The Promise Of Learning Analytics: Using Data To Drive Student Outcomes

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Introduction

Schools have long relied on student data as a tool for making decisions about students, curriculum, instruction, assessment strategies, and more. For decades, though, school had to use rudimentary methods to collect and analyze data—a tedious, labor intensive process that yielded very little useful information.

Now, though, thanks to student data systems, teachers and administrators have a wealth of valuable information at their fingertips—smart data they can use to make informed decisions. The challenge districts now face is how to turn that data into actionable intelligence.

In this special report, sponsored by Dell, *THE Journal* outlines ways schools can use data analytics to personalize learning and instruction and drive student outcomes. The plan includes an overview of potential roadblocks with recommendations for successfully overcoming them.

Education in Crisis: The Need for Analytics

Thirty years ago, the American public was shocked to read a special report from the National Commission on Excellence in Education, called *A Nation at Risk: The Imperative for Educational Reform*. The Report identified a crisis in American education and, among other key issues, suggested that American schools were failing to meet the national need for a competitive workforce.

For many education stakeholders, the report was a wake-up call to what the Report famously called "a rising tide of mediocrity that threatens our very future as a Nation." [1]

Today, not much has changed. Scores from the 2009 Programme for International Student Assessment (PISA) shows that out of 34 developed nations, the US ranks 14th in reading, 17th in science and 25th in math, far behind high-scoring countries including South Korea, Finland, Singapore and Hong Kong in China. [2]

In addition, according to the Organisation for Economic Co-operation and Development (OECD)—the Paris-based organization that develops and administers the PISA exam—only eight countries have *lower* high school graduation rates than the US.

In its critical assessment of American progress in education, the Alliance for Excellent Education notes alarmingly, "On virtually every international assessment of academic proficiency, American secondary school students' performances varies from mediocre to poor." [3]

Once again America is faced with the stark reality that its education system is in trouble. As US Secretary of Education Arne Duncan noted with the announcement of the 2009 PISA results, "This is an absolute wake-up call for America. The results are

Toad Business Intelligence Suite 2.0 Helps Improve Decision-Making in Education

The Toad Business Intelligence Suite, an integrated data analysis platform, is designed to help K-12 and higher education institutions improve their decision-making processes. The comprehensive BI solution enables campuses of all sizes to easily access and extract information from heterogeneous data sources, then view and share the data for meaningful analysis.

Toad helps schools turn data into valuable intelligence with:

1. Self-service reporting and advanced data provisioning;

2. Data discovery tools that allow users to explore, analyze and understand data in simple, intuitive views; and,

3. Data integration and collaboration, for easy sharing and viewing of information.

With Toad—a system that is both simple to set-up and to maintain—both technical and non-technical users can easily and securely access the data they need, when they need it.

Toad offers strong data governance without sacrificing agility and flexibility. "By being able to connect multiple sources of information into a single, integrated view," says Joanna Schloss, product evangelist at Dell Software, "and by being able to analyze those metrics quickly and agilely, users can respond more rapidly."

Editor's Note: Dell acquired Quest Software (the original developer of Toad Business Intelligence Suite) in 2012.

extraordinarily challenging to us and we have to deal with the brutal truth. We have to get much more serious about investing in education." [4]

As educators face these challenges, it has become clear to many that the use of data is critical to how "educators evaluate their practices and monitor students' academic progress." [5]

Using Data More Effectively: Practical Applications

In 2012 the US Department of Education identified five broad areas of applications in which data mining and analytics can be applied to the improvement of K-12 education. In brief, these five practical applications—each of which uses different data sources— include:

1. **Student Modeling (of user knowledge, user behavior, or user experience).** Educational data mining and learning analytics can be used to build a variety of models about a student's knowledge, behavior, or even experience. The data for an individual student can then be compared against a model built from a large number of students. These data enable teachers to determine in real time when interventions may be needed and what instructional strategies are necessary.

2. **User Profiling.** Just like knowledge about a customer's book-buying preferences can inform and guide an on-line book store, a collection of personal data about a student's personal preferences, interests, background, and even learning goals makes it possible for teachers to group similar students into categories and then personalize learning environments for those groups of students.

3. **Domain Modeling.** The goal of domain modeling is to understand how best to present a topic and at what level of detail. It can be viewed as fine-tuning the curriculum with answers to such questions as: "What is the correct level at which to divide topics into modules" and "How should these modules be sequenced?"

4. **Trend Analysis.** Trend analysis looks for underlying patterns that can help answer such questions as what changes have occurred in student learning over time and why. At the school level, trend analysis can be used to examine test scores and other student indicators over time to help administrators determine the impact of policies.

5. **Adaptation and Personalization.** The fifth broad application area has to do with how analytics can help teachers tailor content to learners' interests or learning preferences, thereby personalizing their experience. Adaptation and personalization address such questions as "What next actions can be suggested for the user?" or "What changes need to be made for the next user."

In many cases, educational researchers are just beginning to explore the potential of these five broad categories of application. Yet, taken together, they illustrate how educational data mining and learning analytics can personalize learning, improve teaching, and transform education.

Transforming Data Into Intelligence at Concordia U.

