though, that such collaborations may not be enough to stave off the growing threat. Even with an information-sharing apparatus in place, word of attacks still sometimes takes days to spread in an era where minutes can count. Each institution may draw on widespread best practices, but they're all still reinventing the wheel. "We're going to have to find a path among colleges and universities that gets to a greater degree of efficiency and operational effectiveness at scale, rather than thinking that each campus individually, one by one, can keep up," he says.

But Mr. Kraemer believes it may be a good thing that colleges aren't all dug in behind a unified cyberdefense. "The kinds of protections we've each put in place, the strategies we use, they're not unique, but they're not entirely in sync either, and I think that might actually be a good thing," he says. "If everyone is doing the exact same thing, in some ways that makes us vulnerable." ∎

"If we have to have it, we encrypt it. If we don't have to have it, we get rid of it."

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3 Types of Attacks Colleges Face

PHISHING

These emails are designed to trick recipients into giving up their passwords or financial information, and they're getting more sophisticated all the time. Phishing attempts that target students, faculty, and staff members these days may even mimic missives from within the institution itself. Hackers sometimes "draw on social media, look to see what's going on at the institution, fabricate messages that appear to be legitimate, or even hack the account of someone that you would likely interact with," says Brad Wheeler, vice president for information technology and chief information officer at Indiana University.

RANSOMWARE

Click on the wrong link — even if it seems legitimate — and you might download malicious software that allows hackers to hold a machine or server hostage, along with its data. Many such attacks can be contained, but it's important for victims to report attacks immediately so the damage can be dealt with. Mitchel W. Davis, chief information officer and senior vice president at Bowdoin College, says his institution has worked to encourage ransomware victims not to be embarrassed or worried about penalties: "We get calls very quickly if they realize that they may have made a mistake."

DENIAL-OF-SERVICE ATTACKS

While relatively rare in higher education, these attacks can be devastating, as hackers flood an organization's computer network with data, overwhelming it and blocking legitimate activity in the process. "That is a great concern," Mr. Wheeler says. "If someone doesn't like something an institution is doing, or a former employee has a grievance, they can "rent a mercenary army to flood your network pipes and knock you offline."

—LEE GARDNER

Admittedly, saving the world with things like tattoos and cheese sounds a bit odd. Except here, at the University of California San Diego. Our campus is full of odd. Oddballs, brainiacs, and yes, tons of geeks. But we call ourselves Breakers. Because that's what we do—disassemble the everyday. We shatter theories. We turn conventional thinking on its head. For instance: One of our professors took a fresh look at physics,

We even boast a percussionist who is known worldwide for turning sound inside out—seeing what it's made of by pounding virtually everything he can get his hands on. Still not impressed? Then we'd love to introduce the scientist who's advancing neonatal care by giving brain-injured infants high-tech tattoos. (But don't worry, no needles were used.) So yes. We're a little odd. When you pick up a drumstick and say you're going to

A simple way to save the world using nothing more than drumsticks, some Havarti, and a tattoo.

saying that Einstein's theory of relativity could very well be wrong—that the past, present, and future are all happening right this moment. We're also home to a scientist who's taking something as mundane as cheese and transforming it into a way to change lives. (And you thought Havarti was only useful on rye.)

make a better future, you're bound to get some weird looks. But that's exactly what we're driven to do: dismantle the ordinary to produce the extraordinary. And if this unconventional courage to look at the world differently is in your DNA, then you might just be one of us.
ucsd.edu/breakthingsbetter

Philosopher Craig Callender's research on absolute simultaneity suggests that time is an illusion and everything is happening at once. Which not only questions Einstein's theory, but asks whether Albert is still here.

To grasp the mysteries of the human body, microbiologist Rachel Dutton trained her sights on cheese — specifically, the microbial communities fermenting on the rind. The result: a unique glimpse into what makes them, and us, thrive.

Bioengineer Todd Coleman took wearable technology and turned it into something that can literally read a baby's mind. His "tattoo electronics" detect brain cognition to predict seizures and heart attacks, and even call an ambulance.

Big Data for Student Success Still Limited to Early Adopters

By LAWRENCE BIEMILLER

AT the University of Iowa, "General Chemistry I" enrolls as many as 1,500 students a semester. They can go to the lectures in person — 8 a.m. Tuesdays and Thursdays in a Chemistry Building auditorium that seats 395 — or watch recordings through the university's course-management system. In addition to attending a weekly discussion section led by a teaching assistant, students are told to plan on spending six hours a week online doing homework using Mastering Chemistry, a textbook publisher's product.

The chemistry students are among the first students at Iowa to benefit from a home-grown predictive-analytics project that aims to help make sure they pass the course. The three-year-old project, called Elements of Success, combines data about students who have already taken the course with information about current students' backgrounds, how long they're spending on homework, and how well they're understanding it. Then it offers each student a dashboard with visualizations that show how he or she is doing relative to others in the class, and also forecasts the student's final grade. For students who aren't doing well, it suggests what help is available from the Academic Support and Retention office.

For some years now, learning-technology visionaries have anticipated a time when analytical tools will harness streams of data about how students fare in courses, generating reliable predictive models that will help make sure they succeed in college. But so far comparatively few institutions have seen those visions become reality. Elsewhere, technical challenges, wariness among faculty and staff members, and commercial offerings that fail to satisfy mean that widespread adoption of learning analytics is yet to come.

Last year's edition of the annual Campus Computing Survey found that less than a fifth of respondents rated data-analytics investments their institutions had made as "very effective." Kenneth C. Green, the survey's director, says that's not a surprise. "As with so many new technologies in the consumer, corporate, and campus sectors, the actual, implied, and inferred promises often fall short of initial performance."

Even Ithaka, a nonprofit organization devoted to helping colleges take advantage of digital resources, said in a comprehensive 2016 report that "the potential of these new uses remains underdeveloped," although the report also said that "research using large-scale learner data is progressing along a number of promising avenues."
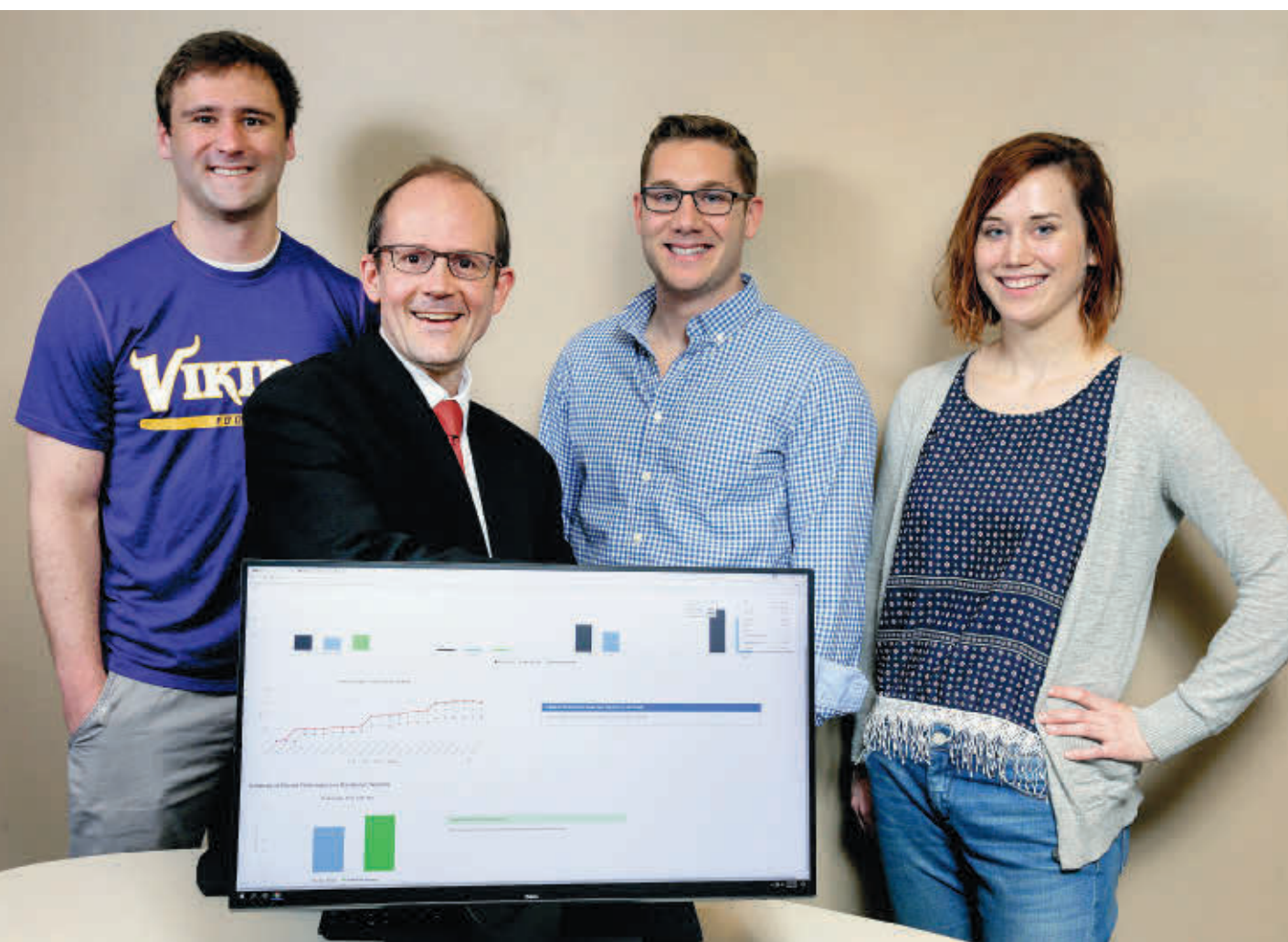
Some large institutions have moved more enthusiastically to deploy campuswide early warning systems for students' academic performance, among them Arizona State, Georgia State, and Purdue Universities, Rio Salado College, and the University of Michigan. And Unizin, a consortium aimed at "enhancing learner success with digital technology and resources," has grown to a dozen institutional members, including Iowa. But Iowa's more cautious approach is by no means unusual.

"General Chemistry I" is a "very large course, a very critical course," says Sam Van Horne, assessment director in the university's Office of Teaching, Learning & Technology. In university surveys, a third of first-year students rank the course as their most difficult, he adds, so "this was a class where we wanted to do more to support learners." Mr. Van Horne worked with several others, including one of the course instructors, Russell Larsen, who wanted to offer students better feedback than was available through commercial products. Elements of Success is now also used in another chemistry course as well as in "Foundations of Biology," and about 90 percent of students in the courses look at the dashboards, Mr. Van Horne says.

