Big Data, Big Expectations

THE PROMISE & PRACTICALITY OF **BIG DATA FOR EDUCATION**

DR. MARC HOIT,
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THE CENTER FOR DIGITAL EDUCATION SPECIAL REPORT is a one-of-a-kind publication that provides education leaders with research-rich content that includes perspectives from industry experts and public sector peers. It consolidates current thinking, best practices, tips for successful implementation, professional development guidance and more — all within a single source.

We hope you enjoy this current Special Report on Big Data. Don't miss our remaining 2013 Special Reports:

▸ Personalized Learning   ▸ Mobility and Cloud

BIG DATA IS, IN MANY WAYS, ABOUT SOME VERY SMALL THINGS. Things like how one student never turns in weekend assignments on time, but is never late on assignments during the school week. Receiving this information in a timely manner can alert a teacher to know she might need to give that student the weekend assignments earlier, or grant an extension. Big data can boil down to a small thing like making sure a student is placed in the right reading program now, instead of 12 months later when the high-stakes testing results come back. Or the fact that a college student is missing all his classes for two straight weeks and could be at risk of dropping out. Big data isn't always about the big things, such as financials, grant tracking or other enterprise statistics. But it still makes a big difference when it sheds light on even the smallest of changes that need to occur. We hope you enjoy this in-depth look at big data in this Special Report.

LEILANI CAUTHEN

Publisher, Special Reports
Center for Digital Education

ONE OF THE MAJOR THEMES in our Special Reports is how technology-infused education is becoming more heavily reliant upon big data and data delivery systems. Making instruction and learning experiences relevant requires two things: First, we must enable student access to real-world issues and applications; second, we must provide content and instructional methodologies that are as personalized for each student as possible. This requires a meld-lock between back-office systems and the classroom. Data-driven decisions have never been more necessary and the tools to enable them have never been more at hand. Learning management systems, student information systems and all sorts of campus management systems play a role. As we incorporate more digital technology into every aspect of the school infrastructure, the more data we generate. The challenge will be to convert that data into timely and effective learning actions. To make this a reality, institutions need policies and operational plans that allow for investments in software, hardware and professional development to help manage this data so students can reap the rewards. We hope this Special Report on Big Data will inform and offer suggestions on how to make those decisions for your school, district or institution.

JOHN HALPIN

Vice President, Strategic Programs
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RODEL FOUNDATION OF ARIZONA

JERRY SPEIER & THE NATIONAL ACADEMY FOUNDATION

HOUSTON INDEPENDENT SCHOOL DISTRICT

BIG DATA GOES TO SCHOOL

I f you've attended a conference, watched a webinar or read a blog on education lately, then you know that the education community is abuzz about the concept of big data. President Obama recently announced a $200-million "Big Data Research and Development Initiative" that is aimed, in part, at improving education. In addition to accelerating scientific research and strengthening national security, the initiative seeks to "transform teaching and learning."[1] This exciting development comes as a result of a decade of work and hundreds of millions of dollars of investment into statewide longitudinal data systems (SLDS), as well as many groundbreaking projects in data warehousing and

analytics. Big data is increasingly applied at all levels of education, including the realm of academic research. States, districts, college administrators, and even individual K-12 classroom teachers have all experienced the benefits of big data firsthand.

Lenny Schad, CIO for Houston Independent School District (Houston ISD), believes, "You're going to see a convergence of a lot of systems that used to be stand alone, like learning management systems, curriculum management systems and teacher dashboards. I see this convergence of big data becoming a very powerful mechanism for parents, students, principals and administrators, so that everybody now has access to this information."[2]

Tracey Barrett, vice president of product management and marketing at Houghton Mifflin Harcourt's Division for Innovative Assessments and Information Solutions, agrees: "This shift puts an emphasis on using data to drive decision-making. This is not about getting a report, putting it in a file cabinet and never looking at it again. This is a time when people are really trying to use the assessment data in meaningful ways so they can better understand the strength and weaknesses of their students."[3]
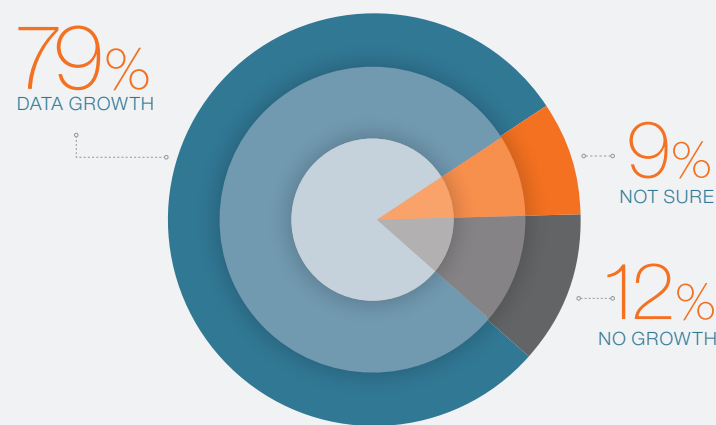
The impact of big data will be equally ground-breaking for higher education institutions. New technologies for data analytics are changing the face of student recruitment, administration and academic research. We've collected mountains of data over the years: course records, student attendance, class rosters, program participation, degree attainment, discipline records, test scores and so on. But while we're good at amassing this information, we've previously lacked the means to apply it toward improving student outcomes. In this way, our vast education data stores have been similar to the 137 million items stored in the Smithsonian Institution. Although these items are of great historical importance, less than 2 percent of the collection is on display at any given time. Very few people will ever come close to experiencing even this 2 percent, let alone gain access to the full collection.

Similarly, what percentage of our vast exabytes of education data ever makes it to an instructor's desk? How much of this data actually directs a new intervention, helps an at-risk high school student or inspires college students to pursue their goals?

Big data can be the solution — applying cutting-edge technologies to sift through this warehouse of dry facts and creating powerful and actionable educational insights. Simply put: Data warehouses are the lock, and big data is the key.

To get to the bottom of big data, the Center for Digital Education (CDE) commissioned a research survey that integrated the perspectives of 110 top leaders from K-12 and higher education from all parts of the country. The results showed that leaders are contending with many of the challenges noted previously, but also see the promise in big data. You will find the results of our research in this report, along with timely insights and interviews from technology leaders, instructors and administrators from around the nation. ∎

Breaking Down Big Data

So what defines big data anyway? According to the McKinsey Global Institute, "Big data refers to data sets whose size is beyond the ability of typical data software tools to capture, store, manage and analyze."[4] Our sister organization, the Center for Digital Government, expanded on this definition in its recent Special Report on Big Data, citing Gartner's "3V" model, which defines big data as high-volume, high-velocity and high-variety information. In other words, "large amounts of different types of data from a number of sources that come in and out of an organization at high speeds."[5]

What types of data do you collect?

Source: Center for Digital Education Survey, 2013

Are you experiencing substantial administrative data growth?
79% say yes!

79% DATA GROWTH
9% NOT SURE
12% NO GROWTH
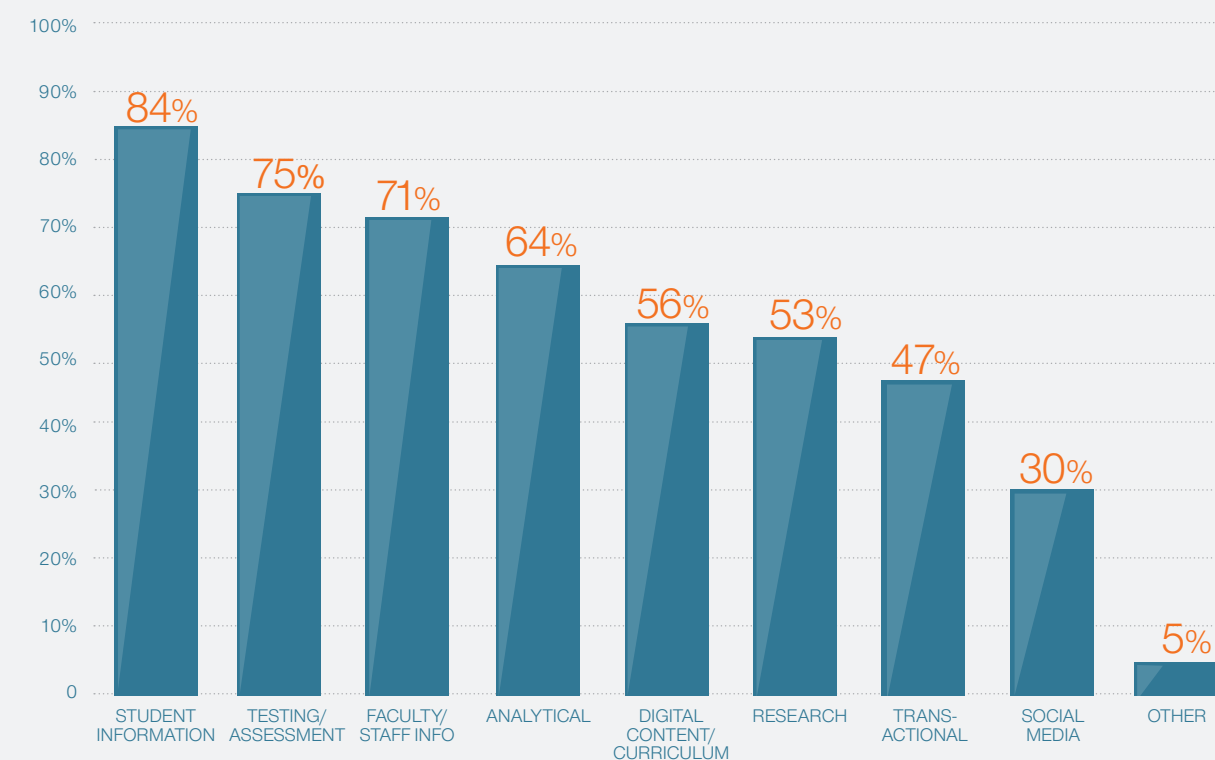
Source: Center for Digital Education Survey, 2013

THE PROMISE OF BIG DATA:

Better Student Outcomes and Career Readiness

The story of big data starts with the needs of our students. Before we map out the tools and technology of big data, we need to put its benefits into human terms to which we can relate. What will it do for administrators, instructors, counselors, advisors, support staff and — most importantly — students to improve education?

Student Success in Scottsdale

Dr. David Peterson and Tom Clark are believers in the promise of big data, and they are already putting it into action at Scottsdale Unified School District in Scottsdale, Ariz. Dr. Peterson is superintendent for the district, and Clark is the district CIO. For Dr. Peterson, big data is more than just a tool to help top administrators make decisions. He believes it can positively impact every level of education, right down to the classroom level at the moment of instruction.[6] "I think first and foremost, we need to come to that true realization that our kids are digital natives," says Peterson. "They're used to working with technology and electronics. By having technology systems in place that can complete assessments, learning is occurring without them even realizing it, because they are so comfortable with it."

Scottsdale Unified School District believes that big data can be used to positively impact every level of education, right down to the classroom level at the moment of instruction.

