What You Need to Know About Learning Analytics
As a Chronicle of Higher Education individual subscriber, you receive premium, unrestricted access to the entire Chronicle Focus collection. Curated by our newsroom, these booklets compile the most popular and relevant higher-education news to provide you with in-depth looks at topics affecting campuses today. The Chronicle Focus collection explores student alcohol abuse, racial tension on campuses, and other emerging trends that have a significant impact on higher education.
THE ADVENT of online learning has made it possible to track an individual student’s path toward understanding and mastering course content. That kind of tracking, known as “learning analytics,” is a hot topic among educators. The question everyone is debating is how the data can be tapped to enhance course design and improve teaching.

This Chart Shows the Promise and Limits of ‘Learning Analytics’
Data can help professors teach better but can also confuse them.

As Big Data Comes to College, Officials Wrestle to Set New Ethical Norms
How much should students be told about their own learning data?

A Pioneer Issues a Warning About the Commercialization of Learning Data
These days, Candace Thille is having darker thoughts about an industry she helped spark.

A Moment of Clarity on the Role of Technology in Teaching
The right way to use technology is to help professors do what they already do, but better.

Reaching Students in the Back Row
Three personalized-learning strategies could make a difference for struggling students.

Adaptive Learning Earns an Incomplete
A majority of courses that used adaptive learning had “no discernible impact” on grades.

Understanding the Origins of Ed-Tech Snake Oil
Product marketers make too much of research findings that are both nuanced and provisional.
DATA VISUALIZATION produced by Utah State U. depicts student activity in one online course.

Taking a college course is a journey, and each student ends up charting a unique path through the assigned materials — bits of lectures that resonate, chance conversations with classmates, the parts of a textbook actually consumed.

With more courses happening online, colleges now can track those individual journeys more precisely. Such tracking is known as “learning analytics,” and it’s how administrators at Utah State University created a single graphic that depicts all the student activity from a recent online course. When I met one of the top officials from the university at the big ed-tech conference held by Educause, this image is what he was excited to show me, as if it held the solution to a longstanding riddle he was working to decode. He called it “the spider graphic.”

There’s certainly something powerful about the idea of having all of this information about student behavior revealed. Before the advent of computers, exactly what materials students looked at, and how long they spent reviewing each item, was unknown to professors, and seemed unknowable. Now such information about dozens of students can be displayed in a single picture, and one with a kind of strange beauty in its curving, interwoven lines.

Promoters of learning analytics talk of using these data-infused pictures to build more effective courses. They talk about teaching with an engineering mind-set, not just a curatorial one. If it’s done right, proponents argue, the average student will learn more than ever before — which will not only help individual learners expand their minds, but also improve an institution’s retention rate. And the best part is that colleges may already have the data, captured by the course-management systems they installed years ago. That’s why learning analytics has suddenly become one of the hottest topics in teaching with technology.

“It takes a lot of mystery out of why students succeed and why students fail,” said Robert W. Wagner, executive vice provost and dean at Utah State, and the fan of the spider graphic. “It gives you more information, and when you can put that information into the hands of faculty who are really concerned about students and completion rates and retention, the more you’re able to create better learning and teaching environments.”

But how much can big data actually reveal about something as personal and subjective as learning? And even if spider graphics can yield valuable insights, will professors know how to read them?

The story of Utah State’s graphic turns out to show the promises and limitations of learning analytics, and it highlights the issues raised when the
A data visualization produced by Utah State U. depicts student activity in one online course.

COURTESY OF UTAH STATE U.
type of data visualizations now common in business are brought to the college classroom.

DATA REPLACES GUESSSING

Courtney Stewart is the professor who designed the course depicted in that colorful graphic. He’s an assistant professor at Utah State’s School of Teacher Education and Leadership, and he’s been teaching online and blended courses for about seven years.

His students consistently give him above-average reviews in their course evaluations, but he has long been frustrated by how little he knows about how students experience his online classes. Without the ability to see students in person, he has to make guesses. For instance, when he saw students not following basic instructions on how to submit one particular assignment — information that was outlined at length in a video lecture — he figured that those students had skipped the video. “I do all this work to make these PowerPoints and these videos, but I was really worried about student engagement,” he says.

So, working with the university’s center for teaching and learning technology, he designed a course that gave students a variety of options, and then made an effort to analyze what students picked and how they did in the class. The course is titled “Instructional Strategies for Diverse Learners.”

For each lesson, Mr. Stewart created several different delivery options. Students could read a text-based version of his lecture. They could listen to an audio lecture. Or they could watch a narrated PowerPoint. And when students did their homework, they could respond in whatever format they wanted to: submitting either a written essay, an audio reflection, or a video response. He would give feedback to each student in kind — so if a student submitted a video reflection on the week’s assignment, Mr. Stewart would reply with his own video critiquing the student’s submission.

The professor wanted to see whether students stuck with one delivery method or mixed it up. But he also just wanted to test more basic assumptions about his course’s design.

One of the biggest surprises he found: Only half the students ever used the home page he had so carefully built for the course. Instead, many students just jumped to the homework, and only clicked to a reading assignment or lecture if they didn’t know the answer to a question.

Now that Mr. Stewart knows that, he is considering some design changes. One idea is to put course material on the assignment pages, where he knows all students visit.

How do the students feel about having every move of their learning tracked? At least one of Mr. Stewart’s students, Kade Hendricks, is fine with it — and in fact he says it might motivate him and other students to stay on task.

Like many online students, Mr. Hendricks works full time and only has time for coursework on weekends or after he puts his kids to bed. So he admits to looking for shortcuts in many of the courses he takes. “If students know that the teacher can pull all the data, they might put in more effort,” he said. The important thing, he added, is to make sure students know they’re being watched, for ethical reasons.

Mr. Stewart is still sorting through the data. And it turns out that the very chart that most excited Utah State administrators — the “spider graphic” — is the hardest for him to use. “It looks pretty, and it’s a really cool picture,” he said. “But I don’t quite know how that has meaning for my practice.” Will online teaching soon require skills in data science?