"We see a positive difference for users that are using it more frequently," he says. It's also cut down on the number of emails instructors get from students seeking to know how they're doing. And it's opened the eyes of some instructors who "believed that women or underrepresented students were doing as well as other students," Mr. Van Horne says, because "we were able to show that they were not."

Tammi J. Anderson, a first-year student in "General Chemistry I," has found Elements of Success to be helpful. "It gives me an idea if I am at where I need to be, and if I'm not, it shows me how far off I am," says Ms. Anderson, who plans to major in neurobiology and attend medical school.

BUT Elements of Success also represents some of the difficulties of using "big data" to help students succeed. Mr. Van Horne, a graduate student, and an undergraduate assistant manually pull data for the project from the university student-information system, the course-management system, and the homework site, although the university recently switched to a new course-manage-

At the U. of Iowa, Sam Van Horne (seated) and his staff members run a big-data project that provides students and instructors in certain courses with continually updated dashboards of information, including a forecast of the student's final grade.

ment provider that will enable them to automate some of the work.

"That's one of the critical roadblocks to learning analytics," he says. "Data exists in different third-party systems." To expand the program, "Either we find better ways to automate or we have to have more resources."

Elements of Success is customized for each course, relying on whatever information best predicts how students will fare on the first exam. For "General Chemistry," that means looking at students' performance on the most recent three homework assignments, but for "Foundations of Biology," the program instead picks up the results of clicker-based quizzes. There's also a different "dashboard" for every course. "We don't want our dashboard to have 50 points of data — you have to distill it down. You want them to get feedback to orient them to take the next action."

Pennsylvania State University hopes to roll out a data-driven early warning system this coming fall for its STEM-centered Millennium Scholars program, which enrolls a number of students from underrepresented minority groups. "We're going at it slowly," says David R. Smith, associate dean for advising and executive director of undergraduate studies.

"We could have all this data that says x, y, or z about students and their behaviors and their patterns, but have you really thought about what you want students to do once you've identified that there's an issue?" he says. "You've got to have the resources lined up to help them. My real thing is, data is great, but it's only as good as the people that are behind it."

Mr. Smith is also concerned that data could be used to unfairly profile students.

"I think there's any number of issues with that," he says. "Doors could get inadvertently closed on the student because you're reinforcing biases that whoever's talking to that student may have.

"Does this add to that? Does it detract from it? Can we use data to better understand interventions to know whether or not those interventions help students succeed?"

MEANWHILE, many smaller colleges say they don't see a need for data-driven early-alert systems, although they are taking advantage of the communications and note-sharing capacity offered by commercial advising systems. "We are too small to have big data," says Kerry E. Pannell, vice president for academic affairs and dean of Agnes Scott College, which has just under 950 students. "We don't have 10,000 students and an algorithm running to show if a student gets a C in this class. The advisers already know all the students."

But Agnes Scott and other small colleges are using data to improve admissions and retention by understanding what kinds of students do well at their institutions, and how to attract and retain them. Franklin & Marshall College's vice president for planning, Alan S. Caniglia, says that a review of admissions data a dozen years ago showed that "financial aid that was not based on need was not increasing the likelihood that the kinds of students we were trying to attract would actually enroll." So the college dropped so-called merit aid, and is

now getting more applications and better students. "If we hadn't been analyzing the data and been open to what the data would tell us, we would never have gotten to that point."

And while many colleges are proceeding cautiously where learning analytics are concerned, there's plenty of interest among faculty members, says Jennifer Sparrow, Penn State's senior director of teaching and learning with technology.

Kyle Bowen, the university's director of education-technology services, says faculty members in different departments are working on projects that would use textual-analysis programs, facial-recognition software, and even smartphones or Apple Watches to capture data about how students go about learning. Someday soon such information could be added to the early warning system the university will roll out for its Millennium Scholars next fall, and could even

> "My real thing is, data is great, but it's only as good as the people that are behind it."

be even augmented with data captured when students swipe into dining halls, dormitories, and recreation facilities, giving the university an ever-more-detailed understanding of how students learn.

"Once you have this really good model to work from, you can begin to use this kind of science to explore engagement questions, course-design questions," says Mr. Bowen. "The more we layer in additional data to our model, the more accurate it gets." ∎

Where Every Student Is a Potential Data Point

By SARAH BROWN

IT'S A LITTLE STRANGE to hear students being referred to as "potential test subjects" by a college president. But when the college in question is online-only and enrolls 80,000 students worldwide, it makes more sense: The possibilities for institutional researchers are just about endless.

That's why Western Governors University, a nonprofit, online institution based in Salt Lake City, has beefed up its institutional-research office over the past few years and initiated a bevy of projects focused on improving student success.

"Our job here is, How do we best serve every individual student given how they learn, what knowledge they come in with, what pace they learn at?" says Scott D. Pulispher, who has been WGU's president for a year. "We're trying to adapt the learning such that we increase the probability for any type of student to graduate."

Virtually every student interaction at

WGU — collaborating with classmates, using course resources, submitting assignments — is tracked online. The institution, which includes half a dozen state affiliates like WGU Texas and WGU Indiana, begins a new six-month term every month, and 4,000 to 5,000 students enroll in each term. Such a structure is ideal for running large-scale experiments, says Jason Levin, the university's vice president for institutional research. Since he joined Western Governors in 2012, its institutional-research office has roughly doubled in size, thanks to the addition of several business-intelligence analysts.

Not only is there an unusually rich repository of data for institutional researchers to take advantage of as they try to improve student outcomes, but they can also test hypotheses much more quickly and accelerate the pace of innovation, Mr. Pulsipher says.

"We have visibility into everything that a student is doing," he says. (A WGU spokes-

man said officials "are very open with our students about our use of data to help us improve student outcomes and satisfaction," and added that none of students' personal information is shared outside of the university.)

At many traditional colleges, terms like "assessments" and "learning outcomes" often draw skepticism because they don't seem to account for the often-intangible benefits that a college education can provide. Not so at WGU, a competency-based institution where standardized measurements and goals are the university's bread and butter. That opens up new possibilities for institutional researchers, who can hold certain variables constant while testing tools and interventions to see how they influence students.

WGU has been a pioneer of using competencies, or demonstrated skills, to help students advance toward credentials and

Continued on Following Page

Jason Levin is vice president for institutional research at Western Governors U. Since he joined the university in 2012, its institutional-research office has doubled in size.

degrees; students master skills at their own pace, rather than taking courses over a defined semester-long period. "That's the notion of competency-based — you keep the standard of the learning constant and you let the time vary," Mr. Pulispher says. "We believe every single person can learn and demonstrate proficiency in the standard."

One focus for the institutional research office at the moment is "learning personas." Personas — composite profiles of specific types of learners — describe students' ability and level of motivation. WGU wants to use that information to craft a "learning path" that's specific to each student. One persona might reflect a student who's a laggard, and not particularly engaged in courses. Another might reflect a "fader" — a student who tends to start strong but has a difficult time staying focused as each course progresses.

"We have visibility into everything that a student is doing."

The idea, Mr. Pulsipher says, is to figure out which type of mentor is going to best support a student, which prompts might best keep that student on track, and what course plan would be most effective. Does the student need general-education courses? Or does he or she have the foundational knowledge and study skills to jump right into more advanced work?

Western Governors will begin a pilot program this month to test a tool that makes use of these personas, Mr. Levin says. He and his research team are collaborating with Excelsior College, an online institution based in Albany, N.Y., to run a six-month randomized control experiment, he says.

WGU'S institutional-research office often teams up with scholars at other institutions. What's unique about WGU is that researchers can easily observe particular aspects of the student experience — for instance, students collaborating with one another in webinars, says Richard W. Patterson, an assistant professor of economics at the United States Military Academy at West Point.

"At traditional universities, you can see grades and outcomes, but no inputs," Mr. Patterson says. That can make it tough to know which specific interventions or activities helped students get over the finish line.

Mr. Patterson and WGU are working together on a project that involves designing and testing online tools with the goal of retaining students, improving their participation rates in courses, and encouraging them to earn degrees. Mr. Patterson says they are analyzing microdata (did particular tools help students submit assignments on time?) and examining broad-scale responses (did those tools also help students complete the course?).

"We're able to see if they log on to look at their courses," Mr. Patterson says, "but we're also able to see whether they're reaching those more important benchmarks."

If students are weak self-regulated learners, Mr. Levin says, one remedy might involve technology-based interventions that would give them a nudge to stay on top of coursework. His staff is working with a team of behavioral economists on a weekly planner that integrates with Google Calendar, so students would have a visual representation of their week ahead and could receive text reminders about study plans, assignments, and tests.

Another recent institutional-research project involved designing and testing a new "Leadership and Communication" curriculum aimed at making students more resilient, Mr. Levin says. In partnership with the Academy for College Excellence, WGU researchers set up three pilot programs and tweaked the course as they figured out which aspects of the curriculum were improving students' ability to progress on time toward a credential of some kind, he says.

WGU often touts its high proportion of graduates who go on to obtain jobs in their respective fields, as well as their salaries and their general well-being. That's all thanks to the institutional-research office, which works with companies like Gallup and Pay-Scale to, as Mr. Levin puts it, "get a broad sense of how our alumni are doing professionally and personally in their lives, compared to students from other institutions."

WGU and Gallup recently published a study that found that the employment rate of WGU alumni five years after graduation was higher than the national average. It also found that 73 percent of alumni said their educational experience was worth the cost, compared with a national average of 38 percent.

In the future, Mr. Pulsipher would like the institutional-research office to delve into the roadblocks that may prevent adult students from obtaining credentials and degrees.

Mr. Pulsipher also believes that traditional colleges can learn some lessons from the way WGU uses data to adapt the education it offers. For instance, why leave some students floundering in lecture halls if you have data suggesting that they might not learn well that way? he asks.

At many colleges, he says, "it's kind of like, You're admitted and we're done." ∎

Coding 'Boot Camps' Come Into the Fold With Campus Partnerships

By GOLDIE BLUMENSTYK

CHAPEL HILL, N.C.

HOUSTON Breedlove had several reasons for enrolling in the coding boot camp that Trilogy Education Services now runs in collaboration with the University of North Carolina at Chapel Hill.

At a cost of $9,500, the six-month course was less expensive than those offered by competitors. It was designed as a part-time program, so Mr. Breedlove, who worked his way through the University of North Carolina at Greensboro as a martial-arts instructor and graduated in 2013 with a religious-studies major, could keep his job at a nearby hotel. Just as importantly, he says, the program had "that legit university" behind it.

For Mr. Breedlove, it paid off. Partway through the program, he felt confident enough and "hireable" enough to quit his hotel job to focus exclusively on his boot-camp assignments. A week later he landed a paid internship at a nearby company that develops an app to help manage workflow on creative projects. Once he finished the boot camp in January, he was hired at the company full time. "If I had to do it again," he says of his educational journey, "I would have gone straight to boot camp."