Peterson is taking advantage of students' technological fluency to attack one of the most entrenched and seemingly unsolvable problems in education: How do you provide remedial help without stigmatizing students, isolating them or embarrassing them in front of their peers?

"We know that not every student learns in the same way, and so better use of data will help us customize some of the learning for students," says Peterson. "As we see different students progressing at different levels, we can make adjustments seamlessly, so that students don't even notice what we are doing to maximize their learning. In some cases, we can provide enrichment, and in some cases, we can provide adjustments to help them make up or catch up."

CIO Tom Clark sees the trend towards big data as working hand-in-glove with other technology initiatives that have developed over the past few years, including bring your own device (BYOD), pervasive wireless networks and advanced networking that connects institutions to the outside world.

"When you stop and think about the amount of computer processing power that students have in the bottom of their backpacks or in their hip pockets, it is the equivalent to what Apollo 11 had when they went to the moon," says Clark. Instead of banning advanced technology devices from the classroom, as many schools do, Scottsdale has implemented the exact opposite policy.

"We have teachers and technology trainers who are going into classrooms and using mobile-based audience polling, just like the way you vote for American Idol," Clark explains. "You can 'vote,' if you will, for the correct answer on a math problem that was put on the interactive whiteboard during the first five minutes of the class while the teacher is taking attendance. Instead of sitting there waiting for the teacher, the students could be working out the problem of the day and submitting their answers via smartphone."

This sort of student polling has the potential to enrich and direct daily instruction. As the students are voting, a graph could appear at the front of the classroom that shows what percentage of the class was able to solve that problem correctly. Instead of waiting weeks to determine where the students are in terms of mastery of the subject, the teacher can have that data at his or her fingertips instantaneously. So, for example, if only a few students were able to solve the problem, the teacher might decide to retool the instructional lesson right on the spot.

"We don't have to wait for the teacher to take home the stack of papers to grade that night to figure out that she or he may have missed an opportunity earlier in the day," Clark says. "It has lots of potential."

According to Clark, leveraging data is simply expected these days. "I think we all have to face the reality of the changes that we're undergoing in society. What happens in schools becomes a reflection of that. We are more and more dependent on technology to do our jobs, and if you're using chart paper and Sharpies to analyze your data, then I don't think you're doing justice for your students. You're not making your decisions on the best data that you already have."

But even the most extensive big data applications can't work in isolation. They require networks and ample bandwidth to make them accessible to every participant. To address this necessity, Scottsdale has implemented a wireless infrastructure across all of its campuses and allowed students to access the network.

Clark adds, "This lets them leverage our district connection to the Internet, as opposed to their own or their parent's cell phone bill. It's a nice partnership. We're leveraging technology that they already have with a component that we can provide for them."

Uniting Administration, Research and K-12 in North Carolina

Big data has diverse and wide-ranging applicability, as evidenced by its implementation in many disparate fields of academic research. One such field seems,[7] at first glance, like an unlikely candidate for big data analysis: medieval manuscript studies. Textual scholars have been studying books as physical artifacts for some time already — trying to determine their provenance, ownership lineage and so forth. But Dr. Timothy Stinson, an assistant professor of English at North Carolina State University (NC State), determined that the manuscripts produced in the monastic scriptoriums of the Middle Ages had more information to offer, given the right application of the right tools.[7]

He reasoned that the many manuscripts written on vellum (treated animal skins) might also contain the DNA information of the animals from which they were made. A DNA analysis of the vellum would reveal a kind of "genetic history" of the texts, enabling the scholar to better determine what area of the world the materials originated. Depending on how much we know about a particular manuscript's history already, this could answer questions about the medieval book trade and the circulation of manuscripts.

Another field of academic research that has benefited from big data is infectious disease. Suzanne Kennedy-Stoskopf, a research professor of veterinary medicine, was conducting a study that involved placing collar-mounted sensors on wolves. The collars transmit GPS coordinates and environmental data, such as temperature, at regular intervals. Naturally, the more wolves tracked and the longer they are tracked, the more data is accumulated. Eventually there was too much data for the veterinarian to discern patterns easily.

However, at an NC State-hosted "Big Data Retreat," the infectious disease expert was able to find the kind of support and technology she needed to make sense of the data. And, as if to underscore the idea that big data is indeed ubiquitous, the veterinarian found retreat-goers in disparate fields whose experiences paralleled her own. As Dr. Marc Hoit, vice chancellor for information technology and CIO at NC State, explains, "Now they're matched up and working together, and they're using analytics and computational technology to understand the data they are creating."

Dr. Hoit's experiences at NC State show that academic research isn't the only field that benefits from this sort of collaboration. Work at NC State demonstrates how big data can foster beneficial relationships between elementary and secondary education as well. Dr. Hoit is also a professor and a researcher in the department of Civil, Construction & Environmental Engineering. He and his team work with the Friday Institute for Educational Innovation that focuses on technology and K-12 systems.

In partnership with the state, the Friday Institute's goal is "to study the benefits of technology for student education from kindergarten all the way through their high school graduation." The process involves the integration of in-use systems in schools and districts, and the collection and use of student data to improve performance and detect potential problems.

As Dr. Hoit explains, "We're looking for the same types of things in students as in biosecurity or fraud detection: anomalies, in order to catch a problem before it becomes uncorrectable." This could be an anomaly in overall GPAs, changes in GPAs for courses necessary for students' majors, fluctuations in attendance patterns and more. Just as early detection in the public health sphere often means the difference between life and death, the speed with which we detect red flags in a student's academic career could mean the difference between a quick fix, a drawn-out intervention or failure.

The Friday Institute is connected with Centennial Campus Middle School, which

TECHNOLOGIES CONVERGE:
Is this administrative, instructional or research computing? Is it for higher education or K-12?

The world of technology used to be a lot less complex than it is today. Whenever a new piece of technology came on the scene, it could be placed into one of three neatly defined categories. Administrative systems, like payroll and accounting applications, ran in the back office to manage the operations of the institution. Instructional technologies were leveraged by instructors while they taught their students. And research computing assets were locked away in a lab somewhere, as the lonely province of academic researchers. Today, those boundaries are quickly collapsing. Big data spans all of those separate designations, and integrates them in a way that was never possible before. This convergence means that big data is more than a nuts-and-bolts technology proposition. It's a strategic solution that requires the attention of top officials, executives and faculty to bring to fruition. Alex Kaplan, national practice leader for education for the Global Business Services Division of IBM, sees big data being relevant across all domains of education. "From IBM's point of view," says Kaplan, "Big data is the largest topic in education today. I would say that is true for both K-12 and higher education. Momentum has really been building over the past few years." According to Kaplan, "The primary reason for this is a realization on the part of policy makers and practitioners that if you are really going to make a difference in terms of teaching and learning in the classroom, or in terms of operational efficiency in running your school system, you need to anchor all of this in data. All of the education institutions in the United States have a plethora of data. It isn't a lack of data that is the problem — the problem is that they are still struggling with converting that data into useful information."[8]

Hiring our Heroes' "Fast Track" program utilizes a significant amount of data to map high-demand careers by industry, identify the skills needed for veterans to apply for jobs and help veterans gain additional credentials to increase their opportunities.

is tied to the university and located on its Centennial Campus. They are key components of the state's Race to the Top grant. NC State is also participating in what's called an "early college high school" — a high school where students can take university classes, which Dr. Hoit describes as similar to a "dual degree program with community colleges." The Wake NC State University STEM Early College High School program is focused on offering STEM (science, technology, engineering and mathematics)-related courses. Dr. Hoit notes that these types of collaborations, with the university, Friday Institute and middle school; and with the university and early-college high school, offer a wealth of information that can be utilized for further learning opportunities.

Career Readiness to Power Hiring our Heroes

This past decade has been a challenging one for the United States military. Many veterans struggle to fully assimilate back into society, finding it difficult to become career ready and find a job. Fortunately, big data has a place in vocational and job training as well.

While veterans often have specific and useful skills, many have been in the military since high

school or college, and simply do not know where to look to find employment. Hiring our Heroes was launched in March 2011 to address this problem. Working with Chambers of Commerce, Hiring our Heroes partners with state and local chapters and others from the public, private and nonprofit sectors to help veterans and their spouses find meaningful employment.

This program would not be possible without the utilization of data. Recently, Hiring our Heroes created the "Fast Track" program to show veterans critical paths to employment and assist them in making decisions about education and employment opportunities. This program utilizes a significant amount of data to map careers by industry to 100 metropolitan statistical areas (MSAs) that are forecasted to see the largest amount of job creation in the near future. The program also identifies the skills needed for veterans to apply for jobs in these MSAs, provides information on how veterans can use the GI Bill to gain additional education and helps veterans gain credentials to increase their opportunities.[9]

As a part of the Fast Track program, Hiring our Heroes has partnered with a technology firm to construct an online "Hiring our Heroes

Talent Community." This community will provide a single website to help veterans and transitioning service members find employment opportunities in high-demand regions and industries in the United States. The community will also bring veterans and employers together and provide assessments that allow veterans to identify career paths (including additional education) that are best suited for them.[10]

This community will require the aggregation and implementation of a significant amount of big data. In order to locate employment opportunities in high-demand regions and industries, Hiring our Heroes will need to aggregate and analyze data from states, cities, municipalities and companies around the country. And in order to help veterans identify the career paths that are right for them, the program will have to construct assessments and link them to specific career paths, utilizing data about the interests, skills and certifications required for different careers. This effort is a perfect example of how big data is transforming the world for service members returning from conflicts overseas. As such, big data is changing education in myriad ways, including improving career readiness for today's veterans.[11] ∎

WHY IT MATTERS:
Decoding the Technology

Big data is full of possibilities. Some specific benefits anticipated by education leaders are:

▸ Identifying at-risk students before the trouble starts
▸ Targeting research-based interventions in real time
▸ Predicting and managing campus goal attainment
▸ Improving professional development strategies
▸ Implementing student, teacher and instructor value-added growth models
▸ Improving student outcomes
▸ Achieving career readiness

LAYING THE FOUNDATION:

Gathering, Collecting and Capturing Big Data

Big data isn't just about the final stages of the data process: data visualization and direct analytics applications. It's also about the hard work, systems, processes and data governance that help to get us there in the first place. Since the early days of the education data movement, groups like the Data Quality Campaign have been highlighting the importance of getting information right from the source systems themselves, such as student information systems (SIS), learning management systems (LMS) and the like.[12]

"Data quality is probably one of the biggest areas you struggle with, because there's so much variation on how people do things, particularly at the campus level," explains Houston ISD's CIO Schad. When you are pulling data from many different systems, sometimes IT staff need to implement "work-arounds" or process changes that

hurt data integrity but are necessary for system functionality. When source systems have been in place for a while and have been collecting data for a long time, these problems can be magnified.