Kevin Reeve, director of teaching and learning technology for Utah State, says that the long-term goal is to create “dashboards” that give professors easy-to-understand views of the data — and to work with professors to find out what information is most useful to them. The dashboard metaphor seems to highlight how this technology might change teaching. If in the past professors could take in what they needed to know by simply looking out the windshield, now they also need to consult a range of gauges and dials.

“A NEW FRONTIER

Mr. Reeve describes Utah State’s work as “charting a new frontier” when it comes to teaching, and that means that norms haven’t been developed yet. Some preliminary research done at other colleges may be able to give him and other administrators some guidance, though.

Isaac Chuang, senior associate director of digital learning at the Massachusetts Institute of Technology, says that one early lesson has been that the

“It takes a lot of mystery out of why students succeed and why students fail.”
One of the biggest surprises he found: Only half the students ever used the home page he had so carefully built for the course.

Originally published on January 4, 2016
As Big Data Comes to College, Officials Wrestle to Set New Ethical Norms

By GOLDIE BLUMENSTYK

A week before classes begin at the University of Maryland University College, students can start poking around the online course materials. Some do, looking over the syllabus and getting a feel for the subject, but others don’t bother. It turns out that with just a little number crunching of that pre-course behavior, university officials can make some surprisingly accurate predictions about who will flourish and who will flounder.

“We know the day before the course starts which students are highly unlikely to succeed,” says Marie Cini, provost at UMUC, where most of the 60,000 undergraduates take courses online.

Colleges are increasingly awash in information and so-called clickstream data about their students — much of it ripe to be mined and analyzed. Data is becoming ubiquitous thanks to advances in analytics software, a slew of new personalized-learning and student-success companies, and course-management platforms that collect and analyze students’ online interactions. The promise is that colleges can use such data to improve retention and help students graduate.

But as more colleges experiment, they’re facing complex questions about what to do with the findings the data-crunching reveals.

What, if anything, should students be told about the judgments institutions are making about them from the data footprints they’re leaving behind?

Should companies be able to profit from that data? And should students have the right to opt out of being monitored?

Just as a new medical finding can create standards by which doctors provide care to their patients, does having such information establish a new standard of care for colleges?

“We are entering a new era of data and data responsibility,” says Mitchell Stevens, an associate professor in Stanford University’s Graduate School of Education who has long pushed for ethical standards around educational data that go beyond legal issues of privacy or security. In an era of ubiquitous data, he says, colleges need to decide: “Are we acting responsibly as educators? What values are we trying to pursue and preserve?”

Those were also some of the questions Mr. Stevens put front and center this month at a private convening of several dozen academics and a smattering of ed-tech company and foundation leaders.

Sponsored by Stanford and Ithaka S+R, a nonprofit education consultancy, the meeting at the Asilomar Conference Grounds, in California, was designed, in the words of its website, to produce “succinct statements to inform institutional, national, and global policies regarding the research, application, and representation of adult student data.”

The group has no formal authority, but it is building on precedent. In 2014, in the wake of MOOC
mania, Mr. Stevens and others met at Asilomar and established principles to guide research using student data while respecting the rights of students and the “humanity of learning.” Those principles were prompted by concerns that colleges and MOOC providers were collecting reams of digital data about the hundreds of thousands of people signing up for MOOCs. But since most of those students weren’t enrolled in the institutions offering the courses, there were no clear guidelines governing how the data could be used.

**FLOOD OF DATA**

This month’s meeting, Asilomar II, was focused more directly on how institutions treat their own students — and the flood of data they generate every time they log in to a course-management system to turn in an assignment or answer a quiz in a digital textbook equipped with “personalized learning” software.

The group’s findings won’t be formally released until August, but Mr. Stevens and his co-organizer, Martin Kurzweil, director of the Educational Transformation Program at Ithaka S+R, provided The Chronicle with a rough summary of the conclusions. Among them:

- Student data collected into analytics programs should be thought of as a joint venture, where the students, institutions, instructors, and — where they are involved — third parties all need to have a shared understanding of how the information is used, including when it is developed as a revenue source for colleges or companies.
- Data-analytics programs and products should be designed with “transparency,” especially in cases where an algorithm in the analytical software makes decisions about what happens next to a student; those decisions should be explainable and appealable.
- Educators using data analytics have a responsibility to take action based on what they learn from their data analysis, a principle that the group called “informed improvement.”
- Decisions and discussions about the ethical use of data analytics need to be under “continuous consideration” that, ideally, is embedded in an explicit governance process.
- Colleges relying on data analytics, and particularly tools that use information to predict student outcomes, should ensure that students have “open futures.” As Mr. Stevens put it: “Education should create opportunity. It shouldn’t foreclose it.”

Participants at Asilomar II noted that the explosion in data analytics will also create new ethical issues around students’ transcripts and other official academic records that colleges have traditionally stewarded. With today’s predictive-analytical tools, colleges could conceivably calculate a student’s likelihood of graduation and make that prediction part of the academic record, says Mr. Kurzweil, “but should you?”

The group also spent a lot of time considering ways to ensure that student data remains useful to academic researchers. Today, says Mr. Kurzweil, too many institutions are organized in ways that actually inhibit such research. Many still keep their data in silos that can’t or don’t connect with one another, he says, or they use commercial products where the key information about student learning is controlled by a proprietary “black box” algorithm that’s off limits to outside researchers. At many institutions, he says, instructors still have “absolutely sovereignty” in their classrooms, so there is little compelling them to collect or share data that could inform educational research.

‘IT’S EVOLVING’

The debate over data and privacy recently played out at the Open University, in England. The largely online institution tracks its 126,000 undergraduates daily on how far they’re progressing in their courses and other metrics. Last year officials there considered an opt-out policy after instituting a major effort to use learning-analytics data to intervene more actively with its students.

The internal debate, says Sharon Slade, who took part, was “a tussle between the obligation to act and recognizing the student as an adult.” She’s a senior lecturer and regional manager in the faculty of business and law.