Coding boot camps, which burst onto the education scene about five years ago, initially developed their cachet as the antithesis to traditional colleges. Their courses were intensive, narrowly focused, and job-oriented. They attracted career changers, students who had never finished college, and recent graduates like Mr. Breedlove, who were seeking specific job skills.

That's all still true. But today, with more than 90 companies and a few nonprofit organizations in North America operating short-term programs in software coding, data analytics, and other information-technology fields, several of the boot camps are discovering the value of a more direct connection to universities. And vice versa.

"The alums want jobs. The companies want talent," says Ann Kirschner, who just stepped down as special adviser to the chancellor for strategic partnerships at the City University of New York. "Over time, if we don't address that, we in higher education are giving away our birthright." Earlier this year, she brought a coding training company called Revature to CUNY's Queens College.

Revature, along with Trilogy, a company called the Software Guild, and the boot camp called Level, which Northeastern University created in 2015 and now boasts campuses in five cities, is among the most visible examples of this growing university-boot-camp symbiosis.

Trilogy, in fact, bases its entire business model on its partnerships with universities, much in the way companies like 2U, Pearson, and Learning House have contracted with institutions to help them design and market their online courses and degrees. In distance education, such outsourcing companies are known as online program managers, or OPMs. Trilogy is the first OPM for coding boot camps, and works primarily with colleges' continuing-education divisions.

Besides UNC-Chapel Hill, Trilogy has current or pending partnerships with 17 institutions, including Northwestern and Rutgers Universities and the University of Central Florida. The universities typically provide the space — for the boot camp here, it's a modern university conference center located a couple of miles from the historic main campus — and they OK marketing materials, admissions criteria, and curricula.

Revature has active or pending partnerships with 10 colleges now and expects to add a few more soon. Unlike most other coding boot camps, where tuition can run as high as $15,000 for an intensive six-month course (the national average is about $11,500), Revature has an unusual business model: It pays its admitted students a stipend during the 12-week coding course and then a salary of at least $50,000 after that, for the remainder of the student's two-year commitment. Revature makes its money from companies that pay it once they hire trained employees. Currently Revature recruits recent college graduates from more than 700 institutions, but within the next 18 months it hopes to find up to 80 percent of its new recruits from its partner institutions.

For the college partners, says Joe Mitchell, who oversees Revature's partnerships, "it's about ensuring access to high-value jobs in technology." For Revature, the partnerships create a pipeline for new talent, including minority students. "Every major organization has a diversity agenda," says Mr. Mitchell, and the colleges, particularly institutions like CUNY, can help fulfill that.

Colleges in partnership with Revature have no direct financial relationship with the company; other boot camps with ties to colleges typically share the tuition revenues under formulas that are not generally made public.

The Software Guild, which was acquired by Learning House in 2015, now boasts a half-dozen college partners. In most cases, the partnerships are primarily co-branded ventures, in which ties to the university are slight. But at two of the partners, Concordia University in St. Paul, Minn., and Stark State College, in Ohio, the Software Guild's courses can also count toward a degree.

Although the company receives the lion's share of the revenues, Eric E. LaMott, Concordia's provost, says the arrangement helped the college establish its own computer-science degree recently. The boot camp began

Houston Breedlove, who graduated in 2013 with a religious-studies degree, got a job at a software company after finishing a coding boot camp run by Trilogy Education Services and the U. of North Carolina at Chapel Hill.

CHRIS HILDRETH FOR THE CHRONICLE

on the Concordia campus but has since moved to what Mr. LaMott calls "a hipper location in Minneapolis." Since it began in 2015, only 57 students have taken the Software Guild's courses for credit, and only seven have gone on to enroll at Concordia. But the provost says the university sees this as a long-term play. If a boot-camp student eventually decides to pursue a full degree, says Mr. LaMott "we want to be the path of least resistance."

FOR ALL THE HYPE about them, boot camps still make up only a small niche in the educational market. Course Report, a search site for students looking for boot camps, has estimated that the 90-plus such schools in the United States and Canada had about 18,000 students complete their programs in 2016. That's less than one-third of the estimated number of students graduating from college with computer-science degrees annually, but a notable uptick from the 10,000 boot-camp graduates the year before.

Some boot camps also have a spotty record in reporting their job-placement rates and graduates' salaries in a way that would be truly useful to prospective students, although several efforts are now underway to correct that. (This month, for example, the 14 founding members of a new Council on Integrity in Results Reporting plan to publish their first set of results, based on a uniform set of reporting standards for boot camps.)

Better reporting of results would be a welcome improvement, says Rich Flynn, a managing director at Tyton Partners, an investment-banking firm, who follows the boot-camp industry. "Everyone's not getting 98 percent" job-placement rates, he says. "There's a lot of BS out there." Still, he regards boot camps as a good, albeit pricey, career investment for students. As for the university relationships, even if some might see those partnerships as a way for boot camps to "rent" the university's reputation, Mr. Flynn says they serve both parties: "I think the universities are happy to have their brands rented," he says. "They need the money."

Dan Sommer, Trilogy's founder, insists

that the academic partners are more than just window dressing. "We wouldn't be successful if the universities weren't involved," he says.

J. Jeffrey Jones, vice provost for regional campuses at the University of Central Florida, says his institution vetted the Trilogy program before signing on and continues to do so. So far, most of the students have not had direct ties to his university, but, he says, "There clearly is a need for this in our economy."

One of the costs Trilogy assumes is that of helping its students find jobs. The company claims a 90-percent success rate. Two months after graduation, at least a couple of Mr. Breedlove's classmates are still looking. But like him, both say they're far more hireable now than before. They expect to land jobs soon.

As for Mr. Breedlove, he's not only happy with his job, but he also reports he's about to get some additional responsibilities. And this month he'll start supervising a new intern: a student from the Trilogy boot camp at UNC-Chapel Hill. ∎

Growing Pains Begin to Emerge in Open-Textbook Movement

By BEN GOSE

DANITA ARMSTRONG started community college so that she could compete for higher-paying jobs, but the former bus driver and mother of five found herself with a $1,300 textbook bill last fall.

Ms. Armstrong, a student at Bay College's West Campus, in Iron Mountain, Mich., expected more of the same this semester, but instead she got a nice surprise — she learned that the textbook for her macroeconomics course would be free. The instructor assigned a textbook from OpenStax, a publisher at Rice University that uses what are commonly known as open educational resources, or OER, and makes online versions of its textbook available at no cost.

"I'm not looking for a free education," says Ms. Armstrong. "But if I can save money on textbooks, it takes some of the stress away. I can focus on my courses and not worry about whether we're going to be able to pay our bills at the end of the month."

The open-resources movement has come a long way since the Massachusetts Institute of Technology unveiled the OpenCourseWare project in 2001. Dozens of colleges now offer some courses featuring textbooks that

> "You're going to have to take some OER from here, some from there, and write some of your own stuff. It's a lot of work."

are free or nearly so, and that rely on openly licensed materials. Grant programs in Virginia and California have supported the development of entire degree pathways that feature openly licensed textbooks at community colleges — and the reform organization Achieving the Dream is supporting a national effort to roll out more such degrees.

But growing pains are also emerging as the movement reaches adolescence.

Colleges are learning that creating openly licensed courses and degree plans costs real money and takes real time. Advocates say the movement frees faculty members from the prescribed path of a commercial textbook and allows them to patch together a more meaningful classroom experience through openly licensed reading materials, quizzes, and videos.

However, as the movement spreads beyond the early believers, more colleges have been forced to offer grants to encourage faculty to incorporate openly licensed materials. And the grants are often modest, raising the question of how many instructors will take the bait.

College leaders may ultimately offer richer incentives because the use of open resources eliminates multiple barriers to classroom success. When a textbook is free, every student has the required learning materials on the first day of class. A 2014 study by U.S. PIRG, a consumer advocacy group, found that 65 percent of students said they had decided against buying a textbook because it was too expensive. And the savings from not having to buy a textbook can be plowed back

into more classes — improving the odds that a student will graduate.

The potential of open resources to help more students complete degrees means plenty of grant money is available from foundations and some state legislatures to support experimentation. The William and Flora Hewlett Foundation and the Bill & Melinda Gates Foundation have supported both OpenStax and the nearly $10-million Achieving the Dream effort, which is providing grants to develop OER degrees at 38 community colleges in 13 states.

Proselytizers like David A. Wiley, a co-founder and the chief academic officer of Lumen Learning, a company that helps colleges assemble courses based on open resources, say it's only a matter of time before openly licensed textbooks begin to crowd out more-expensive offerings from commercial publishers. "When the outcomes are the same or better, the cost to students is drastically reduced, and the pedagogical freedom for faculty is greatly increased, it's hard to see how such a product doesn't come out on top in a relatively short period," Mr. Wiley says.

Commercial publishers say their products continue to be preferred in most classrooms because of the innovative online learning tools that are often included with a textbook purchase. Publishers also point out that course materials are more affordable for students than they were a decade ago. According to a survey by the National Association of College Stores, students spent an average of

$602 on textbooks and other course materials last year, down 14 percent from 2007, not only thanks to open educational resources but also because options such as renting and buying used books have lowered the cost.

L AST SUMMER California's Legislature appropriated $5 million to create zero-textbook-cost degrees (known as Z-degrees) at the state's community colleges. All materials developed under both the California effort and the national Achieving the Dream grant program are required to hold a Creative Commons license, which allows others to freely use and adapt the resources, as long as attribution is given.

"We're hoping to create a ripple effect among community colleges in the adoption of OER," says Karen A. Stout, president of Achieving the Dream, which aspires to lift college completion rates for low-income and minority students.

A similar but smaller grant in Virginia didn't live up to its hype. In 2015, the Virginia Community College System, with support from the Hewlett Foundation, gave grants worth $15,000 apiece to help 15 colleges create new Z-degrees by June 2016. The system was looking to expand on Tidewater Community College's successful creation of a Z-degree in business administration. But even today, only two of the colleges are on their way to a Z-degree, says Jenny Quarles, the system's director of teaching and learning technology. "It was a little ambitious," she says. "We were teaching large majorities of the faculty about what OER means."

The Achieving the Dream initiative offers more money and a longer timeline. Bay College, which currently has about 15 courses that use openly licensed materials, including the one taken by Ms. Armstrong, received a $100,000 grant last summer to create OER degrees in liberal arts, business administration, and robotics.

About $30,000 of the grant will go to faculty stipends. The largest stipend, $1,000, requires instructors to build their own content, rather than tap existing textbooks, such as those available from OpenStax.