"The analogy of 'garbage in, garbage out' is never more relevant than when we're talking about data quality in dashboards," says Schad. "Because what tends to happen is, when there is bad data coming in and you're reporting on it, the first assumption is that the tool is bad, or the tool is reading it incorrectly." This poses major risks for big data initiatives, which can be easily shut down before they are even started. "You end up spending a lot of time justifying that the tool's right, rather than spending the energy on fixing the data going in. There can be a lot of time lost there. You have to have the processes in place so that the quality of the data in the system is being corrected as it goes in," explains Schad.

Contributing to this problem is the rapid increase in the amount of data that education institutions are expected to master. Seventy-nine percent of respondents to the CDE survey told us that their organization was experiencing substantial administrative data growth. And that's only one part of the picture, since districts and institutions are increasingly responsible for cataloging a wide range of types of information in increasingly large quantities. This starts with the largest single data source, student information, which is collected electronically by 84 percent of districts and institutions. But it goes way beyond that to include digital content, assessments, transactional information, research and even social media.

According to research by the Data Quality Campaign, "Best-practice districts have well-established, documented, and consistent procedures and business rules for data validation. Lacking clearly defined business rules for data entry can lead to duplication of information in [source] systems or sometimes omission of data."[13] To get big data right, we must manage our source systems properly, and consider them a vital link in the overall chain leading to high-level analytics. ∎

> ❝ DATA QUALITY IS PROBABLY ONE OF THE BIGGEST AREAS YOU STRUGGLE WITH, BECAUSE THERE'S SO MUCH VARIATION ON HOW PEOPLE DO THINGS, PARTICULARLY AT THE CAMPUS LEVEL."
>
> **LENNY SCHAD**, CIO, HOUSTON INDEPENDENT SCHOOL DISTRICT, TEXAS

FOR MORE INFORMATION

The Data Quality Campaign is committed to realizing the vision of an education system in which all stakeholders are empowered with high-quality data to make decisions that ensure every student graduates high school prepared for success in college and the workplace.

www.dataqualitycampaign.org

Where are you storing data?

Category	Value
STUDENT INFORMATION SYSTEM (SIS)	73%
CLASS/COURSE SCHEDULING	68%
TESTING OR ASSESSMENT SYSTEM	65%
STATE REPORTING	62%
TRANSCRIPTS	61%
LEARNING MANAGEMENT SYSTEM (LMS)	60%
GRADE BOOK OR REPORT CARDS	55%
PROFESSIONAL DEVELOPMENT SYSTEM	49%
STUDENT BILLING SYSTEM	45%
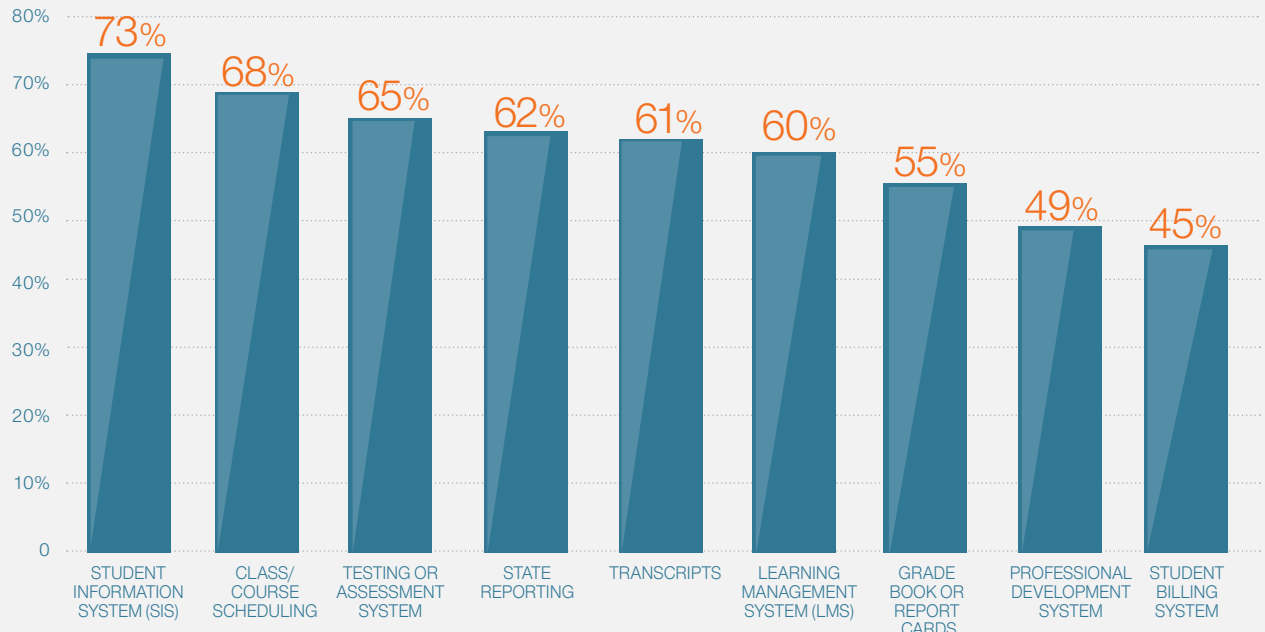
Source: Center for Digital Education Survey, 2013

THE RESPONSE TO BIG DATA:
FEEDBACK FROM BOTH SIDES

AS PART OF CDE'S RESEARCH SURVEY, we asked education leaders how they are preparing for big data and what big data applications they need. In interviews, we asked the private sector how they are responding to the big data trend and in what ways they are seeing the market shift.

THE EDUCATION PERSPECTIVE

"We are still using monolithic database and data warehouse systems to process the data to get business analytics. We need to invest in newer processing platforms such as Hadoop (NoSQL) or NewSQL. Current data sets are too large to process quickly with our traditional methods."

"Line speed capability in our smaller offices around the state, which would enable us to make our data collection through interactive trainings more robust."

"Would like to have a system to extract data in a timely manner for greater use and benefit to our districts."

"Seamless student information system (SIS) and learning management system (LMS) integration, as well as integration into sensible workflows — meaning ways to do something with the data."

"Integration — tracking a student's data from kindergarten all the way through college."

"Being able to provide information while still maintaining confidentiality is the ultimate goal. That translates to an indexed reporting system with filters to address confidentiality related to the Family Educational Rights and Privacy Act (FERPA) and identity theft."

"I would like to see a campus management system that ties together all units within the institution to make data access and tracking seamless. Our entire culture needs to change to implement this."

THE INDUSTRY PERSPECTIVE

"Big data is less about the volume of data or new technologies; it's more about new usage patterns that inform action at the point of delivery, such as better student advising or personalized learning pathways. Our customers realize they do not need expensive new tools to get started — they are already doing big things with just a little SQL."
ROBERT CURTIN, MICROSOFT CORPORATION

"Our shift is going towards predictive analytics in particular. There is so much big data out there. We are looking at different ways of asking questions, or perhaps to help our customers ask questions that they didn't even know they needed to ask. Predictive analytics opens up so many avenues that can contribute to student success."
CARRIE HANDLEY, DESIRE2LEARN

"With the abundance of data, stored in multiple locations, schools should consider an eDiscovery solution to identify and locate important information."
MIKE MAXWELL, SYMANTEC

"Big data is education's secure, scalable and cost-effective answer to driving student success by unlocking the power of adaptive learning plans for all students."
CRAIG POWELL, CONNECTEDU

"Districts have to manage this influx in storage — all of the increased video, electronic records, student data — everything that is growing from a data standpoint. More and more of those records are online, and the amount of data is skyrocketing. We are focused on helping districts protect it, manage it and secure it. When it comes to data, districts need to have a disaster recovery plan, of course, but they also need a growth plan for how they are going to keep up with their enormous storage needs and secure data for an extended period of time."
JOE SIMONE, CDW•G

"Big data to us means ensuring our schools can teach without limits. Making sure schools can engage students with innovative, state-of-the-art formats to amplify learning such as virtual classrooms or allowing students to bring their own mobile technology onto campus is big data. Our private network allows schools and universities to unleash new levels of collaboration among students, parents and teachers like never before, and we at Cox Business are dedicated to making big data a reality for the schools and students in our footprint."
PHIL MEEKS, COX BUSINESS

CONNECTING THE DOTS

Linking Systems Together for Big Data

The source systems have the information, but it won't be useful if it stays there. Big data requires that data becomes mobile. It needs to be extracted from source systems, amassed and integrated into a coherent, unified picture.

The National Academy Foundation's (NAF) initiative in "connecting the dots" provides an excellent example of how this concept can work. NAF is a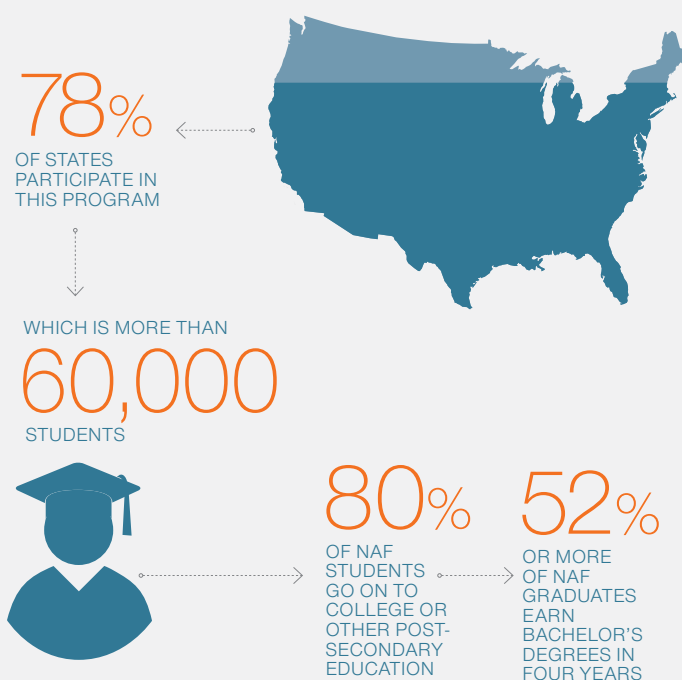n organization of college and career-prep academies that prides itself on industry-focused curricula, work-based learning and the utilization of business-partner expertise. More than 60,000 students participate across 39 states.

NAF recently implemented a new electronic data initiative that was able to incorporate information from upstream sources. According to JD Hoye, president of NAF, "[The new system] provided us with the intelligence necessary to successfully initiate a critical phase of our performance management system. [The upstream information] is essential in helping us reach our research and evaluation goals."

Last year, NAF began building a performance measurement system to evaluate the progress and achievement of students in NAF academies. It wanted to be able to see, in real time, exactly how its students were performing and be able to compare them with other groups of public school students. This would allow NAF to back up its success with empirical analysis, test the effectiveness of the curriculum and implement consistent changes to better serve the educational needs of NAF students.