After about a year of spirited debate, officials decided on a policy of disclosure instead. But even so, Ms. Slade is quick to acknowledge that the disclosure policy goes only so far. “Do we describe in the policy the complete range of activi-
ties? Probably not,” she allows, “because it’s evolving.” (The Open University’s policy, along with other relevant documents, can be found on Asilomar’s resources page.)

Many of those at the Asilomar meeting were chosen because they or their institutions have been wrestling with these issues.

Take UMUC and what it knows about students who don’t log in early, for example. Ms. Cini says the university has been experimenting with various kinds of automatic alerts or “nudges” to students to see what works best to encourage them. “You don’t want to just start throwing data at people,” she says. “It can be very overwhelming.”

The institution developed the insights about those who log on from its work with Civitas Learning, one of several new data-analytics companies. It is also part of the PAR Framework, a consortium of institutions that collect and share data about students’ progress. And in some of the university’s economics courses, students use an adaptive-learning product called Waymaker, developed by a company called Lumen Learning.

Ms. Cini says UMUC is already abiding by the “informed improvement” principle articulated by the group; based on what it has learned from the PAR Framework, officials have been redesigning a number of courses to reduce withdrawal rates. Having the data does create a different standard of care, she says. “If you know this, you have to do something.”

Yet one thing UMUC doesn’t do is explicitly explain to its students how deeply their data is being mined. Unlike the 11-page Open University policy, UMUC says only: “Unless otherwise notified, information provided to the university may be shared among offices within the university and with the University System of Maryland and outside entities as necessary or appropriate in the conduct of legitimate university business and consistent with applicable law.”

Ms. Slade, at the Open University, says she believes in the usefulness of data analytics, but she wishes her institution had gone with the opt-out provision. “They are adults,” she says. “We shouldn’t treat them as children.”

Students at the Open University were consulted extensively during that decision-making process. Many of them didn’t realize the extent to which their data was being collected, says Ms. Slade, and some were “horrified by it.” The president of the student association, Ruth Tudor, says, however, that once students were made aware of the potential support that could be offered, they were “satisfied that they would not be pushed in any one direction.” She credits the university’s consultative process with easing anxieties.

For Lumen Learning, the company that developed the Waymaker product, the ethical challenge is less about disclosure to its more than 6,000 student users at UMUC and 11 other institutions — each student is asked to sign a consent form — and more about how to ensure that the tool is put to the best use. Studies of the product show that when professors send customizable prompts to students saying things like, “nice job,” the students perform better.

Knowing that, says Julie Curtis, Lumen’s vice president for strategy and communication, “we feel this obligation to let instructors know and strongly encourage them” to use it. Until now, she says, Lumen has made the prompts optional but has emphasized their importance during instructor training. But now she wonders if following one of the principles of Asilomar II — that, once a practice is found to work, it should be used — means that Lumen and other companies should set the feature as a default.

Originally published on June 28, 2016
As Big-Data Companies Come to Teaching, a Pioneer Issues a Warning

By GOLDIE BLUMENSTYK

CANDACE M. THILLE helped kick-start the move to bring big data to college teaching. She has founded the Open Learning Initiative at Carnegie Mellon University, won millions of dollars in grants, and been a fixture on the lecture circuit about the power of so-called adaptive learning, where data-powered algorithms serve up content keyed to what a student is ready to learn next. Publishers, venture-capital investors, and foundations have followed her lead. They’ve poured hundreds of millions into new companies and new products vying to score big contracts with colleges, sometimes promising to be the “robot tutor” for struggling students.

It seems like a classic business success story. These days, though, Ms. Thille has begun to have darker thoughts about an industry she helped spark.
She still believes that adaptive learning will become an increasingly important tool in teaching. But she fears that rapid commercialization is exactly the wrong way to foster innovation at this early stage. What’s more, she thinks professors and higher-education leaders are making a dangerous mistake by letting companies take the lead in shaping the learning-analytics market.

Ms. Thille, who moved to Stanford University’s Graduate School of Education in the fall of 2013, has only recently begun to go public with that critique, voicing it to a few small audiences. But as she shared during extensive interviews with The Chronicle over the past few weeks, it’s a message she hopes college leaders and professors will heed, if only because she’s a messenger who understands, despite all the hype, both how “crude” and simplistic many of the products are today, and how educationally valuable they could one day become.

Her concerns boil down to these:

- **Colleges should have more control over this field.** Like it or not, she argues, using data to predict student needs and deliver the right material at the right time will become essential. “And a core tenet of any business is that you don’t outsource your core business process,” she notes.
- **Companies aren’t as well equipped to develop and test new teaching algorithms as colleges are.** She argues that colleges are the ideal living laboratories for any teaching system because they are home both to the research on learning and the actual teaching. As she puts it, “You have a very quick feedback loop, where the research informs the practice and the practice informs the research.”
- **When companies lead the development of learning software, the decisions those systems make are hidden from professors and colleges.** Ms. Thille says companies that won’t share their processes are essentially saying, “Just trust the black box.” To most academics, she says, “That’s alchemy, that’s not science.”

The proprietary “black boxes” are the algorithms that might automatically serve up, say, an extra lesson on quadratic equations when a student’s responses to a quiz indicate that she didn’t quite grasp the concept. Every algorithm, and every decision about what data it will weigh, is also ultimately a pedagogical judgment call. For the companies selling adaptive software, “that’s where the gold is,” says Ms. Thille.

She contends that the demands of the market — with venture capitalists expecting returns 30 times what they’ve invested and companies facing pressure to deliver products priced so they don’t scare away customers — will inhibit innovation rather than foster it, even if the companies have the best intentions.

Ms. Thille (it’s pronounced “Till”), who is in her late 50s and spent 18 years in the private sector before joining academe, is a person who chooses her words carefully. She recognizes that her critique of the burgeoning learning-analytics marketplace is also fundamentally a critique of the commercialization model of the investor-fueled ed-tech sector, and in some sense, of her own Stanford community.