"You're going to have to take some OER from here, some from there, and write some of your own stuff," says Joseph Mold, the college's director of online learning and instructional design. "It's a lot of work."

Whether $1,000 will be enough is an open question; some other colleges have been forced to raise the amount they pay instructors to develop new open content.

Five years ago, Lane Community College, in Eugene, Ore., enticed faculty members to begin using openly licensed materials by offering free iPads. When that incentive no longer worked, Lane began offering a stipend that pays for 70 hours of curriculum development. The college now has more than 170 OER class sections available, saving students an estimated $460,000 per year, it says.

But some faculty members say the stipends still aren't enough.

Berri Hsiao and Wendy Rawlinson, Lane math instructors, have been piloting open textbooks in a three-course algebra sequence. They hope the math department will consider adopting an OER textbook for the sequence when its existing contract with the publishing

giant Pearson runs out in the spring of 2018.

"I have always thought, why am I assigning a textbook when I can literally write these homework problems myself?" Ms. Hsiao says.

The two instructors estimate that 1,700 Lane students a year buy a textbook for those courses. With average savings of $100 per textbook, a move to OER could save Lane students $170,000 per year.

But as they dove into the work, the instructors gained some respect for the time involved in creating a textbook. Simply finding open materials to use has been difficult; without a central repository, Ms. Rawlinson felt like she was searching in a "chaotic environment." Some of the material they did find used computer programming languages they weren't familiar with. And the open-resources textbook they ultimately chose for this year turned out be disappointing; the problem sets at the end of the chapters weren't challenging enough.

"Wendy and I would meet at a coffee shop to talk about this," Ms. Hsiao says. "We soon realized that we weren't making enough money to pay for the coffee. I don't think the people at higher levels who are promoting this have any idea how much work is involved."

Paul Corey, Pearson's managing director of higher-education courseware, says the Lane instructors' frustrations illustrate the value provided by commercial materials. Many textbooks sold by Pearson include online tools — including animations, simulations, and tests — at no additional cost. And as more students purchase digital textbooks, he says, Pearson's huge reach allows it to pinpoint exactly where students are struggling and revise and improve those portions of the textbook.

Mr. Corey says defections to open resources have been happening for years, but Pearson is now regaining one account that has experimented with open resources for every new one that is lost. "In all candor, it's part of the conversation: 'Tell me why you're better than free?'" Mr. Corey says. "The onus is on us to demonstrate the value."

Ms. Hsiao and Ms. Rawlinson say that the exploration of OER has been worthwhile because of what they've learned, and because of the impact an adoption of open resources may have on low-income students.

Jerric Arceo, a student in Ms. Hsiao's beginning algebra class who is pursuing a de-

gree in dental hygiene, says the open-resources textbook will allow him to graduate with less debt. "It's just like any other textbook, except it's online," Mr. Arceo says. "I'm saving money, and that's all that matters."

S OME open-resources advocates think the model of depending on grant money to roll out textbooks is doomed to fail. What happens when fickle philanthropists lose interest and move on to the next thing? And even OER textbooks need to be updated regularly — who's going to pay for that?

Many colleges are exploring fees to maintain the textbooks — which suggests that the term "zero textbook cost" could soon be on the way out. Lane is considering a fee of $1 per credit hour, which, among other things, would pay the salary of a new full-time OER librarian whose job is currently supported by grants. Bay College is also considering a nominal fee for its OER courses.

Chemeketa Community College, in Salem, Ore., is taking a different path. It is competing with the big publishers by producing its own printed textbooks through what it calls Chemeketa Press. The books use original content from the college's own faculty and openly licensed materials, and are sold for a fraction of the price of commercial textbooks.

The college's art faculty came to Chemeketa Press and said they thought they could make a better textbook than the $210 book that they had been assigning, says Steve Richardson, the press's managing editor. That experience was full of challenges — including when he realized that a draft of the art textbook had openly licensed photos of unlicensed art. Donations by local artists ultimately helped make the book, *Art for Everyone*, possible. It sells for $28, and the press's math and writing textbooks cost even less.

Revenue is being used to recover the book's development costs and eventually will be recycled into the creation of new books.

Mr. Richardson believes the college is more likely to succeed using that model than if it were to depend on grant dollars to pay for the adoption of open resources. "We sell our books at an affordable price, and students will save a ton of money," he says. "But we're not giving it away." ∎

Danita Armstrong (left front), a student at Bay College, in Michigan, and a mother of five: "If I can save money on textbooks, it takes some of the stress away. I can focus on my courses."

Big Hopes, Scant Evidence

Acquiring expensive data tools does not guarantee real improvement

By MARK SALISBURY

DESPITE ALL the cheerleading that seems to have accompanied big data's arrival on campus, its promise to transform higher education continues to surge well ahead of its supporting evidence. That is not to say that thoughtful gathering and interpreting of information can't be a powerful tool in the effort to help colleges improve. But the letdowns of the last overhyped remedy for higher education's shortcomings (MOOCs, anyone?) ought to remind us that we would do well to genuinely understand the limitations and caveats of big-data analytics before jumping on a bandwagon that turns out to be in the wrong parade.

Although specific definitions vary, big-data analytics generally combines the ability to link disparate data sources, apply quantitative methods of analysis, and convey results interactively. However, at its core, it is only a tool that might help an organization's efforts to improve. For example, colleges can already apply statistical analyses to identify the types of students who are less likely to persist to the second year or to graduate in four years, or even (if the institution is set up to capture more-granular data) to use support resources more frequently.

But acquiring the ability to deploy big-data analytics doesn't guarantee anything. The first mistake colleges make is to conflate acquiring an expensive tool with achieving demonstrable and sustainable improvement. When a college's leaders lack a clear understanding of what big-data analytics can and cannot do, this newfangled tool can end up draining an organization of time, money, and morale.

Moreover, a naïve allegiance to big-data analytics can subvert the very improvement that institutions hope to achieve. At the very least, an uncritical approach may predispose some to see causation where there is only correlation. Worse, others might succumb to the more detrimental assumption that getting answers from big-data analytics is no more complicated than asking Siri a question on your iPhone.

Take the issue of student retention. Research indicates that a student's decision whether or not to persist can be influenced by numerous factors, including pre-college academic preparation, time-management skills, or the feeling that he or she doesn't belong on the campus. An analysis of a single student cohort might reveal several statistically significant persistence predictors, some of which represent pre-college demographics (such as race, first-generation status, or socioeconomic status), while others denote first-year experiences (such as peer relationships, academic support, or sense of belonging).

But if the data set isn't robust enough to determine which of these variables is more influential, or if a combination of pre-college characteristics and college experiences produces an additional effect above and beyond the effects produced by those two factors individually, then this institution is just as likely to make an expensive mistake or to see improvement merely by chance as it is to stumble upon a change that works. To make matters more difficult, institutions can tackle only those problems for which they have data. While pre-college preparation or course-grade data might be readily available, data on time management or a student's sense of belonging may not. All of the analytic firepower in the world can't make up for data that you don't have.
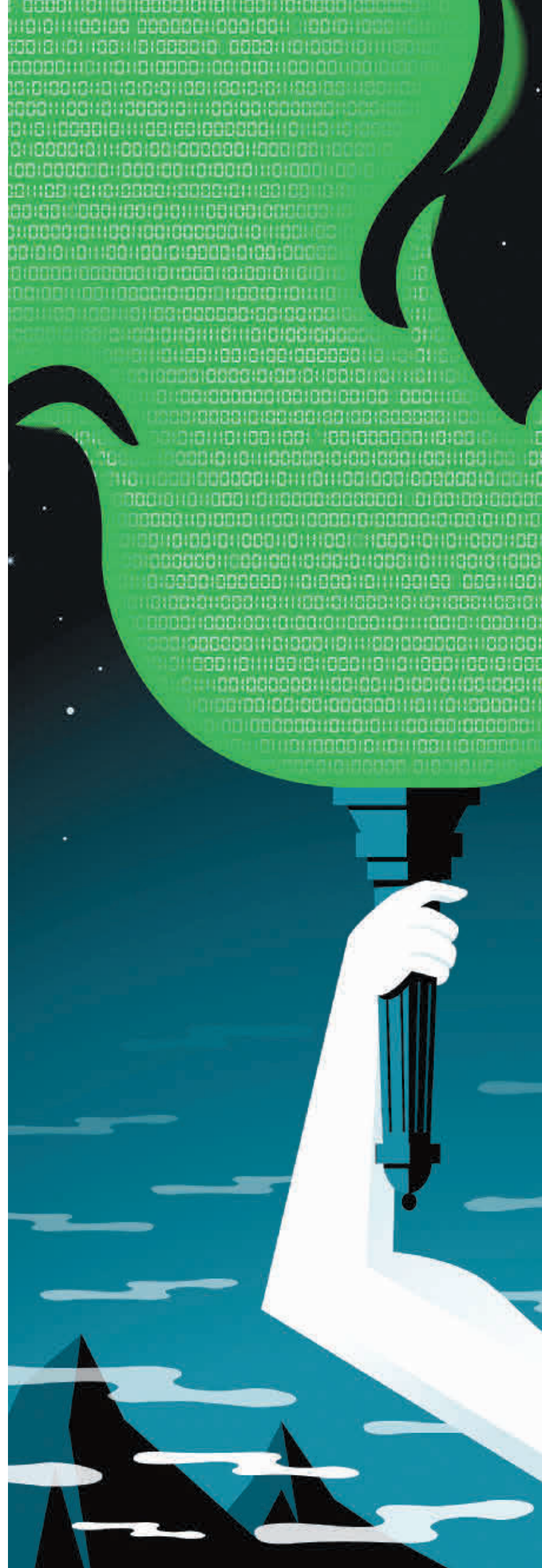
EQUALLY TROUBLING, blind faith in big-data analytics can devolve into a belief that quantitative methods are the only way to investigate a problem. This misstep would be especially troublesome for smaller colleges where the numbers of students from certain populations (such as underrepresented or first-generation students) are often small enough to require three to five years of data collection before any statistical analysis can be conducted. Yet these are the students who are often the most at risk and in need of immediate support. In such cases, focus-group findings can provide useful insights that can be swiftly applied, helping institutions sustain the momentum required to achieve improvement. For example, improving advising practices for first-year students can be as simple as asking them what has worked best and then plugging in their responses.

Sometimes qualitative research methods are the only plausible way to fully grasp the obstacles that hinder student success. Instead of doubling down on big-data analytics, colleges would be better off developing an array of research skills with the ability to discern which tool to use when.