To solve this problem, NAF partnered with a technology firm to gather and collect data from thousands of NAF students and public school students around the country. The firm gathered academic and demographic data, as well as data on socioeconomic status, attendance rates, GPA and SAT/ACT scores from a variety of sources. This comprehensive data gathering would allow NAF to drive analysis

National Academy Foundation Facts

78%
OF STATES PARTICIPATE IN THIS PROGRAM

WHICH IS MORE THAN

60,000
STUDENTS

80%
OF NAF STUDENTS GO ON TO COLLEGE OR OTHER POST-SECONDARY EDUCATION

52%
OR MORE OF NAF GRADUATES EARN BACHELOR'S DEGREES IN FOUR YEARS

> " [THE NEW SYSTEM] PROVIDED US WITH THE INTELLIGENCE NECESSARY TO SUCCESSFULLY INITIATE A CRITICAL PHASE OF OUR PERFORMANCE MANAGEMENT SYSTEM."
>
> **JD HOYE**, PRESIDENT, NATIONAL ACADEMY FOUNDATION

based on a number of key components, and allow the organizations to control for those components when comparing student outcomes.

Once they had the data, the organizations worked to build college- and career-planning tools. They also developed a real-time data system for tracking students' college and career readiness by leveraging data warehouse capabilities, student-level data aggregation and customized, real-time progress reporting. The results were stunning.

Today, NAF can analyze student performance at the student, school, district, state and national levels in real time (with administrators at all levels driving the analysis). This analysis allows NAF to measure student achievement, monitor progress, drive targeted interventions and draw conclusions about key components, decisions and curricula that drive success in students.

In addition, this system has proven NAF's success. The data showed that students in NAF academies attend school more frequently, receive more credits and earn higher grades than non-NAF students in the same district. In addition, more than four out of five NAF students go on to college or other post-secondary education, and more than 52 percent of NAF graduates earn bachelor's degrees in four years — compared with 32 percent nationally. Data analysis now helps NAF better serve its students every day.[14] ∎

STARTING AT THE SOURCE:
Decoding the Technology

Connecting systems takes work and specialized tools. Consider all of the following in your own system connection efforts:

- ▶ Managing passwords and user profiles
- ▶ Integrating with legacy and transactional systems
- ▶ Interacting with offline sources and survey information
- ▶ Gathering unstructured data
- ▶ Implementing ETL technologies — extract, transform, load
- ▶ Uniting disparate software systems and products

FINISHING THE JOB:

Visualizing, Analyzing and Leveraging Big Data

Once we have connected the dots, it's time to finish the job. To do that, practitioners need to demystify the endpoint technologies that make big data real, and present the data in a way that is visual and intuitive for the decision-makers who will actually use the information to improve education. According to our research, education institutions are increasingly aware of the benefits of big data, and are making its implementation a priority.

Visualizing Student Performance in Dashboards

Lenny Schad, Houston ISD's CIO we noted earlier, aims to transform his district with powerful new performance dashboards. "We're in the process of rolling out a data warehouse," explains Schad. "We have our principal dashboard done, we have our teacher dashboard done and now we are starting on the business side." Houston ISD's challenge is not only to make the data available, but to also spend enough time with its users to help them understand how to properly utilize the data. Powerful visualization tools can impart a lot of information quickly and easily, but teachers need professional development and training to be able to analyze data and understand what the dashboards are really telling them.

In order to achieve this, data must be integrated and visualized in one centralized location. "All of these [dashboards] are going to start converging together so they become one platform," says Schad. "Your teachers will be able to go in and see longitudinal data about their students, along with the homework and the lesson plans for the day." Schad envisions visualization tools for students as well, which will work together with the teacher resources for common outcomes.

Schad explains that teachers and administrators are already effectively utilizing information under the current system: "Your teachers and principals can use the data longitudinally, so that they can now tie their student data together to see, historically, how their students have done on various tests or where they have struggled. That helps them formulate what needs to be done, especially when they're receiving new students." Moving forward, Schad wants to improve accessibility and utilization by making a wide range of information available in dashboards that are customized for each user.
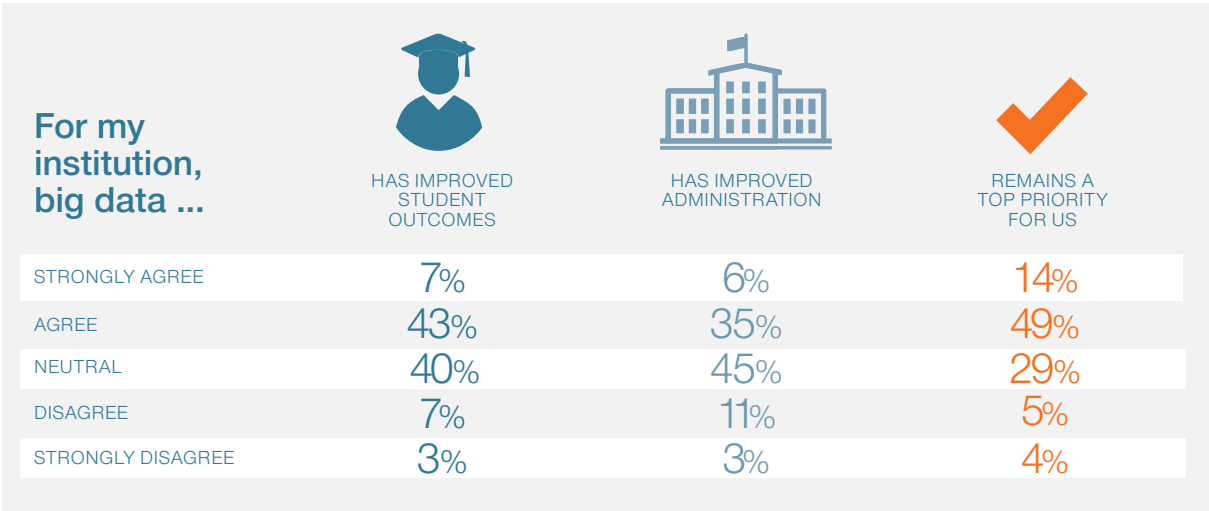
Houston ISD's teachers and administrators use dashboards to gauge student performance historically, and ultimately to improve student outcomes.

"There are so many ways that you can make data accessible to people," says Schad. "If you think, from a daily perspective, dashboards are probably one of the best mechanisms to get people to really use data that's relevant to them every single day." Houston ISD doesn't expect to stop with a successful data warehouse and dashboards project. The district's vision goes beyond this and towards an integrated learning platform: "Then there's more of the just-in-time reporting, trending, forecasting analysis," Schad explains. Ultimately, he sees these initiatives leading to the full scope of predictive and prescriptive analytics and personalized instructional experiences for students that are adaptive to their unique needs.

Dr. Jeff Borden, who leads the Research and Innovation Network at Pearson, sees big data as closely tied to improving student outcomes. But he thinks the value of data presentation and analysis tools goes well beyond the classroom. "To me, the ultimate goal of big data is true individualization for a user experience. If you really get big data doing what people want it to do, what they believe it can do and what it is starting to do, it is going to create individualized experiences at every level. And that means not just for students. You will start to see more individualization in terms of teaching, facilitation and administrative work."[15] ■

MAKING IT WORK:
Decoding the Technology

All of the following are the tools that can support or enhance big data at the end of the day — they are what will help you decode data to turn it into a final product:

▸ Data warehousing
▸ Performance dashboards
▸ Standards-based student/parent portals
▸ Descriptive analytics
▸ Predictive analytics
▸ Prescriptive analytics
▸ Machine learning models

For my institution, big data …	HAS IMPROVED STUDENT OUTCOMES	HAS IMPROVED ADMINISTRATION	REMAINS A TOP PRIORITY FOR US
STRONGLY AGREE	7%	6%	14%
AGREE	43%	35%	49%
NEUTRAL	40%	45%	29%
DISAGREE	7%	11%	5%
STRONGLY DISAGREE	3%	3%	4%

Source: Center for Digital Education Survey, 2013

A PLACE TO PUT IT ALL:

Storage, Bandwidth and Computing Power

Big data isn't a once-and-done proposition. To be valuable, much of this data needs to remain available for a long time. In order to be preserved, huge volumes of information — sometimes entire data warehouses — often need to be moved from one physical location to another. And powerful analytics demand even more powerful processing hardware. This reality creates key challenges in the big data movement: storage, networks and computing power.

Storage, Storage and More Storage

Having more data, and using it effectively, changes the storage requirements of our IT enterprises. In fact, 55 percent of K-12 IT professionals and 47 percent of higher education IT professionals say that they need to make improvements to their server and storage environments in order to accommodate and incorporate more advanced technologies, such as big data.[16] But this isn't just about getting more space.

There are other aspects of storage that could make or break a big data project. Consider the following:

Data access speed. How quickly can you get data onto the disk and off of it? Or is your operation data even stored on a hard disk at all (some new technologies are allowing greater in-memory processing)? Once a big data application is in place, you will be making many more "reads" and "writes" than ever before. And your users will want the results fast.

Archiving and backup. There is a simple answer to questions of backup frequency and archiving: Save everything forever. The problem is that this isn't practical. We can't keep everything forever, so we need a smart plan for keeping what we need. Users should be informed about any changes.

Data compression techniques. Many new storage systems are capable of compressing data, not merely storing it. This saves disk space and consequently, hard dollars.

Network connectivity. No storage area network (SAN) is an island. To be useful, almost all storage needs to be on an accessible internal network. Much of it will need to be accessed between trusted physical sites, and some will even need to be available on the public Internet (more on security later).

Networks and Bandwidth are Crucial for Big Data

In an earlier section, we covered the success that Scottsdale and other districts have had getting their campuses wired to the Internet. Today, it goes without saying that K-12 and higher education institutions need network bandwidth, and they need it now. As new capacity is brought online, application possibilities emerge. Call it the circle of network life.

No institution requires networked speed like a research university. Many of these institutions already have great connections but they do not reach out into the community, and together they are looking to gigabit Ethernet networks as the solution. Implementing these programs in conjunction with the university can benefit the broader community, sometimes through direct partnerships but also over the longer term.

For instance, the national Gig.U project aims to bring ultra-high-speed Internet connectivity to universities and communities as a starting point for more extensive broadband initiatives. Former FCC Administrator Blair Levin, now the executive director of Gig.U, says that universities are logical and cost-effective places to develop and test these gigabit networks. Thirty-seven member universities are working to build next-generation networks and to galvanize the spread of these networks to other universities and their surrounding communities.