But she is also convinced that colleges need to find ways to raise the money for research and development of learning software so that companies don’t end up owning the classroom delivery system of the future. Colleges could come together to build such systems, or perhaps the federal government could step in, as it did with the Darpa research that led to the Internet. Society has stepped up before for matters of importance, notes Ms. Thille. “I would claim that this is one of them.”

**BIG CLAIMS**

Ms. Thille’s argument could easily be dismissed as naïve, or even self-interested — she does, after all, head up a research lab that lives by grants. But it meshes with a broader national conversation now surfacing among academics and other experts over the growing role that data and algorithms play in higher education.

Data-driven technologies already touch many corners of the student experience. “Student success” tools send text messages reminding students to see an adviser. Course-suggestion engines at some colleges can recommend that a student switch majors, from pre-med to history, if he did poorly in Biology 101. But educators are especially focused on the ways data engines are used in teaching.

Companies such as Knewton, whose chief executive boasted to an NPR reporter that the software was like “a robot tutor in the sky that can semi-read your mind,” epitomize the problem, says George Siemens, an internationally known theorist on digital technology and the professor who co-taught the very first MOOC, in 2008.

“They make very bold claims, but they aren’t involved in the research community at all. That means we can’t validate their algorithms. We can’t validate the results that they say they’re getting,” he says. “That’s a system that doesn’t serve the future of education well at all.”

He compares the state of learning platforms to the earliest days of networked computing, when it wasn’t clear whether the open Internet or a paid service like America Online would become dominant. If the learning-analytics model goes the way AOL hoped to go, says Mr. Siemens, “we don’t have the ability to create a rich ecosystem on top of that platform.”

The chief executive of Knewton, Jose Ferreira,
declined to comment for this article.

A small community of academic researchers and others are beginning to press on this issue. Mr. Siemens hopes others will too. “Students should care a whole lot because they’re the ones being sorted algorithmically,” he adds. Among those concerned is Ms. Thille’s successor at Carnegie Mellon, Norman Bier. Without greater transparency for the way tools direct students and dashboards signal their progress to professors, “we face a real danger of hurting our students,” he says. The systems need to be more open, he says, so professors can understand and trust them without having to get an advanced degree in computer science.

But the trend is going in the other direction. More and more colleges are turning to the commercial market for their adaptive-learning products, often in response to vigorous marketing by companies. That includes Acrobatiq, a company that was spun off by Carnegie Mellon after Ms. Thille left. The university still owns a stake in it.

Acrobatiq advertises that its products are “powered by Carnegie Mellon” and “based on cognitive science and educational theory” of the Open Learning Initiative, even though none of the company’s products use OLI-developed software.

Eric Frank, Acrobatiq’s CEO, counters that companies can innovate, and notes that his company focuses on the important role of making sure its products work for a broad range of professors. “We spend less time refining our predictive models and algorithms and more time trying to help faculty to use them,” he says.

As more and more colleges work with more and more companies, he acknowledges, researchers will lose out on opportunities to collect large sets of data on how students learn and use them to advance the field because the data will be “bifurcated into these little fiefdoms.” Acrobatiq’s contracts, he notes, do ensure that colleges own the data. But he notes that the learning-analytics industry still lacks the kinds of standards and protocols that would make it easy to extract, organize, and share such data among institutions for research purposes.

Even some foundations and education associations can operate in ways that undermine the momentum for open learning analytics. For example, in inviting universities to take part in a new $4.6-million Bill & Melinda Gates Foundation grant for the members of a new Personalized Learning Consortium, the Association of Public and Land-Grant Universities specified that applicants could use only 19 specific products approved by the foundation. All of them are owned by com-
panies. One of them is Acrobatiq; the Gates foundation is also an investor in that company.

The foundation specified those “approved suppliers” for the quality of their products and because they “appear likely to be robust and sustainable for the future” as businesses, according to the request for proposals for the grant.

Travis Reindl, a spokesman for the Gates foundation, said last week that the list was not “the be-all and end-all of the possible providers” for the grantees and that other products could be added even after the winning institutions are selected. at the end of May. Asked specifically about whether open courses from OLI or those Ms. Thille is now creating at Stanford would be allowed, he said, “APLU will provide the updated provider list to the selected institutions. The list is still being developed.”

As for Acrobatiq, he said the foundation was “not in any circumstances” trying to favor that company. “There is no thumb on the scale” for Acrobatiq, he said.

DEEPER LEARNING

Ms. Thille, who now co-directs a team of 15 master's and Ph.D. students in the sleek, high-ceil inged Lytics Lab, on prime real estate on the Stanford campus, can't pinpoint an “ahah” moment when she began to feel a sense of urgency for her concerns. While she maintains many cordial relationships with the ed-tech crowd in her Silicon Valley neighborhood and around the country, she was influenced in part by seeing the flood of investments and acquisitions in the market: Knewton alone has received more than $157 million, including $10 million this month, according to CrunchBase.

One of her Ph.D. students was another influence. Last spring he came up with a wholly new approach to creating predictive-algorithmic models for deciding what content a student should see next in an adaptive course. She thinks his “deep learning” approach runs circles around Bayesian Knowledge Tracing, the approach used by OLI, her Stanford lab, and many of the commercial learning-analytics products.

“As a researcher I was thrilled,” says Ms. Thille, beaming at the thought of a graduate student who could “beat my stuff” and make it better. “But you can imagine if you were a company whose whole proprietary value proposition was built on, and built around” the existing model. Companies, she says, would find it pretty difficult to say, “OK, that’s not good anymore, now I’ll switch over to a completely different method.”

That deep-learning method may prove not to be ideal either, says Ms. Thille, but it illustrates just how early-stage the field of learning analytics really is. For that reason, she says, colleges should be cautious in their dealings with companies. “Go ahead, experiment with some of these systems,” she advises. “Just don’t get locked in for a long-term contract and develop your whole approach around a particular system, because it’s going to change, or it should change.”