Certainly, colleges need to improve educational effectiveness and efficiency. But change on a college campus is a process, not an event. In order to improve outcomes like student learning, retention, or completion, institutions must commit to a four-stage process:

- Identify an end result or experience that can be improved.
- Design a plausible change grounded in evidence.
- Put that change into effect responsibly.
- Assess its impact and adapt as necessary.

Consistently achieving positive results requires a carefully balanced investment of people, time, and resources across all four stages of this process. Administrators and faculty members can tell countless stories of campus initiatives that failed because they botched the design or bungled the implementation. Quantitative analytical skill is a useful tool for identifying problems or assessing the impact of a recently adopted change, but it cannot design an intervention, put a new program in place, or navigate the interpersonal nuances of helping colleagues adjust to change. Without committing to the entire process of improvement, even colleges with the best suite of analytic tools will find real improvement a long way off.

In addition, most ideas designed to increased efficiency or effectiveness in the corporate world don't fit nicely into a higher-education context. Big-data analytics emerged in a corporate environment where adopting new ideas required only a mandate from the top brass in the corner office. But in higher education, where the organizational culture prioritizes academic freedom and defends its autonomous clusters, the most effective mechanism for bringing about real change comes from the bottom up. Again, this doesn't mean that we should throw out the big-data babies with the analytical bathwater. But institutional investments in big-data analytics can't make these new tools appear to be the playthings of the senior administration. If the goal is improved educational effectiveness, and if real change comes from the ground floor, then the tools must be easily accessible to the faculty and staff members who are best situated to design and bring about change.

All of this suggests that maybe colleges should listen more skeptically to the sales pitch of big data and instead focus on aligning their investment in improvement with the process through which real change actually occurs. This might start by asking if your institution collects the information most germane to improving student success. With the National Survey of Student Engagement, Gallup, and the decades of research on college-student outcomes, resources that spell out what data to collect and how to collect it are not hard to find. Furthermore, with careful collaboration and planning, colleges can gather this information entirely in-house at almost no cost. Data-management and data-analytics software are typically already available on campus. And learning how to use this software, as well as how to marry data sets together in order to analyze them more expansively, is often only a YouTube tutorial away.

With tools like these, the bulk of the institutional investment in improvement can be redeployed to tackle a wider range of challenges and empower the people on a campus who can make real change happen. ∎

Mark Salisbury is assistant dean and director of institutional research and assessment at Augustana College, in Illinois.
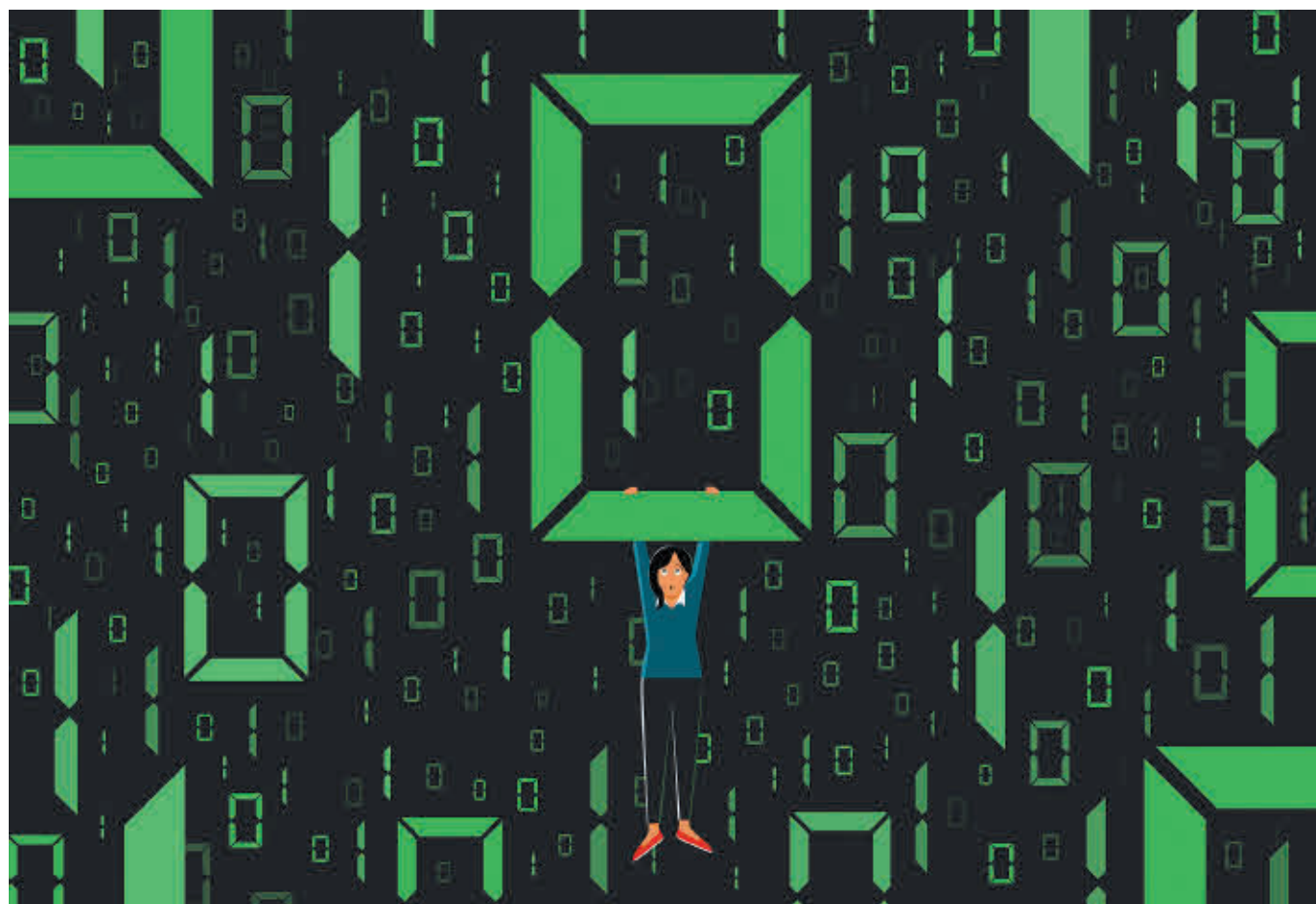
The Cost That Holds Back Ed-Tech Innovation

Hint: It's not what you think

By JOHN LYNCH

RECENTLY, I had an unexpected revelation as I watched a colleague of mine work with a pair of instructors to "hybridize" their introductory foreign-language class.

The team spent weeks breaking down their expected learning outcomes, then more weeks drafting scripts for videos (to supplement the existing textbook) and quiz questions to help students practice those skills, then months recording the videos and building those quizzes in Moodle, our campus learning-management system. Finally, after almost a year of planning and production, the instructors were able to begin testing their new tools by rigorously comparing the learning outcomes of students in the hybrid sections to those of students in traditional-format classes.

Recent research indicates that creating an instructional environment rich in real-time data about student achievement is perhaps the most powerful positive intervention that an instructor can make. So I was excited to see that the new hybrid materials were designed to collect substantial data about student achievement and behavior throughout the course. Want to know how well someone understands past-tense verb conjugation? What about the vocabulary for giving directions? Or matching the gender of nouns, articles, and adjectives? All of these data are available, and given a properly designed dashboard, a skilled instructor could use them to personalize the learning experience of every student in the class. Alternatively, motivated students could use these data to direct their own practice.

But if such an intervention is so effective, why aren't we doing this in all of our classes? The answer, of course, is cost — but not the cost that I expected. Specifically, it wasn't the technological cost. Although the instructors used some innovative technologies in their course redesign, none of those is critical to the personalized-learning aspect: The quizzes could be delivered by any learning-management system, or even on paper, and one could reveal the same data in almost-real time with only a properly designed spreadsheet. Nor was it the cost of the instructional designer, or the educational technologist. The single greatest cost of the course redesign that I watched was the faculty instructors (or "subject-matter experts," as they're often referred to), who spent hundreds of hours planning and designing all of the new content.

More important, I also realized that faculty will be the biggest cost for just about any successful educational technology project. Instructional designers can advise instructors on learning outcomes and ways to measure them, but they cannot actually design the assignments or reconfigure the readings and other supplemental materials. Technologists can build a quiz in a learning-management system from a spreadsheet listing questions and answers, but they cannot create the spreadsheet in the first place, without an expert's knowledge of the course content, and they certainly cannot record videos on an instructor's behalf, authoritatively explicating a subject, even from a script!

A technology platform might be able to transform structured data into an easy-to-parse graph or dashboard, but it cannot structure that data by itself, and we're still a long way from being able to effectively and efficiently measure "critical thinking and analysis" or "written communication skills" via multiple-choice questions. The instructor, the content expert, is the thread that ties all of these other pieces together, the one without whom the others would be irrelevant.

UNFORTUNATELY, when it comes to improving instructional outcomes, giving instructors adequate time and support for course redesign isn't how most universities seem to spend their money.

John, B.F.A., Class of 2018

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Anecdotally, I can think of instructional "innovations" at many institutions where the administration paid a high price for a new, much-praised technology platform while expecting faculty members to voluntarily commit their own time to learning it and putting it in place. Unfortunately, technology platforms are rarely the holy grail. That is to say, they do not solve problems merely by being licensed. Instead, they must be learned and used, and using such tools effectively generally requires labor far beyond what faculty members can afford to do while still meeting their other job requirements, whether they are tenure-track or contingent.

> The instructor, the content expert, is the thread that ties all of these other pieces together.

Recent data indicate that faculty members broadly agree. A 2016 study from Inside Higher Ed examining faculty attitudes toward technology found that only 26 percent of faculty members think that they are fairly compensated for developing online courses.

The New Media Consortium reports that 66 percent of the respondents in a recent survey "felt that faculty members lack critical support to advance new teaching and learning practices."

"Scaling innovative teaching and learning practices requires resources and incentives, yet pedagogical efforts are seldom incorporated in tenure review," the report says.

I am excited by a lot of the cutting-edge ideas in educational technology, such as personalized learning and predictive analytics. I believe that college students at all levels would benefit greatly if we could all evolve our teaching method from "the sage on the stage" to a data-rich "conversation" with clear learning outcomes, effectively turning every class, no matter how big, into a small seminar. Even for the most qualitative of the humanities, there are viable models that would let us implement these teaching techniques without sacrificing any of the content, depth, or diversity of experience that has traditionally characterized our fields of study.

But if we want to see serious experimentation with such teaching models, we need to first seriously consider how to compensate our instructors for the hundreds, if not thousands, of hours that such experimentation will take. Obviously, one possible approach is to actually pay them to spend extra hours on course redesign, via summer appointments or buyouts from other responsibilities. But there are other possibilities. For example, if leading universities took steps to ensure that evidence-based instructional innovation counted toward tenure advancement as much as an equivalent amount of time spent on research does, I expect that we'd see an explosion of valuable experimentation in this area.