The University of Washington, a Gig.U member, in conjunction with Seattle, issued and filled a request for proposal (RFP) to develop a gigabit network in several neighborhoods in Seattle, and the University of Chicago is doing something similar in its region. Just this year, NC State — in cooperation with Gig.U, three other universities and six communities — put out an RFP to the region (Raleigh–Durham–Chapel Hill and Winston/Salem) to bring gigabit connectivity to North Carolina residents and businesses. This partnership looks to bring down costs by sharing assets such as the universities' "dark fiber" (i.e., excess fiber-optic capacity), so the wider community can more quickly reap the business, research and other benefits of this high-speed, high-capacity networking infrastructure. A high-speed network would remove barriers to all kinds of frequently discussed but not-yet-feasible ideas, from the practice of telemedicine and distance education, including training in the performing arts, to the speedy and reliable delivery of high-definition movies to home audiences.
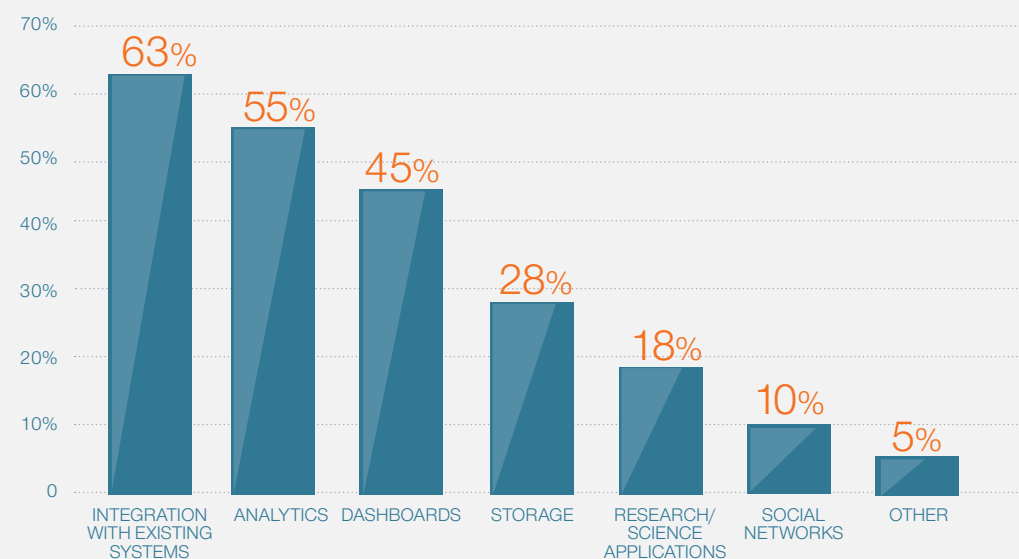
The Gig.U strategy is consistent with trends in innovation and development: Dr. Hoit from NC State posits that "major innovation comes from a 30- to 50-mile radius of universities," noting that in the history of innovation, "it followed where the telegraph wires went; it followed where the railroads went; it eventually followed where the highways went. And the new infrastructure that's going to spur innovation is bandwidth."

BIG DATA AND THE CLOUD

Some may think that big data and the cloud cannot co-exist. After all, with huge amounts of data sitting out in the cloud in one data center, how could other systems access it? As it turns out, the network is the answer, and big data in the cloud is already a reality. As tools become available to more users — teachers working at home on the weekend, students on a field trip and parents away from their office in the middle of the day — a cloud computing strategy is increasingly seen as a convenient and easily accessible solution.

Lenny Schad from Houston ISD agrees: "If it's a cloud-based solution, now you have parents and students and teachers and administrators being able to leverage big data anytime, anywhere. It's not restricted to the school day anymore."

What are your investment priorities?

Category	Percentage
INTEGRATION WITH EXISTING SYSTEMS	63%
ANALYTICS	55%
DASHBOARDS	45%
STORAGE	28%
RESEARCH/SCIENCE APPLICATIONS	18%
SOCIAL NETWORKS	10%
OTHER	5%

Source: Center for Digital Education Survey, 2013

TGen is a nonprofit genomics research institute that is using data from the human genome to try to find a cure for cancer.

BRINGING IT ALL TOGETHER:
Decoding the Technology

There are many parts to a successful big data infrastructure. Here are some of the most important ones:

- ▶ Servers and processing hardware
- ▶ Storage area networks (SAN) and network-attached storage (NAS)
- ▶ New technologies for faster access and retrieval
- ▶ Network upgrades and bandwidth considerations, i.e., next-generation networks for big data
- ▶ Archiving and disaster recovery

Cities that don't implement these programs in their communities will be at a disadvantage. When companies consider where to locate, they look for three things: "A good supply of workers (in which case they look for universities that produce the kind of graduates they want to hire); a good living environment, which includes good schools for their children; and high-speed Internet connectivity, because you can't run a modern business without it," says Dr. Hoit.[17]

Just How Important is Computing Power to Big Data?

As we noted earlier, the applications for big data run the gamut from teaching numbers and letters in kindergarten to the heady realms of academic research in higher education. The Translational Genomics Research Institute, or TGen, is at the far end of this range in terms of both complexity and importance. TGen is a nonprofit genomics research institute that is using data from the human genome to try to find a cure for cancer. Its specific target is curing neuroblastoma in four-year-old children. Neuroblastoma is one of the most common cancers in children, and is particularly hard to treat. It isn't a single disease, and scientists can't separate out the different types of disease simply by looking under a microscope. To find a solution, TGen had to dig deeper.

TGen's research methodology involves running a clinical trial by utilizing personalized medicine. It starts with the analysis of an individual patient's tumor by comparing

the tumor's genome and a normal genome. This gives TGen insight into the types of treatments that can be applied for each specific patient. But the current trial requires the sequencing of an entire genome. And since these patients are four-year-old children, timing matters.

The process of sequencing an entire genome is lengthy, and generates tremendous amounts of data. And it's only becoming more complicated as the trial progresses. When TGen started, it looked at 10,000 markers across the genome. Today, it looks at more than 3 billion markers and it counts each of those markers 30 times to determine what's happening. As you can imagine, this requires some serious firepower from TGen's hardware and generates a lot of data to store and transport.

To decrease data processing time, increase the amount of data storage and allow for easier transport, TGen partnered with a technology company to acquire new servers on a new architecture. The result was a 12-fold increase in computing power. The new architecture allows for high-speed access to data and parallel file access. TGen is also able to store larger amounts of data, specifically three times the number of cores, in the same physical space. With all of that computing power, TGen predicts that it will be able to get the right drug to patients much faster. This, TGen says, would have been completely impossible with its legacy systems.

Moreover, TGen is now able to target new data analysis challenges. Prior to installing the new systems, time-sensitive problems were off limits. TGen could analyze the data, but it took too long to get the results back to the patients to make any significant impact. In addition, the smaller hardware footprint allows TGen to house more scientists and fewer computers, and its new architecture system boasts interconnectivity among systems — all with fewer administrators and no additional space. Finally, TGen's new servers use less power and improve cost-efficiency, which allows for more patients to be in the trial and helps TGen to better more lives.[18] ∎

SECURITY & PRIVACY
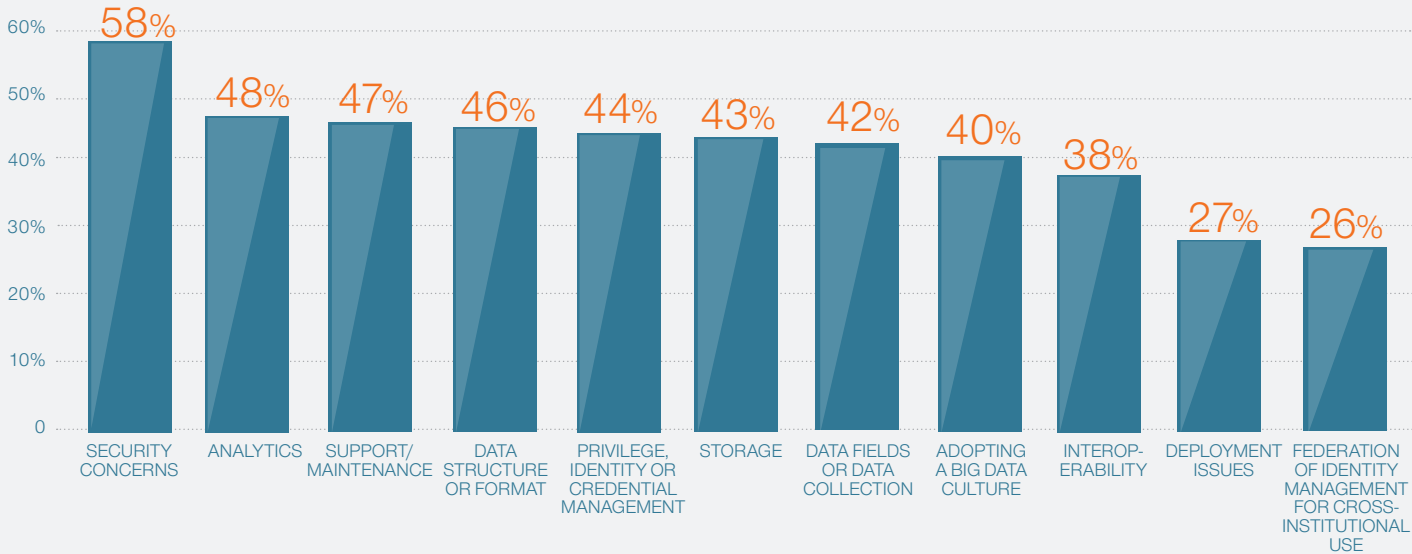# IN THE AGE OF BIG DATA

We all know that security is a very important consideration when working with big data and its applications. The sharing of so much data opens up a range of important security concerns — more than can be adequately addressed here. But even at this stage, our CDE research drives this point home: Security is at the top of the list of everyone's concerns when it comes to big data.

However, real information safety is possible and achievable if education institutions adhere to the bedrock principles that have made security and privacy initiatives work in the past. We need to comply with the Family Educational Rights and Privacy Act (FERPA), of course. But we need to go beyond the specifics of rules and procedures to leverage new strategies for aggregating and analyzing information without compromising the rights and educational experiences of those who are providing the information in the first place.

One promising development is the recent advances made in masking data at its source. New techniques and capabilities for ETL (extract, transform, load) software applications allow sensitive data to be masked at the database level when brought into a data warehouse. This means that even if someone gained physical access to the data warehouse's database, sensitive information like Social Security numbers would still be obfuscated. Masking may not work in every circumstance, but it's an indication of the types of creative approaches that will make big data applications possible while still protecting confidential student and instructor information. ∎

What are some of your data challenges?

Challenge	Percentage
SECURITY CONCERNS	58%
ANALYTICS	48%
SUPPORT/ MAINTENANCE	47%
DATA STRUCTURE OR FORMAT	46%
PRIVILEGE, IDENTITY OR CREDENTIAL MANAGEMENT	44%
STORAGE	43%
DATA FIELDS OR DATA COLLECTION	42%
ADOPTING A BIG DATA CULTURE	40%
INTEROPERABILITY	38%
DEPLOYMENT ISSUES	27%
FEDERATION OF IDENTITY MANAGEMENT FOR CROSS-INSTITUTIONAL USE	26%

Source: Center for Digital Education Survey, 2013

OVERCOMING BARRIERS AND MAKING IT REAL

Simply put, big data is hard work. But with planning and effective diligence, project risks and the barriers to adoption can be overcome. The first, and perhaps most glaring barrier, is a lack of skilled people. Where will we get the people we need, the "data scientists" who will make big data a reality for our organizations?