Back when she was at Carnegie Mellon, Ms. Thille initially preached the value of adaptive courses not so much as a tool for students but as one for professors, a way for them to gain greater insights into how their students were making their way through the material. Later, studies found at least some of the methods were also helping students complete courses more quickly and successfully than standard courses were.

The courses developed at OLI were important, she says, because they were created collectively by professors at all kinds of institutions with all kinds of students. “We need the robustness of that perspective and that context to design an

“They make very bold claims, but they aren’t involved in the research community at all. That means we can’t validate their algorithms.”
In her “Introduction to Data Analysis and Interpretation” course, where she uses OLI statistics courseware, she sees exactly what the students understand, and “based on that, I decide what we’re going to do in class the next day.”

In another course, “Engineering Education and Online Learning,” where she doesn’t use OLI courseware, “I’ll tell you, it is frustrating. I feel like I’m flying blind,” she says. “I have no idea what meaning they’re making of it.”

As part of her latest work, she’s also creating a way for professors to see why an algorithm does what it does, and to select different “skill-modeling” approaches if they prefer them. The professor wouldn’t have to be “some big data geek” to see what’s going on, she says. And even if professors aren’t interested in digging into that level of detail, they could have the confidence of knowing that the system had been “peer-reviewed in an academic way.”

Commercial products, of course, offer some insights to professors, too, but not in the same detail. And some professors who use them say their opacity can be frustrating.

Irene R. Foster, an assistant professor of economics at George Washington University who says she loves technology and new products, uses a McGraw-Hill product called Aleks to help her students brush up on the algebra they need for the course.

“We’re better off with it than without it,” she says, but she finds its analytics engine a bit crude. “I don’t really know how smart it is,” she says. When students miss problems, it just generates more questions on the same topic. “I’m not sure if it can fully capture why they are missing the problems.” And in some cases, she says, the software doesn’t distinguish whether the student doesn’t understand the mathematics concept or simply messed up the underlying arithmetic. “We need to understand how students learn, and we’re not getting that.”

R.G. Wilmot Lampros, chief product officer for Aleks, says the ideas that undergird the product, referred to as Space Theory, were developed by professors at the University of California at Irvine and are in the public domain. It’s “there for anybody to vet,” he says. But McGraw-Hill has no more plans to make the product’s analytics algorithms public than Google would for its latest search algorithm.

“I know that there are a few results that our customers have found counterintuitive,” he says, but the company’s own analyses of its algebra products have found they are 97 percent accurate in predicting when a student is ready to learn the next topic.

As for Ms. Thille’s broader critique, Mr. Lampros is not persuaded. “It’s a complaint about capitalism,” he says. The original theoretical work behind Aleks was financed by the National Science Foundation, but after that ended, he says, “it would have been dead without business revenues.”

ON THE HORIZON

Ms. Thille stops short of decrying capitalism. But she does say that letting the market alone shape the future of learning analytics would be a mistake.

Colleges should be investing in learning analytics in the same way that they invest in maintaining their buildings, she says.

Some moves on the horizon could, in fact, give a boost to the movement to open up learning algorithms.

In June, Carnegie Mellon announced that it would openly license the OLI software, along with several other key pieces of software that are collectively based on more than $30 million in research. The university said it hoped that the technologies could serve as the foundation for a large-scale, open-source collaboration with other universities interested in forming a community of users and researchers in the field of learning analytics. Mr. Bier says they should be available by the summer.

Mr. Siemens says he and several other experts in learning analytics plan to seek NSF funding for a major project in open-analytics research.

Ms. Thille, meanwhile, is taking a page from the collaborative approaches she’s used in creating OLI courses to develop some new financing models for open-analytics research.

One idea, she says, could be a new technology platform to allow crowdsourced contributions from universities, enabling even “micro but meaningful participation” by professors who may lack the expertise or the time to play a major role but still want to contribute to the effort.

With the vocabulary of a data scientist, not a PR pro, Ms. Thille paints the choices starkly. “To commodify it at this point in time, when we’re still doing very active research in it, almost assures that we’ll get less innovative, suboptimal products,” she argues. But if colleges themselves took up the learning-analytics challenge to “co-construct” learning activities, institutions could both “support teaching and learning and help us understand better how learning happens.”
A Moment of Clarity
on the Role of
Technology in Teaching

BY PHIL HILL

With all of the discussion around the role of online education for traditional colleges and universities, over the past month we have seen reminders that key concerns are about people and pedagogy, not technology. And we can thank two elite universities that don’t have large online populations — MIT and George Washington University — for this clarity.

On April 1, the MIT Online Education Policy Initiative released its report, “Online Education: A Catalyst for Higher Education Reforms.” The Carnegie Corporation-funded group was created in mid-2014, immediately after an earlier initiative looked at the future of online education at MIT. The group’s charter emphasized a broader policy perspective, however, exploring “teaching pedagogy and efficacy, institutional business models, and global educational engagement strategies.”

While it would be easy to lament that this report comes from a university with few online students and yet dives into how online learning fits in higher education, it would be a mistake to dismiss the report itself. This lack of “in the trenches” experience with for-credit online education helps explain the report’s overemphasis on MOOCs and its underemphasis on access and nontraditional learner support. Still, the MIT group did an excellent job of getting to some critical questions that higher-education institutions need to address.

Chief among them is the opportunity to use online tools and approaches to instrument and enable enhanced teaching approaches that aren’t usually possible in traditional classrooms.

The core of the report, in fact, is based on the premise that online education and online tools can enable advances in effective pedagogical approaches, including constructivism, active learning, flipped classrooms, problem-based learning, and student-centered education. It argues that the
right way to use technology is to help professors teach more effectively:

Technology can support teachers in the application of the relevant principles across a group of students with high variability. In fact, technology can help tailor lessons to the situation in extremely powerful ways.

The instrumentation of the online learning environment to sense the student experience and the ability to customize content on a student-by-student basis may be the key to enabling teachers to provide differentiated instruction, informed by a solid foundation in cognitive science. Modern online courses and delivery platforms already implement some of these concepts, and provide a framework for others.