I believe that the real barrier to widespread instructional innovation is not technical but cultural. The greatest cost of leveraging a new technology isn't the tech itself, or the technical support for it; it's the time required by local experts to build, revise, and sustain content that will make the most effective use of it. And since most universities do not compensate their instructors for this time, in either the short or the long term, that innovation isn't happening nearly as fast as it could.

If successful teaching truly matters, universities (and the elected officials, donors, and other figures who influence them) need to invest more in giving faculty incentives to engage with evidence-based and learner-centric models. Will such an approach be expensive and full of false starts? Sure. But no more so, I suspect, than another 10 years spent buying software licenses in hopes of finding the holy grail. ∎

John Lynch holds a Ph.D. in Near Eastern languages and cultures and is academic-technology manager at the Center for Digital Humanities of the University of California at Los Angeles.

How Open E-Credentials Will Transform Higher Education

By DANIEL T. HICKEY

THOSE WHO dismiss higher-education e-credentials today are acting like retailers who dismissed e-commerce 20 years ago. At that time, many retailers, publishers, and booksellers were skeptical of consumer e-commerce. Amazon's 1997 claim to be the "Earth's biggest bookstore" garnered lots of attention, as did Barnes & Noble's lawsuit claiming that Amazon should not be allowed to call itself a real bookstore. While the standards for web payments were well established by 1997, it took perhaps another 10 years for consumer reviews to become sufficiently numerous and credible to create the trust networks that would allow consumer e-commerce to become a thriving and sustainable business model. But by that time, some vendors who were slow to embrace e-commerce had already begun their slow but steady slide toward closures, layoffs, and bankruptcies.

Today e-credentials are at a similar juncture as e-commerce in 1997. Most educators and administrators are aware of efforts to extend traditional credentials with innovations such as digital badges, e-portfolios, and "extended" transcripts. Unlike traditional grades and transcripts, e-credentials can contain specific claims of competency and web-based evidence of those competencies. They can be curated, annotated, and distributed over digital networks under the earner's control. Rather than relying on vague reputations and opaque accreditations, e-credentials speak for themselves.

The concept of e-credentialing got a boost in 2013 with the publication of the Open Badges 1.0 standards by the Mozilla Foundation. Just as web-payment standards made companies like PayPal possible and simplified e-commerce, the Open Badges standards made it possible to issue e-credentials that work across current and future platforms. Also around that time the John D. and Catherine T. MacArthur Foundation funded 30 pioneering efforts to develop new educational programs around badges and to add badges to existing programs. Those events established a thriving community around Open Badges. Innovative programs like the Catalyst Credential initiative at Georgetown University and the Writing Center at Coastal Carolina University are now using badges to motivate students to go beyond course requirements by helping those students stand out from their peers to employers and graduate programs.

But five years is not a lot of time to transform entrenched practices for accrediting, credentialing, admitting, and hiring. Today, many of those stakeholders don't believe that e-credentials are "real" credentials. Most of the colleges now exploring e-credentials insist that they be scrutinized the same way as conventional credentials. The majority, however, are simply waiting for more employers, recruiters, and graduate programs to value e-credentials more widely before making the leap. Five recent developments suggest that this time is near.

THE MOST IMPORTANT development supporting expanded e-credentials is the release of the Open Badge 2.0 Specifications last December. Akin to consumer reviews, these new standards support the addition of verified third-party endorsements to Open Badges. This means that badges can now carry a
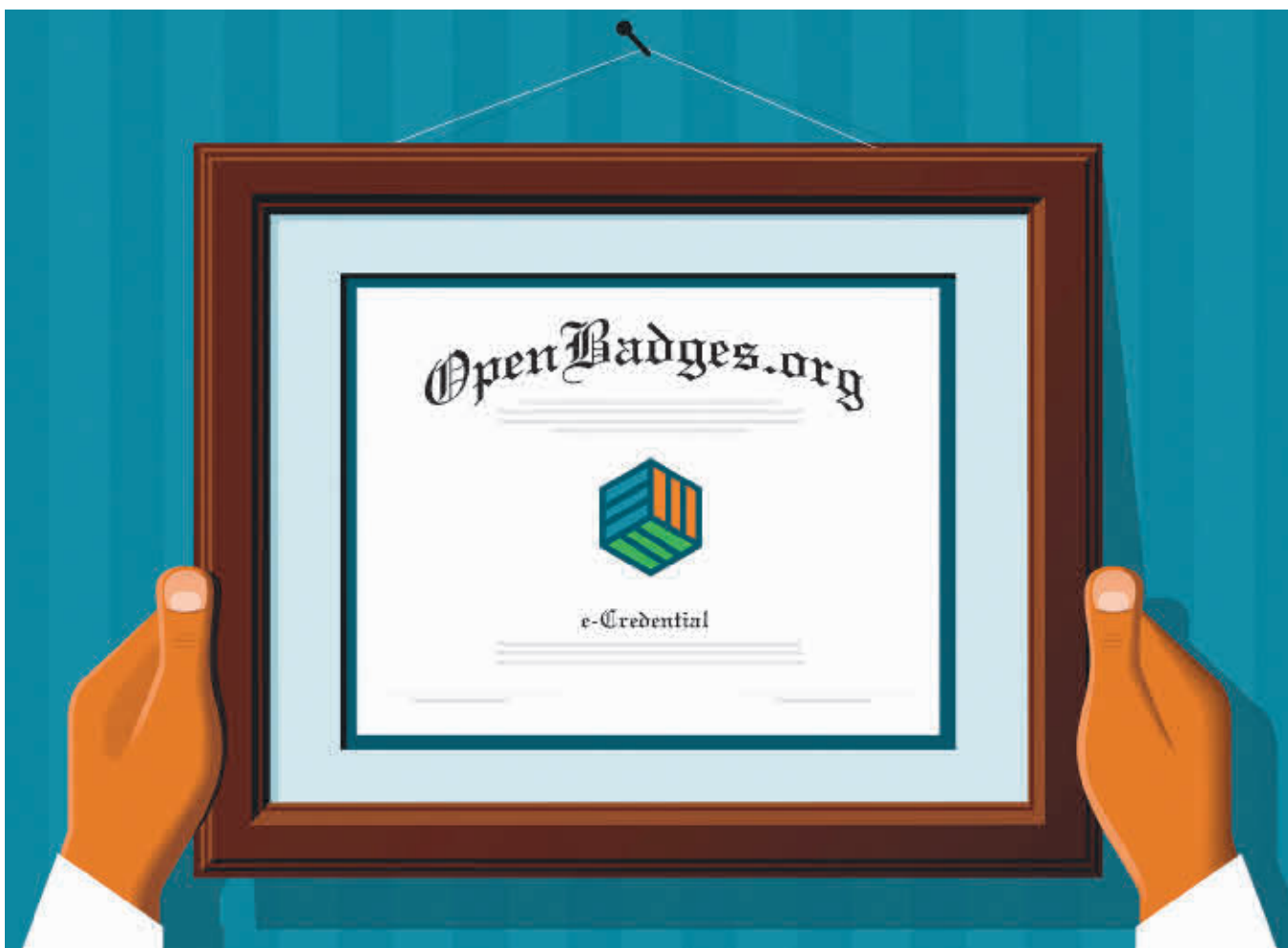
name and a logo of a third party, along with a statement regarding the nature of the endorsement, in addition to information about the badge issuer. Consider, for example, Coastal Carolina's Writing Program. The new standards make it possible for the university's Writing Center to endorse writing badges issued by instructors, and to determine which instructors are allowed to issue particular badges. Alternatively, the Writing Center might ask an employer association or professional group to endorse the writing badges issued by relevant degree programs.

More important, it is now possible for Open Badges to gain multiple verifiable endorsements after they are issued, and to allow each endorser to include an endorsing statement and feedback. Together, these developments pave the way for previously unimaginable e-credentialing "ecosystems." For example, a writing program might offer peer-reviewer badges to advanced students who have met certain criteria, who could then endorse the writing badges of other students. Because the peer-reviewer badges could contain links to all reviews and endorsements provided by the earner, those badges should motivate the peer reviewer to offer high-quality peer reviews and send a strong signal to employers and graduate programs that value writing. All the standards and technologies needed to create and automate such systems now exist.

The second relevant development for the rise of e-credentials is the explosive growth of open learning, online learning, and learning in digital social networks. Those innovations support 21st-century learning that is networked, self-directed, project-based, and personalized. E-credentials are ideally suited to credentialing such learning because they can include links to information about courses and programs, completed student work on complex projects, and detailed reviews of that work. Less obviously, e-credentials can document participation in networked learning, "crowdsourced" evidence from social networks, and crucial information about how this evidence was obtained. While this might be irrelevant for elite colleges that can rely on their selectivity and reputation, it is increasingly important for their less-selective counterparts. In the face of low-cost and no-cost competitors, such colleges will be hard pressed to offer value and therefore attract students without turning to evidence-rich e-credentials.

The third recent development was the adoption of the Open Badges Specifications by the IMS Global Learning Consortium in January. IMS Global is responsible for developing the standards that make it possible to create plug-and-play applications that easily add new functionality, including badges, to learning-management systems. This will support further refinement of badge specifications and systems and streamline their integration with other technologies.

The fourth relevant development for e-credentials is the new synergy between Open Badges and digital e-portfolios where students can showcase their work. Thanks in part to interoperability standards, many e-portfolio providers are adding badges to their platforms. This development is producing what one innovative firm has appropriately labeled "learning recognition networks." These networks make it dramatically easier for learners, educators, employers, and graduate programs to find and communicate with each other, and they have attracted the attention of several American foundations that support education and work-force readiness.

The fifth development is the publication of the Bologna Open Recognition Declaration at an international gathering of innovators last fall. The declaration highlighted the centrality of Open Badges and the belief that much of the innovation will emerge outside of accredited colleges. Open Badges, the declaration stated, "create the conditions for individuals to be in control of their own recognition, to establish their identity and agency, whether formally (within institutions) or informally (across communities)."

Together, these developments suggest that open e-credentials in 2017 are indeed as inevitable as e-commerce was in 1997. While something other than Open Badges may prevail, it seems certain that e-credentials will transform education in the next two decades much as e-commerce has changed retailing today. If that is true, colleges and academic programs that continue to ignore or resist e-credentials may have already begun a slow but inevitable decline. ∎

Daniel T. Hickey is a professor and program coordinator with the Learning Science Program at Indiana University at Bloomington. He recently concluded the Open Badges in Higher Education Project with the support of the John D. and Catherine T. MacArthur Foundation.