Fortunately, Dr. Hoit has an answer for this as well. Working with SAS, Dr. Michael Rappa created the Institute for Advanced Analytics at NC State, the nation's first professional master's program in data analytics. One year, a single company offered to hire the program's entire cohort of 40 students. According to Dr. Hoit, "Employers want to come to one place and know that they can find a large cohort of possible candidates and hire them." Other higher education institutions are following NC State's lead and developing similar programs of their own.

This program was a natural move for NC State, whose reputation for big data leadership is the well-deserved result of decades of accomplishments in data analysis. In the late 1970s, a faculty member and some graduate students founded what has become one of the world's largest and most influential data analysis companies, SAS, with headquarters near NC State. Dr. Hoit explains that the university's partnership with this "good next-door neighbor" led to the creation of the Institute for Advanced Analytics about five years ago. It is a
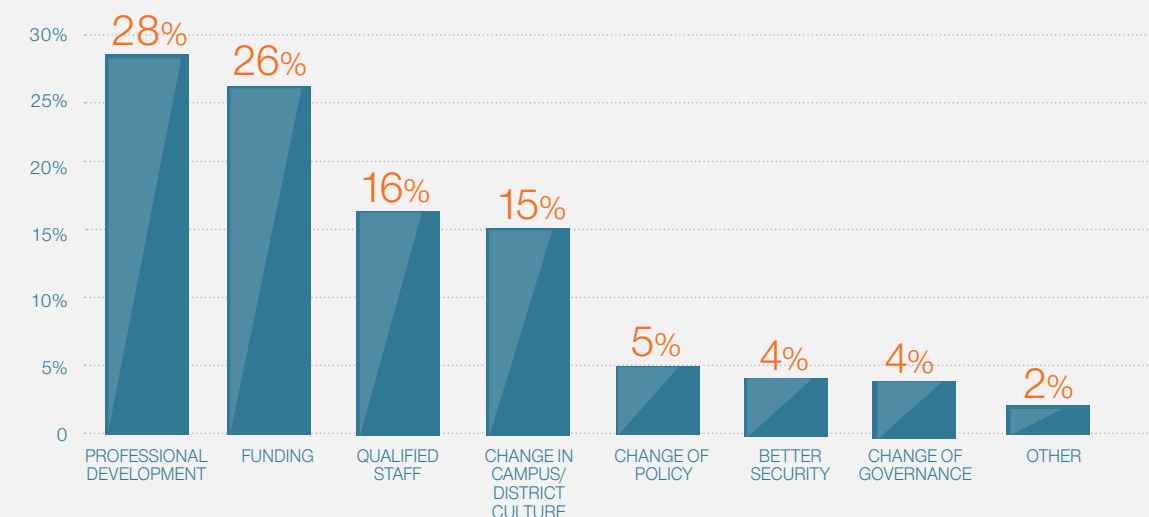
professional master's program — "almost an apprentice program," Hoit explains — dedicated to producing analytic or data scientists. In the Institute's master's program for data analytics, students are taught all the skill sets they need to tackle big data problems over 11 months. If its graduates' multiple job offers — all at the top end of their salary range — are any indication, the program has been very successful.

Since its inception, the program has doubled in size and now prepares 80 students each year for a workforce in need of data scientists. The students are heavily involved with the campus departments and beyond. Each cohort is divided into teams of four or five students. The program director assigns each team a problem; sometimes that problem will come from government agencies, such as the Department of Justice, which may, for example, want help sorting and making sense of large amounts of data. Other problems might come from private industry. For instance, a business may need help processing the data generated by its machinery, or identifying and/or tracking production-line flaws and inefficiencies.

Students in the program learn statistics, how to extract desired information from databases, how to manage the signal-to-noise ratio in data sets, how to clean the data and how to figure out what is required of the data for each unique problem to meet the customer's requirements. With help from the class mentor, students are connected with the people whose problem they are working on, as they would be in a real-world scenario.

With a steady pipeline (or at least some emerging sources) of data scientists identified, we can move on to overcoming the other barriers to adoption of big data. We'll need to identify our stakeholders, and solicit their active involvement in our projects. We need to secure solid executive sponsorship while providing the funding needed to make projects and programs a success. We'll need to integrate IT systems and business processes, and overcome the typical turf battles that accompany them. And finally, we will need to establish a comprehensive vision of what the future of big data will look like. ■

The Institute for Advanced Analytics, a professional master's program at NC State, is dedicated to producing data scientists and prepares 80 students each year for this specialized workforce, says Dr. Hoit of NC State.

BRYAN REGAN

What would help you better leverage big data?

Category	Percentage
PROFESSIONAL DEVELOPMENT	28%
FUNDING	26%
QUALIFIED STAFF	16%
CHANGE IN CAMPUS/DISTRICT CULTURE	15%
CHANGE OF POLICY	5%
BETTER SECURITY	4%
CHANGE OF GOVERNANCE	4%
OTHER	2%

Source: Center for Digital Education Survey, 2013

BIG DATA LEADS TO BIG RESULTS

The potential of big data in education is huge. It allows campuses to anticipate the needs of their students, and empowers instructors to do what they do best: educate the next generation of leaders.

SHUTTERSTOCK

Lenny Schad sees a great future for big data. But he also expects that current modes of thinking will need to change to make that potential a reality. "Big data conversations typically jump down into the weeds, and I think that is the most dangerous position that we, as leaders, can take. I think the big data conversation, from a leadership perspective, needs to focus on what our expectations are, what we want people to do with the data and preparing them for access to that data."

While the challenges loom large, the potential benefits are larger still. Imagine having a conversation with a student just as his or her academic trouble starts, instead of many months after the problems have become full blown and obvious. Imagine tools that let instructors apply the best, most research-proven interventions to the students who need them. Imagine administrators who are aware of the potential trends in their school's performance — up or down — and can act on them before anything irreparable happens.

Imagine a campus where data isn't just collected for posterity in a dusty mainframe, but mined in real time for actionable insights. Where the campus anticipates the needs of the student and meets them — before the student even asks. And where instructors are empowered to do what they do best: educate the next generation of leaders.

This isn't a dream. With some elbow grease and the right big data tools, it could very much be reality. ∎

Data to Information to Insight — The Promise and Opportunity of Big Data

BIG DATA. Two little words with such promise for education. Whether it's Common Core State Standards, online testing, IEPs or just a general desire to tailor lessons to an individual student's needs, data is a huge key to success. Luckily, there's no shortage of data — but bringing it all together in a meaningful way is not necessarily easy. That's where Big Data and Business Intelligence solutions can help — converting data to usable information, which in turn gives educators the insight they need to make meaningful changes in the classroom.

Districts have endless sources of data available to them. There's unstructured data that's held in spreadsheets, departmental reports and even social media. There's also structured data like test scores broken out by grade level, gender, ethnicity and socioeconomic status. Today, teachers and administrators spend a lot of time looking at all these pieces to ensure that they are helping their students where they need it the most. This is where Big Data comes in.

Business Intelligence garnered from Big Data helps districts quickly generate actionable insights from ever-growing volumes of internal and external data to make better decisions that can improve teaching. Districts can then layer this information and bring it all together through Business Intelligence and Business Analytics. These tools give educators the ability to extract and leverage the data in near real time without always having to depend on other resources, such as IT, to deliver the results. Finally, Big Data and Business

Intelligence strategy can lower total cost of ownership (TCO) by leveraging newer deployment models to offset limited IT resources, while improving ROI on existing investments through consolidation, improved use and end-user training.

CDW•G understands that districts need help navigating the complexity of data's volume, velocity and variety to create a solution that meets each district's unique needs — with a faster time to insight, greater productivity and lowered TCO. CDW•G's breadth of market-leading partners, combined with its team of technology experts provide districts with full support — assessment, design, proof-of-concept, implementation and support — to ensure success.

Big Data. Two little words with so much opportunity for education.

For more about CDW•G's solutions and services to K-12 schools, please call **1.800.808.4239,** email **cdwgsales@cdwg.com** or visit **CDWG.com.**

EDUCATION
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SOLUTIONS

Managing data, eliminating unnecessary administrative tasks and improving student achievement

Teachers and administrators today rely on data to provide critical feedback on student progress and drive curriculum corrections. They look to technology to provide this data on demand and in an easy-to-consume format. Student achievement relies on real-time data being in the hands of the people who need it, when they need it.

Samsung understands these needs and provides integrated, scalable printer solutions for administrators and teachers to quickly scan, test, grade and manage data to more effectively and securely track student progress and eliminate unnecessary administrative tasks. These best-in-class printers check data for compliance with federal privacy regulations, scan documents and physical objects to help teachers develop digital lessons,

retrieve and assemble mandated special education annual reports on students, and print out student data and reports for formal presentations.

Samsung printers are truly "Education Innovated" solutions that improve teacher effectiveness, student achievement and administrative efficiencies through an open platform that allows for creative, education-focused solutions.

PRINT SOLUTIONS PROVIDE:
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- Test grading and integrated reports with student information systems and learning management systems
- Secure data with FIPS compliance to address HIPAA and FERPA needs
- Ability to scan objects to create digital objects for lessons
- Capability to retrieve and assemble mandated special education student annual reports
- Printed student data and reports for formal presentations
- Scanning and storing for disciplinary, health & other sensitive records

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Shock-resistant and reinforced with more durable hinges, rubber bumpers, and stronger USB ports, it can handle all the wear and tear inflicted by students. Boot it up and quickly discover a machine tailor-made for a 1:1 learning environment: fast, customizable, and enhanced with digital learning tools such as Skype, Kindle for PC and more.

BUILT TOUGH.

This machine is designed to withstand wear and tear inflicted by even the toughest students. An Active Protection System™ protects the hard drive in an accidental fall. Rubber bumpers safeguard against nicks and bumps. In addition, a spill-resistant keyboard can handle milk or water with ease.

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TRUE 1:1 LEARNING.

Lenovo is working to provide the digital foundation needed for 1:1 eLearning. Tools and applications, including software featured in the Intel® Education Series, help students learn, improve teacher usability, and help parents monitor student activity. Plus Stoneware provides secure and shared access to coursework, research and papers.

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Setting Schools Up for the Future

Cox Metro Ethernet Provides Access to Educational Data Over One Reliable Network

Ensuring Access in a Big Data World

In today's technologically advanced world, educational institutions are confronting droves of data, so much so that it is being dubbed "big data." Although this can be daunting, it also has the capability to transform education.

To maximize the potential of big data, institutions need secure, real-time connectivity to support:

- **Anytime, anywhere access:** As students, educators and staff become more mobile and learning evolves beyond the confines of the traditional classroom, schools must be able to provide fast, secure connectivity wherever and whenever it is needed.
- **Increasing use of technology:** Students and faculty are bringing in their own devices, and oftentimes more than just one, to access educational resources. Additionally, they are using these devices to access digital content that can vary from interactive e-textbooks to streaming video. To accommodate this, districts and systems are seeking more bandwidth and network convergence solutions.
- **Collaboration:** Whether it's schools within a district or research organizations across the country, institutions are finding that sharing data and improving collaboration can have a significant impact on learning outcomes. It is therefore critical to centralize data where it can be securely and easily accessed.