But there is value in seeing what happens when that advice is ignored. And that’s where an incident at George Washington University comes in. If technology is just thrown at the problem with no consideration of helping educators to adopt sound pedagogical design, then we can see disasters.

On April 7, four students who took an online program for a master’s degree in security and safety leadership from George Washington’s College of Professional Studies filed a class-action lawsuit against the university for negligence and misleading claims. As reported by The GW Hatchet, a student newspaper:

The complaint alleges that the students took classes without instruction from professors assigned to the class. It also alleges that their materials included “often nonsensical PowerPoint slides pilfered from other instructors’ in-class lessons” for the 12 online courses.

“There remains one crucial difference between the two programs: the in-class program actually provides instruction, while the online version does not,” according to the complaint.

Students in the program were promised professors who “specialized in distance learning,” but the complaint alleges that instructors were not qualified to teach online courses.

If these claims are mostly true — and I should note that George Washington officials have stated through the media that they disagree with the charges but have not yet responded in court — then we have a case study in how not to design an academic program. There appears to be little to no real consideration of educators supporting students, or of sound pedagogical design.

NBC Washington’s story describes a course based on PowerPoint slides without an accompanying lecture or context, with students complaining that they had great difficulty getting instructors to respond to complaints or requests for help.

The students who filed the lawsuit have said that while they did get a degree, they didn’t get an education.

The GW lawsuit is not a story about online education. This is a story about a lack of sound pedagogical design and a lack of faculty involvement in the courses that just happened to occur in an online program.

The MIT report provides a description of the best that online education can be — and that goes beyond just trying to duplicate current face-to-face practices in an online environment. It involves advances in teaching design based on learning sciences, with deep involvement from educators and course designers.

And this gets to perhaps the most significant aspect of the MIT report — the fourth recommendation, to “foster institutional and organizational change in higher education to implement these reforms.” As described in the executive summary:

In particular, we recommend the creation of thinking communities to continuously evaluate the kinds of education reforms proposed here, and the identification and development of change agents and role models in implementing these reforms. Here, we refer to change agents as groups of experts collaborating toward a common end, rather than just individual visionaries, and role models as successful groups and institutions that are willing to pilot new, thoughtfully designed approaches.

This recommendation goes well beyond distance education, and I think it describes the central challenge for educational technology in general. The challenge is not how to create new tools and new companies trying to “disrupt.” We have plenty of both. The challenge is not even to discover new pedagogical designs enabled by technology. We have plenty of those. The challenge is how to get the organization — at the institutional level or at the program level — to identify and expand ideas that work based on sound learning design and real evaluation of what works and what doesn’t.

The MIT recommendation describes the academy actively being the change agent — not having change done to it.

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As somebody who chose to become an academic, you were probably pretty good at school and enjoyed most of your classes. But there must have been at least one class that didn’t click. Maybe the professor was a bad teacher. Maybe the course was a huge, impersonal lecture. Maybe you just didn’t find the material interesting. Or you struggled with it because it wasn’t in a subject you’re good at. Or there were other things going on in your life that distracted you. Maybe you were just too young or immature to recognize the value of material that you would later grow to appreciate.

At some point, we’ve all been that student in the back row, the one that you recognize as being lost or struggling, bored or tuned out.

If you got through a graduate program and are now working in a college or university, then you must have managed to get past that semester yourself and then found other classes that ignited your passion. Not all students are so lucky. If you had learned to think of yourself as one of the students in the back row, then your life might have turned out differently. You may even remember the moment your life changed. Maybe there was one specific class that ignited your passion and put you on the path you’re on today.

It is impossible to reach every student in every class. But every time you manage to reach one of those in the back row, you have a chance to change the course of someone’s life. It may turn out that doing so will change the course of that student’s life in ways that enable her to change other people’s lives. Making that one connection could turn out to be the single most consequential thing you do in your professional life, and one of your more consequential accomplishments as a human being. Those are pretty high stakes. High enough that we should be collecting and sharing methods for reaching students in the back row. And we should have a name for that collection of methods, because naming things makes them easier to talk about.

Phil Hill and I have proposed that we co-opt the term “personalized learning” for this purpose. Nobody is using it for anything useful at the moment. It’s just a label that vendors slap on their products to make them sound more humane, or to be more in fashion with the latest tech lingo. “Personalized learning” is a term that everybody has heard of but nobody knows what it actually means. It’s perfect. Let’s colonize it.

So far, Phil and I have identified three personalized-learning strategies. These are techniques that good teachers have used since the dawn of time. But they have become harder to employ because of the changing nature of schooling — larger class sizes and a more diverse student body, for example. In all three cases, thoughtful use of technology can help us reclaim these strategies and even improve them:

Move content broadcast out of the classroom:
In many disciplines, the ideal teaching format is a seminar, in which students spend class time engaged in conversation with a professor. In others, it is a lab. Both models have students actively engaged in academic practice during class time, when the professor, as the expert practitioner, is present to coach them. Every class spent lecturing...
is a wasted coaching opportunity. Many disciplines have traditionally used assigned readings to move content broadcast out of the classroom, and some still do. But it is not always possible to find readings that capture what you want to cover, and in any case, it is becoming harder to persuade students to read. Luckily, there are tools that can help with this problem. You can record and post your lectures as videos, which students can watch as many times as they need to absorb what you’re trying to tell them. You can assign podcasts that they can listen to on the go, or find interactive content that keeps them more engaged.

Make homework time contact time: Good teachers help students see the direct connection between the work they do at home and the overall purpose of the class. They do this in a variety of ways. Sometimes they mark up and comment on the student work. Sometimes they ask the students questions in class that require them to build on the work they did at home. For a variety of reasons, which often boil down to professors’ having less available time per student, this has become harder to do. The great crutch that is now being used to limp along without actually solving this problem is robo-graded homework assignments. By itself, automated practice might help some students drag themselves through to the end of the semester. But it doesn’t often inspire them to think that maybe they are not destined to be the student in the back row forever. (There are important exceptions to this rule, which I address below.)