> Rather than relying on vague reputations and opaque accreditations, e-credentials speak for themselves.

Big Data Alone Won't Help Students

Educators must know how to make sense of and use the information

By BRAD C. PHILLIPS AND JORDAN E. HOROWITZ

"BIG DATA" has become the rage among America's community colleges. The promise of big-data systems is that predictive analytics will help educators better understand where students get stuck, helping them intervene more effectively to support students at risk of failure. These systems come with a steep price tag: generally $100,000 and higher. Other rarely anticipated outlays include system supports such as annual updates, maintenance, secure data storage, and customization. There are staff costs as well. Local staff have to enter data, check for data quality, and ensure that users have access to the system. And educators have to organize to review results and make use of the data.

At some community colleges these systems are working well and living up to their promise. These systems have the capacity to provide more sophisticated analyses to help educators understand the challenges facing students. However, colleagues who have worked to put these systems in place tell us they are frustrated by a lack of support to manage them and get useable information into the right hands when needed. Even when that is accomplished successfully, it is not enough. What is not addressed with these systems is the same problem data solutions have struggled with for decades: They ignore the fact that human beings have to derive meaning from the data in order to bring about change.

Efforts to improve data use have tended to focus solely on making improvements to the mechanics of an information system or on professional development to improve users' data literacy. However, these approaches have rarely improved student success. In response to this need among educators and educational institutions, we developed a model for data use that goes beyond mere analytics and training.

In our forthcoming book on improving data use among community colleges, we explore how recent research in neuroscience, psychology, behavioral economics, and organizational change can be integrated to help us reframe data use. The three-component model we've developed includes: (a) analytics, (b) human judgment and decision-making, and (c) organizational habits.

We argue that analytics, although a crucial component, is not enough; and certainly not the way community colleges currently present data. Canned research reports run to dozens of pages of tables full of rows and columns of data. Furthermore, we have reviewed reports from colleges in which upwards of one-third of the cells in these tables contain zeros. There is no nar-

Human beings must turn data into meaningful information they can act upon.

rative in such reports, and educators must go on a fishing expedition to identify the issues and where to act. We argue it is essential to focus on both what matters and what is in the institution's control.

This is why our model is driven by both leading and lagging indicators. Too often colleges focus on lagging indicators, those indicators that occur at the end of a process. Degree, certificate, and transfer rates are common lagging indicators — the big goals for which funders and accreditors hold colleges accountable. But can colleges influence these directly? Our experience is that they cannot. And these statistics only report on the survivors who end up graduating or transferring and give no information about students lost along the way. On the other hand, leading indicators, such as in-class retention and course success (C grade or better), which influence lagging indicators, are actionable with research-based interventions and supports.

Odessa College, in Texas, whose story is highlighted in our book, focused deeply on in-class retention (students who stay in a class to its completion and do not drop out), which served to increase course success for all students, nearly close the achievement gap between students of different ethnic/racial backgrounds, improve term-to-term persistence, and increase the graduation rate by 65 percent.

But good analytics are not enough. Human beings must turn data into meaningful information they can act upon. Our current reporting systems do not make this easy. In the dozens of colleges where we've worked, even with sophisticated systems and high-end display tools, understanding the data is still a challenge. To solve this problem we need to apply what is known about how people make judgments and decisions. Behavioral economics research helps us understand how to present the information so that educators can ask the right questions about what it means and make decisions that lead to changes in policy and practice. We recommend that any data that is disseminated must be only in support of improving student success or because a college has to report the data for compliance. Data presented "for information only" misses the point.

We also must acknowledge the historically ingrained habits that plague educational institutions. Too often at community colleges, data is presented as a lone item in a packed agenda instead of as the focus of meetings for decision-making. When data is presented in this way, it is discussed only briefly, and devalued. Instead, we recommend that every meeting in which a decision must be made related to student success begin with data about the issue. This grounds the participants in a common understanding.

Colleges considering a big-data solution have the potential to employ sophisticated analytics to better understand the challenges students face and make changes in policy and practice to improve outcomes for all student populations. But these systems alone cannot increase student success. ■

Brad C. Phillips is the founder, president, and chief executive of the Institute for Evidence-Based Change, in Encinitas, Calif.; Jordan E. Horowitz is the institute's vice president. Their new book, Creating a Data-Informed Culture in Community Colleges: A New Model for Educators, *is due out from Harvard Education Press in the fall.*

The Job-Market Moment of Digital Humanities

By LEONARD CASSUTO

THE ANNUAL convention of the Modern Language Association is the greatest show on earth for the humanities, with thousands of attendees, hundreds of panels, and thousands of job interviews for aspiring professors. The scope and importance of the conference turn it into a bellwether of trends — and for some years now, digital humanities have been all the rage.

Digital humanities — using computer technology to understand literature and the arts, or vice versa — are something more than a fad. They present new ways to approach the work of humanities scholarship, and they've already delivered not just new results but also new kinds of results. Those findings were on abundant display at the MLA.

Digital humanities have also become integrated into the academic job market. That raises the question: Will expertise in digital humanities get graduate students the academic jobs that so many of them seek?

At the moment, demonstrated digital expertise certainly helps. Humanists are generally keen to learn the new uses of technology. Graduate students, who know a call to the keyboard when they see one, have responded. Most are already tech-savvy, and many are using their knowledge to add a digital aspect to their professional profiles. I have a student on the academic job market this year with a sophisticated website under way, in addition to her traditional print dissertation. Interest in her digital work has given traction to her candidacy.

Digital humanities are one of the few growth areas in today's dismal academic job market. Some departments have advertised specifically for digital humanists, while others have proved eager to hire people who bring digital expertise to their applications — even if the advertised job calls for a specialty in something else.

But I don't think this technological drive will change the graduate-school playing field very much in the long run. The excited pursuit of digital humanists reminds me of the way that literary theorists were recruited starting about 30 years ago. Theory — a mixture of deconstructionism, poststructuralist psychoanalysis, and the study of indeterminate reader response — arrived at American colleges and universities in the 1960s from Europe and immediately began to undermine conventional ways of seeking meaning. That made it a good fit for scholars living in an uncertain time. On the heels of trendsetters at Yale and elsewhere, literary

theorists gradually infiltrated departments of literature around the country.

Theory crossed a certain invisible threshold in the mid-1980s, and then suddenly every department needed to have a "theorist" on its faculty. Advertised openings mushroomed, as literature departments sought to represent this new field on their faculties.

Literary scholars of a certain age know the result: After a few years, those job openings for theorists went away. That didn't mean theory itself went away — quite the contrary. Instead, it was absorbed. New Ph.D.s in literature simply added competence in literary theory to the long list of things they needed to know. Just about every graduate student learned something of literary theory, meaning that everyone became a theorist of sorts.

As a result, there was no longer a need to hire "theorists," because the understanding of literary theory became part of the basic package that new Ph.D.s were expected to offer to employers. Today, more than a generation beyond the hiring explosion in literary theory, my own department requires an introduction to literary theory for majors in English and comparative literature. In that respect we are quite typical. A handful of my colleagues take turns teaching the course. Others could step up, if need be, because today we are all theorists, more or less.

The same thing will happen with digitally based scholarship, I think. Graduate students everywhere are becoming digital humanists — for two good reasons.

Reason No. 1: Scholarship. Digital technology is the source and home of much lively and interesting new inquiry, both among scholars and in the undergraduate classroom.

One of the most notable benefits of the digital revolution is the way that it facilitates collaboration. Humanists have been slow to embrace collaboration. After all, we've been raised on the myth of the solitary author who toils away in the attic, emerging after years with a work of genius, written in deathless prose. Whenever we ask, "Which part of this is his?" (and versions of that question still come up in personnel meetings), we show the continuing persistence of the lone-scholar myth.

Likewise, humanists have historically found it harder to collaborate than is the case for scientists and mathematicians. Most scientists are socialized into their professions through laboratories,

which are hotbeds of collaboration. Mathematicians, who can do their problem-solving in real time (with the technical matter of "writing up" coming later), schedule visits with one another so that they can work together. But the way that humanists have worked reminds me of the title of a documentary that I saw years ago: *Piano Players Rarely Ever Play Together*.

Computers, however, have been bringing humanists together, and that can only be a good thing. This new work has a chance to revolutionize what humanists do. Sidonie Smith, a professor of English at the University of Michigan at Ann Arbor and a former president of the MLA, declares in her excellent 2015 book, *Manifesto for the Humanities*, that the new digital environment "ratchets up the urgency of pursuing a 21st-century vision of doctoral education."

Reason No. 2: Jobs. Graduate students understand all of that, of course, but they're becoming digital humanists because it gives them a better chance to get an academic job. That's the second and more important reason for the proliferation of digital humanities among graduate students.

Digital humanists are grabbing a disproportionate share of the few professorial openings out there because departments want to bring this new work to their own campuses. Not being born yesterday, graduate students have followed demand and have gravitated to this promising intersection of literary study and computing technology.

Flash forward 10 years, and digital humanities will be present in just about every humanities department. Everyone will be a digital humanist, more or less. And as with theory, the digital-humanities job openings will go away.

I'm not describing a bad thing, just a predictable evolution. Digital humanities will stay, but their job-market moment won't. That moment is now. If you're a digital humanist, you've got a horseless carriage to ride, and it might just carry you ahead of the horses around you. But hurry, before everyone else gets one, too. ∎

Leonard Cassuto is a professor of English at Fordham University who writes regularly for The Chronicle's Vitae *about graduate education. His book,* The Graduate School Mess: What Caused It and How We Can Fix It, *was published by Harvard University Press in 2015.*

> Digital humanists have an edge in hiring now because departments want to bring this new work to their own campuses.

Reading List for a New World Order

We asked five scholars of our digital age to name a few influential books on technology that they had recently read — or reread. Here are their choices.

Charles L. Isbell is senior associate dean in the College of Computing at Georgia Institute of Technology and a professor in the School of Interactive Computing there.

AMARA'S LAW STATES: We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run. There are many examples of this adage, coined by the late futurist Roy Amara: Automation marches us toward high unemployment; social networks bring us simultaneously closer together and further apart; everything we do is cataloged; and it is all happening far too fast for us grasp.

Two recent books on technology bring this idea into focus for me: *Thank You for Being Late: An Optimist's Guide to Thriving in the Age of Accelerations* by Thomas L. Friedman (Farrar, Straus and Giroux, 2016) and *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy* by Cathy O'Neil (Crown Publishing, 2016). They are companions. The first lives at the level of politics and society, while the latter is a cautionary take on how technology touches each of us, often invisibly, and often to devastating effect.