Concordia University had a problem. The 3,000-student private, liberal arts institution had a wealth of valuable data but it was all housed in disparate locations. The university needed a way to streamline this data so it could be accessed and transformed into actionable intelligence.

After evaluating a number of solutions and vendors, Concordia selected Dell's Toad BI platform. Dell's solution links to all the institution's databases, including Oracle Banner system, MySQL CRM, Blackboard, and Salesforce. University administrators, staff, and third-party vendors can now quickly access data as well as create and share reports using the system's easy-to-use interface

"Toad Business Intelligence Suite had everything I was looking for in a self-service BI tool," said Rebekah Anderson, director of business intelligence at Concordia University. "For the more technical data consumers, I enable them to provision data, make changes and run reports on demand. For the less-technical, consumers, it's super easy for them to browse and visualize data without having the ability to make changes."

Roadblocks to Successful Application

The implementation of learning analytics within a K-12 environment is faced with a variety of barriers and challenges. Bichsel identified some of the barriers to the implementation of advanced analytics at the higher ed level, including limited budgets and resources, "siloed" information (the difficulty of integrating a variety of information from different sources), data stewardship (managing data security and privacy), and technical challenges. Clearly, many of those same barriers apply to K-12 as well.

Perhaps the biggest challenge in developing a successful analytics program in both a K-12 environment and higher ed is cultivating new practices around the use of data. As the US Department of Education says, "Schools must establish a strong culture of data use to ensure that data-based decisions are made frequently, consistently and appropriately." [6]

Yet, policymakers and educational leaders face many obstacles and roadblocks in developing a data culture. One of those obstacles is apprehension and reluctance by educators themselves, As Bichsel, explains, "Many institutions have administrators, faculty, and staff who fear or mistrust institutional data, measurement, analysis, reporting, and change." [7] Consequently, in order to achieve that data-driven culture with a school or district, there needs to be a clear vision and strong leadership. Senior leaders must demonstrate their commitment to using data on a regular basis to make decisions.

Even with a commitment to a data culture, however, learning analytics program will still face a number of issues, including:

1. **Technical challenges.** The successful implementation of an advanced analytics program requires sufficient technical resources, but more importantly it requires a knowledgeable staff—analytics professionals—who understand what data to collect and what questions to ask. As one analytics expert advised, "If you have 100 people working, I would allocate 99 for identifying what questions to answer and one for [the technical process of] data mining." [8]

2. **Lack of data interoperability**. While there are vast amounts of data being collected and stored, this data is generally not standardized nor even kept in the same location. Few districts have the ability to combine data from different types of systems or to link instructional resources to achievement data. "Integrated, interoperable data systems are the key to better allocation of resources, greater management efficiency, and online assessments of student performance that empower educators to truly transform teaching and personalize instruction." [9]

3. **Human resources.** Knowledgeable, experienced personnel are needed at all levels of analytics—collection, preparation, processing, and analysis. As the US Department of Education recommends, "District staff from the information technology department need to join with assessment, curriculum, and instruction staff, as well as top

decision makers, and work together to iteratively develop and improve data collection, processing, analysis, and dissemination." [10]

4. **Legal and ethical issues.** Education institutions must consider privacy, policy and legal issues when collecting, storing, analyzing, and disclosing personally identifiable information from students' education records to third parties for data mining and analytics. "Policymakers bear an ethical responsibility to investigate the validity of any predictive model that is used to make consequential decisions about students." [11]

5. **Limited financial resources.** For many school districts, with their limited resources, an advanced analytics system may seem financially out of reach. The concern many administrators have is whether or not the investment will translate to greater student achievement. Yet, data mining and analytics can be started on a small scale. "In fact, starting with a small-scale application can be a strategy for building a receptive culture for data use and continuous improvement that can prepare a district to make the best use of more powerful, economical systems as they become available." [12]

In addition, as Bichsel points out, in order to successfully implement an analytics program, institutions need to view analytics as an investment, rather than an expense. "Data-based decision making is not an isolated topic within education, but rather one that benefits all subject areas and grades. Principals and district-level administrators should secure and distribute the financial resources necessary to match educators' needs for interpreting and interacting with data." [13]

Conclusion: The Future of Learning Analytics in K-12

Although learning analytics is still a relatively new field in K-12 education, it has the potential to transform American education and help teachers and administrators successfully meet America's educational challenges identified more than 30 years ago in *A Nation at Risk.*

Through advanced analytics, instruction can become both personalized and customized, helping students identify their own strengths and weaknesses, eliminating the need for students to proceed through a curriculum in lock-step fashion, and making education more student-centric.

As Bienkowski et al. note, "Rather than requiring all students to listen to the same lectures and complete the same homework in the same sequence and at the same pace, the instructor points students toward a rich set of resources some of which are online, and some of which are provided within classrooms and laboratories. Thus, students learn the required material by building and following their own learning maps." [14]

While there are formidable barriers ahead in achieving the promise of learning analytics, many educators believe that those challenges can be overcome. "Armed with data and the means to harness the information data can provide, educators can make instructional changes aimed at improving student achievement." [15]

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