On the other hand, these same automated homework tools can also give teachers an easy view into how their students are doing and create opportunities to engage with those students. “Analytics” in these tools are roughly analogous to your ability to scan the classroom visually and see, at a glance, who is paying attention, who looks confused, who has a question. Nor are these the only tools available for making homework time feel less isolated and pointless. Any homework activity that is done electronically can be socially connected. Group work done on a discussion board can be read over by the professor when she has time. Highlights and marginal notes on readings can be shared and discussed in class. This sort of effort on the professor’s part doesn’t have to be exhaustive (or exhausting). Sometimes a small gesture to show a student that you see her is all it takes.

Hire a tutor: You know what tutors are typically good for in your particular discipline. You also know that there generally aren’t enough good ones available, and that even when there are, it’s tough to get students to come into the tutoring center. One of the best uses of machine-graded homework systems, especially when they are “adaptive,” is to treat them as personal tutors that are available to students whenever they need them and wherever they are. They aren’t perfect, but what tutors are? Sometimes getting students out of the back row means helping them to believe that they are capable of learning. And in some cases, students are willing to pose a question to a computer that they would be embarrassed to ask in person. In those cases, a little extra practice and feedback on the basics, without judgment, can make all the difference — even if the feedback comes from a machine. And if adaptive learning robo-tutors don’t fit the needs of your students and your discipline, technology also makes it possible to connect students with actual human tutors, who are available online to help them get through the rough spots.

None of these techniques by themselves will solve the back-row problem for every teacher or every student. Nor can they be applied mechanically. Teaching is a craft. If “personalized learning” is to mean anything, let it mean a set of tools that you as a craftsperson can employ to help reach some of those students in the back row.

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Originally published on May 9, 2016
A recent report by SRI Education is one of the larger attempts to determine whether adaptive learning — the trendy idea that tutoring software can improve student outcomes by diagnosing and responding to their individual needs — is actually helping students learn better than traditional methods do. Call it a midterm for this kind of educational tool.

What's the grade? While adaptive learning definitely hasn't made the honor roll, it turns out there were some limitations in the assessment strategy. Let's call it an incomplete.

The report looks at 14 colleges for a total of 23 courses, including multisection courses. The institutions collected data for three semesters, reaching a total of more than 19,500 unique students and 280 unique instructors. All of the projects received grants from the Bill & Melinda Gates Foundation (which, in full disclosure, has also given funds to my consulting company).

The results are underwhelming, with pockets of modest to moderate gains here and there. But more important, the report demonstrates how difficult it is to research the impact of an educational intervention at scale.

Here are a few of the findings highlighted in the report’s executive summary. Note the qualifications in each finding:

A majority of courses that used adaptive learning had “no discernible impact” on grades, with just four out of 15 that could be assessed resulting in “slightly higher” averages.

SRI found no evidence that adaptive learning had had an effect on course completion in the 16 grantee-provided data sets “appropriate” for estimating that impact.

The study found “minor enhancements of course grades,” on average, but few strong outliers.

Students and instructors in two-year colleges and developmental courses reported high levels of satisfaction with their adaptive-learning experiences.

However, only a third of students in four-year colleges expressed overall satisfaction. The researchers wrote: “It is not clear from the available data whether the qualities of the courseware they were using, the way in which the courseware was implemented, or a sense of loss of instructor personal attention was most responsible for their lack of enthusiasm.”

None of that should be especially surprising. In the 60 or so years of academic research on various forms of electronic tutoring systems, the literature shows strong benefits in a handful of relatively well-defined teaching situations, more modest and uneven gains across a wider range of courses, and very little evidence that adaptive learning is a cross-curricular panacea. Further, as the SRI researchers are quick to point out in the report, their study provided only very limited analysis of crucial differences in the course designs in which the adaptive-learning products were used. Without that context, asking how much adaptive learning affects a course is a little bit like asking how much the use of a calculator affects a course.

Well, it depends. Are you teaching a math
course? An English course? Are you using the calculator as a paperweight? Does the way you use the calculator change the way you teach? Or the way that students learn?

If one were to conduct a study of how much use of a calculator, or a computer, or a smartphone, or an autoclave affects learning across all classes, or even across all math or science classes, the results would probably be murky and unimpressive.

Those results would not prove that calculators and computers are useless for teaching anything. A screwdriver is extremely useful for turning screws but not so much for driving nails. Like any other tool, adaptive learning is an enabler. It has its uses, but those uses do not include magic.

That said, the murkiness of the results are not only, or even mainly, due to the limitations of adaptive learning. This study is plagued by a fundamental and pervasive methodological problem in educational research — namely, that it is often either impossible or unethical to control variables in a way that gets empirically solid, reproducible results.

Anyone who has had at least one high-school science class will probably remember that the key to doing science is to control the variables. To measure the impact of a variable, one must make sure that the variable is the only relevant detail that changes in your experiment. In educational research, the biggest variables are often the students.

So in order to get an empirically valid apples-to-apples comparison of the effects of adaptive learning, which is specifically intended to help students in the same class with different learning needs, you have to start by making sure that the students you are studying are the same as one another.

Setting aside the head-spinning contradiction, how often are the students in any two course sections, even within the same course at the same institution, similar enough for a valid controlled experiment? The answer in the SRI study is “rarely.”

The researchers had to remove “roughly 70 percent of the submitted data from the final student-outcomes analysis” because students in the adaptive-learning course sections had substantially different scores on beginning-of-the-course prior-learning assessments than did their peers in the nonadaptive course. Of the 14 grantees, only one “showed baseline equivalence for every term’s data.”

Suddenly, a study involving more than 19,500 unique students and 280 unique instructors doesn’t look so big. To its credit, the Gates Foundation gave grantees significant latitude to tailor adaptive-learning projects for the specific needs of their respective campuses. But doing so made comparing results across projects harder.

Is there a big takeaway from the SRI study? For adaptive learning specifically, it’s probably “your mileage may vary.” The researchers do a good job of teasing out some of the variables that may make incremental but real differences on educational impact. That by itself makes the study worth reading.