Both books are of the type that reads like a series of anecdotes that elucidate a huge problem and then offers a sketch of a solution that is justified by the preceding chapters but doesn't quite seem up to the task. But, hey, the problem is hard, and sometimes just outlining the problem itself is what's important.

By way of example, O'Neil discusses "recidivism models" that take features of a criminal defendant to "score" that defendant to help determine sentencing. The problem, of course, is that these algorithms are opaque. They provide a veneer of objectivity but hide their underlying assumptions (both to the user and to the target of the system). The reader should decide what consequences such an approach might have when scrutinizing job applicants, determining insurance rates, or just calculating how many police officers should walk one's streets.

In any case, my recommendation is to read Friedman's book for context and O'Neil's book for detail and depression, and then reread Friedman's book for a dose of optimism. We are clearly living in the long run of technology, but perhaps even though we are but linear beings we might still be able to handle exponential change.
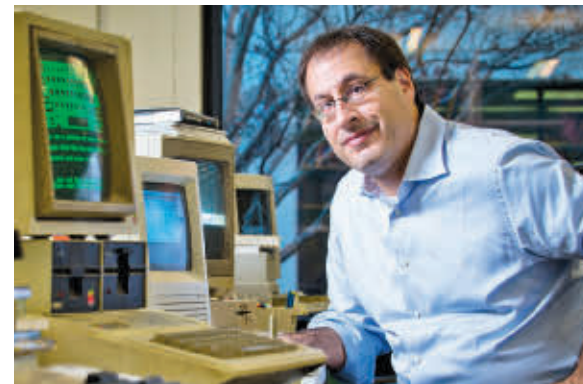
Matthew Kirschenbaum is a professor of English at the University of Maryland and director of the graduate certificate in digital studies.

THAT WEIRD FEELING when you get off the plane after an overnight international flight and you turn on your phone and — despite the jet lag, despite the disorientation, despite what may be an unfamiliar language and unaccustomed options at the espresso bar, it's all right there: all your apps, your digital life just as it was when you boarded seven hours earlier … except. Your phone is roaming on a network you've never heard of, and all your web browsing is torqued through newly localized filters.

Benjamin H. Bratton explains that feeling in *The Stack: On Software and Sovereignty* (MIT Press, 2015), a sprawling book on the relationship between the planetary-scale "megastructures" of contemporary computation and the geopolitics of a world order that still defines itself in terms of nation states and borders. Exhilaratingly written, *The Stack* just might be the unannounced sequel to Michael Hardt and Antonio Negri's millennial *Empire*, which theorized the world order on the eve of 9/11, Facebook, and so much else.

Alongside of that I'm just beginning what first seemed like a far more specialized study but quickly turned into one of those "now why hasn't anyone ever told that story before" books: Marie Hicks's *Programmed Inequality: How Britain Discarded Women Technologists and Lost Its Edge in Computing* (MIT Press, 2017), which traces the role of gender politics in British computing in the postwar period. It starts with everything that *The Imitation Game* obscured in its film treatment of code-breakers during World War II, and from there sets out to explain why and how Great Britain was reduced to playing catch-up by the time the personal computer revolution hit at the end of the 1970s. The party was thrown by guys in their garages in Palo Alto, and not the daughters of all those British women who first perfected the art of speaking to machines at Bletchley Park.

Finally, a novel — Jarett Kobek's *I Hate the Internet* (We Heard You Like Books, 2016), the New Grub Street we deserve: "The Internet," one of the first few lines helpfully explains, "was a computer network that people used to remind other people that they were awful pieces of shit."

David M. Levy is a professor in the Information School of the University of Washington and author of *Mindful Tech: How to Bring Balance to Our Digital Lives* **(Yale U. Press, 2016).**

A S SOMEONE who investigates the acceleration of life and the role that digital technologies may be playing in the process, I was pleased to see two books published recently that will surely add dimension to both my research and teaching. The first of these books is an obvious addition. By Judy Wajcman, a professor of sociology at the London School of Economics and Political Science, *Pressed for Time: The Acceleration of Life in Digital Capitalism* (U. of Chicago Press, 2015) presents a highly nuanced account of the modern experience of acceleration. Drawing on decades of work in science and technology studies, she argues that digital technologies aren't simply the cause of today's acceleration, but rather are one of the factors within a larger sociotechnical matrix of values and practices that is responsible for today's speedup. From this perspective, today's acceleration — which she shows is lumpy, a mix of both acceleration and deceleration, and experienced differently according to gender, and other factors — isn't technologically determined, and so is potentially malleable, open to social and political intervention.

The second book requires a bit more explanation. For decades, three social psychologists, Sheldon Solomon, Jeff Greenberg, and Tom Pyszczynski, have been developing a substantial body of evidence for the cultural anthropologist Ernest Becker's thesis — most fully developed in his Pulitzer Prize-winning book, *The Denial of Death* (Free Press, 1973) — that fear of our mortality is one of the hidden drivers of human culture. In their 2015 book, *The Worm at the Core: On the Role of Death in Life* (Random House), they present their evidence in highly readable fashion. While their work holds insights for many of today's problems, not least a deeper understanding of where prejudice, scapegoating, and terrorism come from, it also allows us to ask, and may supply existential answers to, questions such as: Why are we running so fast, powered in large measure by our latest digital devices and apps, and why are we so busy distracting ourselves? Is it possible that we are trying to escape the inescapable, the fate of all living creatures?

Abby Smith Rumsey is a historian and the author of *When We Are No More: How Digital Memory Is Shaping Our Future* **(Bloomsbury Press, 2016).**

O FTEN we invent tools with wondrous uses in mind only to be surprised how easily they are abused. A compelling and timely book about the misuse of genetic technology by politicians and scientists in Stalinist Russia is Loren Graham's *Lysenko's Ghost: Epigenetics and Russia* (Harvard U. Press, 2016). Guided by newly available sources and his unerring moral intelligence, the historian of Soviet science revisits the frightening story of the Soviet agronomist Trofim Lysenko (1898 -1976). Lysenko's championing the heritability of acquired traits served Stalin's need to bend the will not only of Mother Russia but of Mother Nature herself to his goal of fast-tracking communism. Famines and ecological disasters ensued. Scientists such as Nikolai Vavilov were persecuted and biological science suffered a catastrophic collapse. Graham brings the story up to date with ominous details about the rise of "neo-Lysenkoism" in present-day Russia.

Another take on political abuse of technological know-how is Brian Moore's last novel, *The Magician's Wife* (Bloomsbury, 1997). Based on the life of the magician and inventor Jean-Eugene Robert Houdin, it relates how Emperor Napoleon III recruited him to quell a rebellion in colonial Algeria. The master of illusion's technological sleights of hand pass for miraculous powers superior to the insurgency's charismatic religious leader. The French win this skirmish but lose the war. The proud master is irredeemably corrupted in the process. *The Bestseller Code: Anatomy of the Blockbuster Novel* (St. Martin's Press, 2016) by Jodie Archer and Matthew L. Jockers asks if there is a code for writing bestsellers. Their answer is a qualified "yes, with our algorithm." Is it surprising that the signature features of bestsellers map onto the advice writing coaches give on how to tell a story? Maybe not — and for that we should be grateful. But it is noteworthy that sex and violence are only bit players in a book's success. The lead roles go to emotional intimacy and work. As a bonus, the authors append a list of bestsellers ranked according to how well the algorithm scored them.

Audrey Watters is a Ph.D. dropout and independent scholar who writes about education technology on her website Hack Education.

T OO OFTEN, when we talk about technology, we focus on the latest gadgets and gizmos. We pay attention to products and PR at the expense of practices or processes. This is particularly true — unfortunately true — in education technology. It's for that reason that I often turn to one of my favorite books, Ursula M. Franklin's *The Real World of Technology* (CBC Enterprises, 1990). Franklin insists that "Technology is not the sum of the artifacts, of the wheels and gears, of the rails and electronic transmitters … Technology is a system. It entails far more than its individual material components. Technology involves organization, procedures, symbols, new words, equations, and, most of all, a mindset." Technology must be examined, she argues, as an "agent of power and control."

Franklin died last year, as did the author of my other favorite book on technology — that's Seymour Papert's *Mindstorms: Children, Computers, and Powerful Ideas* (Basic Books, 1980) — and their loss prompted me to reread both of these classics to help think about the politics of technology and the ideology of computing, then and now.

My advice: Read technology books by women. Read technology books by writers of color. Read technology books by writers from the Global South. These authors often subvert the dominant ideologies about technology as progress, as inevitable, recasting those imperialist technological narratives by paying much closer attention to power and control. Take Simone Browne's *Dark Matters: On the Surveillance of Blackness* (Duke U. Press, 2015), for example. The book reframed my own thinking about surveillance — and digital technologies more broadly. Rather than accepting the Panopticon as the archetype for our modern notions of power and control, Browne demonstrates that surveillance systems were an essential part of the trans-Atlantic slave trade. Indeed, surveillance technologies — that is, to borrow from Ursula Franklin, the "organization, procedures, symbols, new words, equations, and, most of all, a mindset" — have been inextricably tied to slavery in the United States and to the construction of blackness.

"What happens when blackness enters the frame?" Browne asks — and this is a question that those in education technology need to be posing a lot more often with regards to the tools and practices that "see" and "don't see" students. ∎

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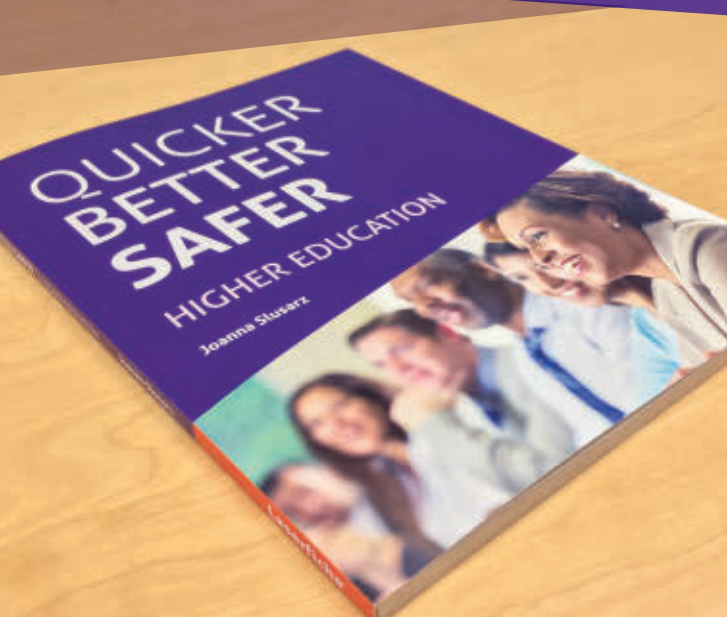
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