A Real-World Solution from Cox Business

Cox offers innovative networking technology to educational institutions looking to take advantage of big data. Cox Metro Ethernet services provide cost-effective, secure and robust bandwidth to support today's next-generation learning environments, all with the simplicity and reliability of an intelligent optical fiber network. Services include:

- **Scalable bandwidth from 10Mbps to 1Gbps and beyond**
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Is Big Data Becoming a Big Challenge?

We Have the Tools You Need to Maintain Control

It's a tough time for data. The amount of information you're generating is exploding while you're trying to do more with less. Plus, with tighter regulations, records retention, and the need for better management, you are tasked with figuring out how to capture, store, transfer, and analyze your data |so it doesn't become an overwhelming burden. What can you do to protect your organization and ensure you have the tools to meet evolving requirements and constant growth?

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BIG
WITH
BIG DATA

LEADING EDGE IN
BIG DATA

National Academy Foundation Benchmarks BIG Results

The National Academy Foundation (NAF) is an acclaimed network of career-themed academies that opens doors for underserved high school students to viable careers and academic success. For 30 years, NAF has refined a proven model that provides young people access to industry- specific curricula, work-based learning experiences, and relationships with business professionals. NAF academies integrate traditional high school studies with a focus on one of five career themes – finance, health sciences, hospitality & tourism, information technology, and engineering. If NAF were a stand-alone school district, it would rank among the top ten largest in the country in terms of number of high school students served.

NAF has always focused on taking a data-driven, outcomes-based approach. Through its partnership with ConnectEDU, a leader in data-driven, student-centered technology solutions, NAF is able to measure student performance across the network of academies and against non-NAF students in the same schools and districts.
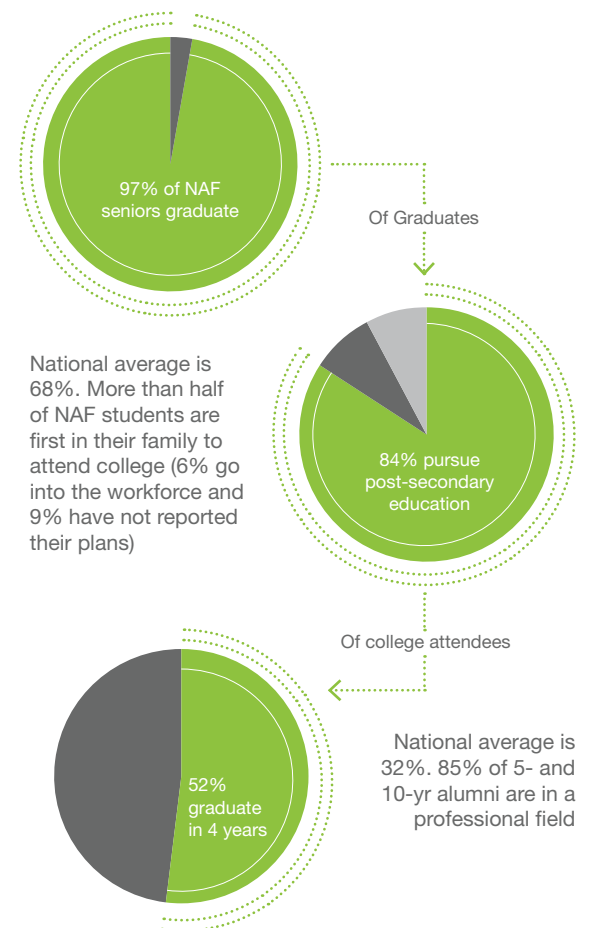
COLLECTING AND CONNECTING THE DATA:

ConnectEDU works with existing data systems and solutions. With over 10 years of experience integrating student information systems and other student data platforms, ConnectEDU's collaborative approach maximizes existing investments made by CIOs.

STORING AND SECURING THE DATA:

100% FERPA compliant, ConnectEDU's solutions, including an education cloud, generate results without compromising on security or reliability. The education cloud provides CIOs with a secure, scalable and cost-effective big data solution.

The Results

NAF students perform better than their non-NAF counterparts in virtually all metrics, including attendance, credits earned, math proficiency, grades in English and math, GPA, and graduation rates.

97% of NAF seniors graduate

Of Graduates

National average is 68%. More than half of NAF students are first in their family to attend college (6% go into the workforce and 9% have not reported their plans)

84% pursue post-secondary education

Of college attendees

52% graduate in 4 years

National average is 32%. 85% of 5- and 10-yr alumni are in a professional field

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Protecting Schools
In The Age of Big Data

How education institutions can cost-effectively govern data during the eDiscovery lifecycle

The bigger data gets, the more problems it can cause in the area of eDiscovery — the process by which organizations are mandated to identify, analyze and produce electronically stored information (ESI) in response to certain requests. The more data an organization stores, the more difficult — and expensive — it becomes to manage.

Education institutions are no strangers to Big Data, and like all governmental organizations, they must adhere to federal regulations that mandate systems be in place for them to retrieve ESI when necessary.

The increase in lawsuits filed against schools has brought eDiscovery solutions higher up on the priority list for many IT and legal departments. Reactionary measures are no longer acceptable — developing a proactive plan is critical to reduce time and money spent during the eDiscovery process.

"Discovering" a Better Solution

Fortunately, new solutions can help education institutions properly govern Big Data during the eDiscovery process, helping them avoid potential fines and saving significant amounts of staff time.

Symantec's Clearwell eDiscovery Platform is the leading enterprise solution to manage eDiscovery from one simple application.

The Clearwell eDiscovery Platform allows users to:
- Easily and efficiently locate data
- Cull-down data up to 90 percent
- Increase review throughput and consistency
- Eliminate movement of data across multiple and disparate tools
- Improve defensibility of the eDiscovery process
- Adapt to evolving records mandates, while also reducing risk

Additionally, **Transparent Predictive Coding**, a critical feature of the Clearwell eDiscovery Platform, addresses costs accrued from eDiscovery. Transparent Predictive Coding reduces a significant portion of manual work from the review process, enabling review teams to achieve highly accurate results with minimal cost. In a 2012 RAND Corporation study, it was estimated that organizations spent nearly $18,000 reviewing a single gigabyte of data during eDiscovery's review process. Many customers actually report that they recoup their entire initial investment on the first case where Clearwell is leveraged.

To see firsthand why so many organizations are selecting the Gartner Magic Quadrant leader in eDiscovery, contact us for your free 30 Day Proof of Concept of the Clearwell eDiscovery Platform.

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Symantec is a global leader in providing security, storage and systems management solutions to help consumers and organizations secure and manage their information-driven world. Our software and services protect against more risks at more points, more completely and efficiently, enabling confidence wherever information is used or stored. For more information, visit **http://go.symantec.com/education.**

BY DONNA BOIVIN, EDUCATION SOLUTIONS SENIOR CONSULTANT FOR DELL, INC.

Education Data Management:

Turning Data into Actionable Information to Enhance Student Achievement

Adopting a powerful, robust, and reliable Education Data Management (EDM) system is critical to the success of students in any educational institution. An efficient and comprehensive EDM solution utilizes technology resources and high-quality data, information, and knowledge to inform instruction practices, enhance educational outcomes, and improve operational efficiencies.

What is Educational Data Management?

EDM is a data system solution for educational institutions that transforms high-quality data into actionable knowledge that can be used to improve educational outcomes and track student information over multiple years. An efficient EDM not only enhances the ability to efficiently, effectively, and accurately analyze academic data and report on that data, it also provides a platform to optimize information management for enterprise-wide operations such as HR, finance, facilities, and other functions.

Our Approach to Education Data Management

Dell is committed to helping districts, states, universities, community colleges, and technical schools create robust, high-quality EDM systems. Dell's services include all of the technology solutions, integration processes, change management strategies, professional learning, and tools needed for success. Our core EDM components include: Master Data Management, Data Warehousing, Education Intelligence Tools, and an Online User Portal.

Education Data Management System

Master Data Management	Data Warehousing/ Longitudinal Data Systems	Data Analytics/ Education Intelligence	Online User Portal
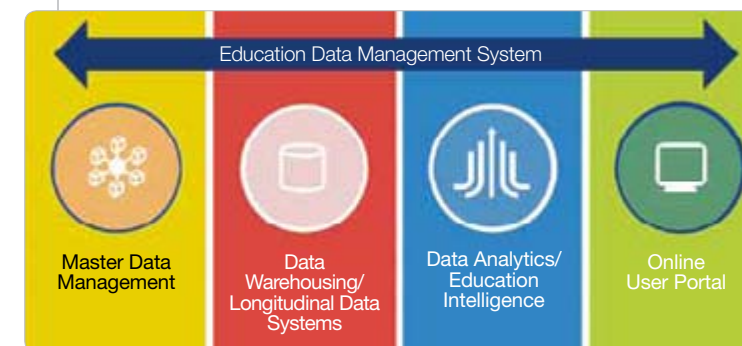
Dell is providing critical EDM support services to help Laramie County School District #1

To provide the foundations for a robust Longitudinal Data System, Dell is delivering frontline support for key technology initiatives

> " When we decided to create a Longitudinal Data System for our district, Dell provided the technology and support services we needed. We are excited for the expected results."
>
> *— Gordon Knopp, Director of Technology (CIO), Laramie County School District #1, Cheyenne, WY*

including virtualization, data storage, and data warehousing. Data is extracted, transformed, and loaded from various district data sources into a comprehensive data warehouse. Educational Intelligence tools and a flexible and easy-to-use SharePoint® user interface will allow users to access, analyze, and report on information. Phase 1 of the LDS project is scheduled to launch in the Fall of 2011.

Robert Morris University realizes $60,000 in annual cost savings with solution designed by Dell

Dell designed and helped the university implement a robust, self-service reporting solution using Microsoft® SQL Server® 2008 data warehouse along with SQL Server Reporting and Analysis Services, and SharePoint®. Benefits to the university include a projected reduction of 31 hours of IT support per week for an annual $60K savings, as well as a six-figure cost avoidance on the purchase of an alternative software solution.

> " We'll no longer have to reinvent the wheel every time someone needs a report. I expect to free up about one-third of my time for more value-added tasks."
>
> *— Dino Cehic, Programmer Analyst, Robert Morris University*

DELL

For additional EDM information, visit www.dell.com/edm, or contact a Dell EDM expert at EDM@dell.com.