More generally, the study does provide a reality check on the role of the learning sciences in the craft of education. We are learning more about how people learn all the time. But we are still at the basic research level, and we face daunting methodological challenges. Professors should be encouraged to develop a basic level of educational-research literacy so that they can factor research into their professional judgment of which approaches to use in their teaching. But at the end of the day, that research is unlikely to yield any simple educational-technology prescriptions that will produce drastic across-the-board gains.

Improving education is not like eradicating polio. Educational research is more likely to be useful as a tool for helping faculty members become more-skilled practitioners than it is as a way of finding a miracle cure.

*Originally published on June 9, 2016*

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PERSONALIZED LEARNING! Adaptive learning! Brain science! Learning science! Big data! New and improved! The marketing for “personalized” educational products can feel a little like a late-night infomercial. Rather than getting common-sense explanations of how the products work or being provided with peer-reviewed research to justify ambitious (if vague) claims, we are simply reassured that a product works because it is “based on the science of neuroplasticity.”

A lot of this is inevitable. The learning sciences, with their connections to both neuroscience and computer science, are young, complex, confusing, and generally difficult to boil down to marketing copy. It doesn’t help that the product marketers and salespeople are on the far end of a game of telephone that starts with a nuanced and usually provisional message about the science in an academic research paper. The informationally impoverished world of marketing blurbs is, unfortunately, the same environment in which overworked faculty often have to make product-adoption decisions for their courses. And someone on a sales team for one of these companies has every incentive to present the science claims behind its products in the most flattering light possible.

In other words, there are plenty of good reasons to be suspicious of the marketing claims even when you trust the company’s leadership completely. And how often do you trust your vendor’s leadership completely? In the worst of cases, I’ve gone as far as calling some marketing claims “snake oil.”

All of this is made worse by the fact that many academics harbor a native distrust of companies. Driven by the hype, that distrust becomes so strong that they not only come to be skeptical about specific products, but start to reflexively dismiss every claim that any technology can improve student outcomes and therefore the lives of students. It becomes even harder to separate fact from fiction.

Consider the following scenario. Ask yourself after each sentence how much the new details change how you would think about the claim:

- The designers of a certain educational software product claim that when students use their product for several semesters, their graduation rates rise by more than 20 percent.
- Those designers present a paper making this claim at the leading academic conference of learning-analytics researchers.
- The paper they present has not been peer reviewed.
- The designers repeat their claims at a number of ed-tech conferences and are quoted in flattering articles that appear in the education press.
- Several critics of the graduation-rate claim emerge, raising the question of whether the results might actually be a statistical error due to poor experimental design.
- One of those critics produces a simulation showing that the same results claimed by the product could be duplicated by feeding students chocolate in several successive semesters.
- Members of the learning-analytics research community think the simulation is plausible and call for the designers of the product to release more information about their study.
- The designers of the product do not provide the additional information, and their employer chooses not to comment on the critique.

As you might have guessed, these statements are not hypothetical but historical facts. The product in question is called Course Signals, and the designers were staff members working for Purdue University at the time of the controversy. The author of the candy retention simulation is Alfred Essa, who now works at McGraw-Hill Education.
but whom I met when he was CIO at MIT’s Sloan School of Business. The root of the problem is not raw greed but a failure of the scientific peer-review process, amplified by the echo chamber of conventional and social media.

I can’t even say that amplification was caused by “marketing,” at least in the conventional sense. The university was spreading the word among its peers about the findings of its institutional research. An earlier study of Course Signals conducted by the same research group, which showed that Course Signals helps students succeed within individual courses, was well received by the academic research community and has not been questioned. The researchers, one of whom I know fairly well, have good reputations. They probably just made a mistake in the experimental design of their second study. It happens. As now-former staff members, they are not at liberty to comment about institutional research. I honestly don’t know why Purdue itself failed to respond to its critics.

What I do know is that none of this would have happened had there been robust peer review of Purdue’s work in the first place. For a lot of reasons, related both to the intrinsic nature of the work and to the organizational challenges of very different academic disciplines still learning how best to collaborate with each other, applied-learning-sciences research claims are actually very difficult to evaluate. This is the core problem that needs to be solved if we want to improve both the effectiveness of educational technology and our ability to evaluate particular effectiveness claims.

But academic suspicion of commercial interests is so strong that narratives of corporate greed routinely eclipse more-nuanced stories that include problems with the ways that academe conducts its own business. For example, a few weeks ago I wrote a column here arguing that colleges and universities should consider empowering students to make their own decisions about their data privacy rather than having the institution always make those decisions on their behalf. Tracy Mitran, academic dean of cybersecurity certificate programs at the University of Massachusetts, wrote a letter to the editor in response, claiming I was using rhetorical “sleight of hand” to somehow justify handing student data over to vendors.

But privacy policies don’t always work to thwart commercial interests and help students. In fact, in the case of educational research, the opposite is true. Textbook and educational-software vendors do not need any changes in regulations or contracts to conduct large-scale research regarding the effectiveness of their products across multiple institutions. In contrast, if university researchers wanted access to the same kind of data, they would have to seek permission from not just their own university’s institutional review board, but from every IRB from every participating institution. And those boards do not all follow the same review policies.

In this case, existing student privacy policies favor the vendors. IRBs exist for very good reasons, but it is worth asking whether it makes sense to adopt cross-institutional standards that are designed to facilitate responsible academic educational research.

The larger point is that reflexive anti-commercialism is an easy answer that can mask deeper problems. In order to get more trustworthy claims of real gains in educational outcomes, the academy needs to both pursue the highest standards of academic research and simultaneously take a long, hard look at the institutional processes that make that pursuit unnecessarily difficult.

As part of that, if you want better learning science, then don’t push vendors out of academe. Instead, push them in. Make them show their work. Make them subject their research to peer review. Vendors should be accountable for their claims. As should universities. The goal for us all should be improving the lives of students, and the main tool for learning how to better achieve that goal should be rigorous research conducted in the context of a strong environment of collegial peer review.

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Originally published on April 6, 2016