85%
69%
40%
36%
23%
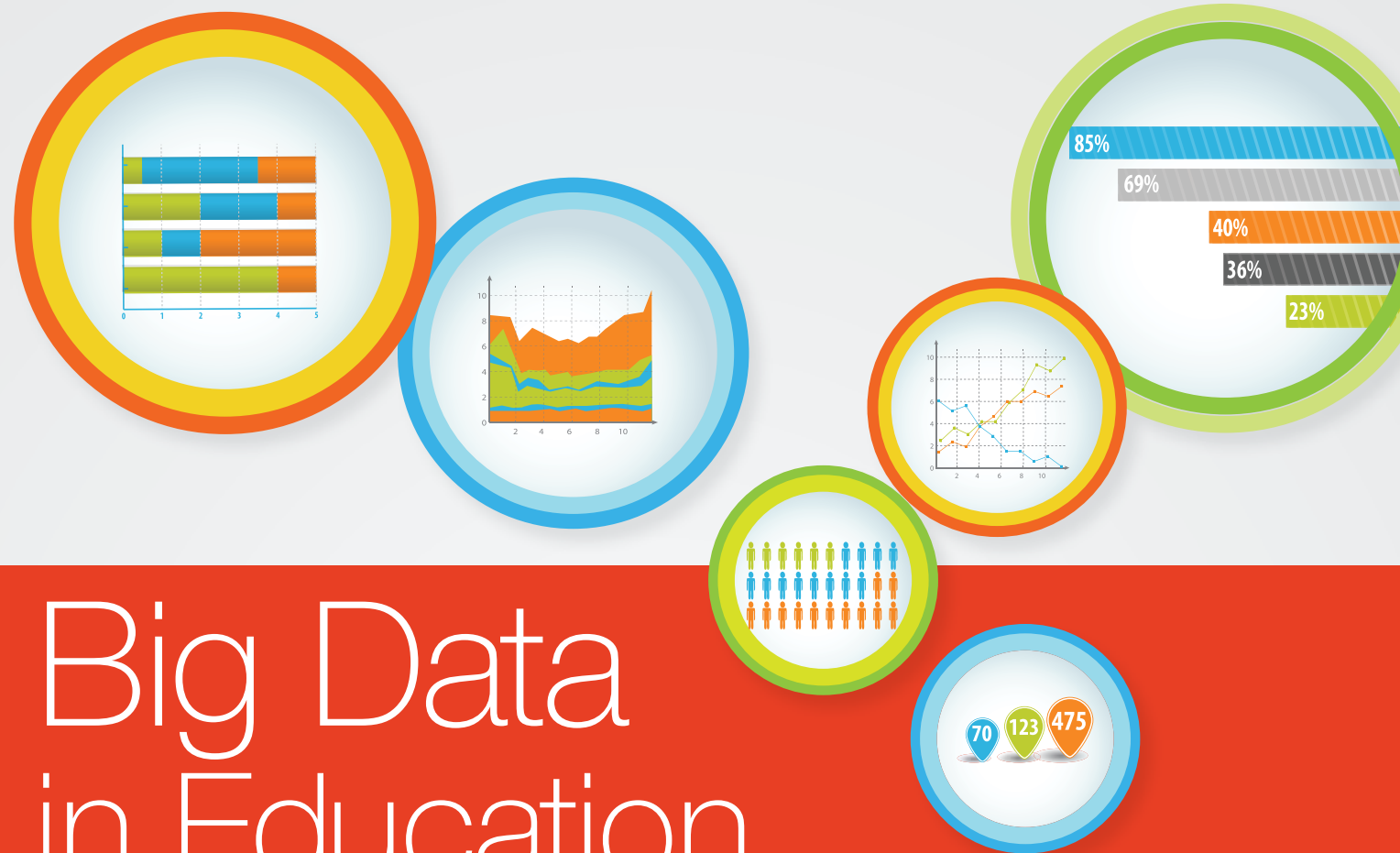
Big Data in Education

Using Everyday Tools to Do Big Things

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BIG DATA ISN'T NEW. For years, the private and public sectors have used it for analysis and study. What is new is that economies of scale have recently made it available to the masses, including education institutions. K-20 education institutions now want to know how they can effectively use big data in everyday roles with everyday tools. They want to do big things with big data, but without big challenges.

In response, Microsoft has made substantial investments into business intelligence (BI) platforms (both on-premises and in the cloud) that empower education leaders to transform real-time data into action. Microsoft puts data into the right hands at the right time, and without the need for specialized analysis.

Through managed self-service business intelligence, Microsoft allows institutions to leverage existing technologies they already use and are familiar with: Microsoft Office in the form of Excel, and other key collaboration solutions like SharePoint. Microsoft strengthens BI with easy-to-use, self-service operability that enables data storage and availability, security, scalability and collaboration. Education leaders can access and combine data from a variety of sources with a variety of Microsoft solutions, and transform massive quantities of information into easy-to-navigate reports with useful data to help drive informed decisions.

This seamless integration of services through accessible tools and programs saves institutions time by not needing to train staffers on new technology, and reduces cost by not having to spend money on new devices or software. With Microsoft and big data, it's all about making information secure and reliable with real-time accessibility, and shaping interactions through tools already in use. It's about putting big data into action to enhance education for all.

Microsoft's Big Data Benefits
○ Real-time access and reliability
○ Actionable results from data accessibility
○ No specialized analysis required
○ Leverage existing technology — use products you already own (i.e. Excel, SharePoint)

For more information, visit **www.microsoft.com/education**.

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Big Data in Education Requires a Powerful Tool: Empower Data-Driven Instruction with DataDirector™

The "big data" capabilities now available to educators give you a unique opportunity to find out what students know and to identify the most effective techniques for reaching every learner. But to make the best use of data, it's important to start with a powerful, dynamic assessment solution.

DataDirector from **Houghton Mifflin Harcourt–Riverside®** is that solution. Developed *by* educators *for* educators, *DataDirector's* innovative tools help you make sense of all the information you gather and use it to guide instruction. You can use *DataDirector* to:

- Create standards-aligned assessments
- Analyze performance through dynamic reports
- Collect data relevant to your district needs
- Manage and track student groups

And **HMH – Riverside** offers you the ability to combine reliable and valid content with powerful data management and analytics. Learn more about *DataDirector*, as well as *Assess2Know®*, a high-quality item bank aligned to state, national, and Common Core State Standards.

Call 877.993.2633 or **contact your local Account Executive today.**
Visit **datadirector.com** for more information.

Textbook reformation and implications for the printed page

Digital Doesn't Equal Paperless

The move to digital content may seem like its taking place at lightning speed, but schools are in a state of transition — and will be for a while. The challenge of digital access is very much still real. According to the Federal Communications Commission, many schools struggle to successfully meet the need for the higher-speed Internet access that digital content requires. It cites this demand as one reason it unveiled the National Broadband plan in March 2010.

Additionally, many students lack access to digital content at home. According to Broadband.gov, approximately 100 million Americans still do not have broadband at home. Although schools may start using more digital content in the classroom, it doesn't mean that students can access it to complete homework or study outside of school.

Not everything can live in the digital ether, either. Teachers want to print customized student worksheets or completed computer work to send home; and student projects such as magazines, newspapers or yearbooks need print access. Cost-effective, on-demand printing solutions are a necessity for every classroom.

This is further supported by Bobby Blount, assistant superintendent of accountability, technology & strategic planning for Cherokee County School District in Georgia: "Even our pre-K classes use printers as they produce PowerPoint slides and craft story boards to express their ideas."

Schools from K-12 to graduate level have technology needs in common: cost control, reliability and energy efficiency.

Standardizing and upgrading to devices with increased functionality and lower operating costs is an effective strategy for schools to increase productivity while reducing the overall costs of their print and imaging fleet.

"Standardizing cuts down on total cost of ownership because we support fewer models across the district," says Jerry Reininger, Ed.D., director of information technology, Meridian Joint School District No.2, Idaho. "Also, in terms of supplies, if a school gets rid of a printer and they still have extra toner cartridges, we can move the cartridges to another building."

HP's newest printers address the need for cost-effective, on-demand printing in lieu of traditional mass pre-printed classroom materials. Furthermore, HP's full line of award-winning digital color printers is among the most reliable and cost effective in the industry, helping you inspire and improve academic performance within your budget. Studies have shown that color has the power to influence, motivate and inspire. It affects students' attention spans and perception of time. Color helps facilitate perceptual organization and memorization, and increases study skills in students — especially those with learning difficulties.

Environmental responsibility is another important consideration. HP has recycling programs for not only supplies but also retired hardware, so schools can safely and securely dispense of materials and equipment that are no longer needed, and even bank those recycled assets toward future purchases.

Real-world sensitivity matters. And when schools are transitioning to the digital age, it's important to include every student. HP supports student learning in the digital age with printing and computing solutions that enable teachers to teach in whatever form best suits each student — on demand, in real time, every day.

For information on special offers for HP printers visit:
www.hp.com/go/SpecialOffers

MAXIMIZING PRINTERS IN THE DIGITAL AGE

As education becomes more digital — with advances such as e-textbooks, mobile devices, big data and more — the need for efficient and secure printers increases. Schools and districts are finding that enabling access to printers for all students, teachers and faculty supports their digital strategies and enhances learning. In order to maximize the use of printers, however, schools and districts need cost-effective solutions that allow them to improve back-office efficiencies.

Canon is a leading provider of innovative digital imaging solutions, including top-of-the-line inkjet printers. When schools and districts purchase Canon printers, they can expect the following advantages.

Ease of Use
• **The Intelligent Touch System** only lights up the necessary keys so the menu is easy to navigate.

Cost Savings and Eco Friendly
• **Auto Duplex Automatic Document Feeder:** Work with multi-page documents and copy/scan/fax two-sided originals without having to turn the pages over.

• **Two-Sided Printing:** Save up to 50 percent of plain paper.
• **Individual Ink Replacement:** Reduce waste by replacing each color as it runs out.

Connectivity
• **AirPrint:** Easily print from iPads, iPhones and iPod Touches without installing any drivers.
• **PIXMA Cloud Link:** Print Web templates such as cards and memos, or print photos from the online photo album sections of Canon iMAGE Gateway and Google Picasa.
• **Google Cloud Print:** Print from anywhere using everyday applications. Print attachments from Gmail and Google Docs.
• **Wireless PictBridge:** Print photos without cables from Wi-Fi-enabled cameras.

Service and Support
Canon offers award-winning U.S.-based customer service and support.
Visit: http://usa.canon.com/cusa/consumer/standard_display/cso_home for more information.

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To learn more about the critical role of printers in today's digital classroom, download the Center for Digital Education's white paper, "Printer Access in a Digital World" at **www.centerdigitaled.com/paper**.

For more information, contact the Canon Education Department at educationsales@cusa.canon.com or visit us at usa.canon.com/educationsales.

Sponsors:

Acknowledgements:

JOHN MIRI, Senior Fellow at the Center for Digital Education, is a nationally recognized expert on Data Warehousing and Business Intelligence who is frequently called upon to address the impact of Big Data on education at the federal, state, and local levels. Miri developed a district-wide longitudinal Data Warehouse and Teacher Dashboard solution for a large urban school district serving more than 90,000 students and he has advised a state education agency on the technical architecture, enterprise governance, and project management for a Big Data initiative that will ultimately serve more than 500,000 teachers and administrators. Prior to his work in government and education, Miri designed and deployed Data Warehouse and Business Intelligence solutions to leading companies in the private sector. Miri is the principal inventor on U.S. Patent #7,571,138 — an advanced data management software tool for financial risk management. Miri graduated from Harvard University with an honors degree in Physics.

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