Analytics for Achievement

*Understand success and boost performance in primary
and secondary education*

IBM

Abstract

Around the world, in both developing and developed countries, too many primary and secondary students are falling below proficiency levels. Measuring and monitoring performance and understanding the factors at play in student achievement can help educators create the right conditions and design the most effective interventions for student success.

Overview

Few would dispute that education paves the way to prosperity, both personal and societal. The ills of developing countries—poverty, unemployment, poor health, high crime—can all be combated through education. And while education has the power to lift people out of poverty, it also helps us live fuller lives, make wiser choices and contribute to our communities in more meaningful ways. Education creates equality by opening up opportunities to everyone, not just those with privileged backgrounds.

Using analytics to help young people stay on course

Young people who are not in employment, education or training (NEET) are a major concern for Medway Youth Trust, a UK charity that aims to improve the life chances of young people. The impact of NEET status on a young person's life can be significant, and the cost to society can be just as great.

Using IBM Business Analytics, the Trust is able to analyze huge volumes of data to accurately predict whether individual young people have a high chance of becoming NEET. This information helps the Trust intervene earlier and more effectively—51 percent of 723 individuals identified as being at risk are now in education, employment or training.

Throughout the world, many adults struggle with basic reading, math and scientific literacy. Dropout rates are unacceptably high in many countries. Teachers, politicians, legislators, employers, administrators, parents and even students want to understand the factors at play in improving student achievement.

Why do some students succeed while others fail? Why do some students stay in school while others drop out? Why do we see such dramatic swings in performance? Educators are eager to respond and make changes, but many are unsure of where to start.

Getting to better performance

Student achievement is a result of a complex interplay of many variables. Background, curriculum, testing style, funding, class size and school size are just some of the possible factors behind performance. But when data is scattered across an organization in paper files or spreadsheets, solving the puzzle of success and failure is next to impossible. Many schools, boards and districts are turning to analytics to combine and analyze their own data, asking and answering such questions as:

- What are the leading indicators of and reasons behind low performance?
- Which efforts, investments and factors affect student success?
- How do attendance, involvement and discipline events relate to performance?
- How much should we invest in teacher development?
- In interventions?

Answering questions from a wide range of areas can help provide the insight needed to keep what is working, and make

meaningful changes to what is not. This paper sets out eight areas ripe for measuring, monitoring, analyzing and changing in order to optimize student performance. These areas include:

1. Measuring and monitoring student achievement
2. Spotting outliers for early intervention
3. Predicting potential
4. Preventing dropout
5. Identifying and developing key attributes of good teachers
6. Testing and evolving curricula
7. Reporting results

A pathway to achievement

Given the clear need for better results, how can institutions respond? In the US, districts are focusing on more effective teachers and principals, more family involvement in schools, support for low-performing schools and college- and career-ready standards. Those standards call for increased emphasis on STEM skills (science, technology, engineering and math), and educators and industry partners are creating innovative new approaches to meet that need.

One new model is a six-year high school, like the Sarah E. Goode STEM Academy on Chicago's South Side. Students of the academy graduate with an associate's degree on top their high school diploma—and with the skills employers are looking for. Students who successfully complete the program are first in line for jobs at IBM, one of the school's corporate partners.

The approach of the school, known as Pathways in Technology Early College High School or P-Tech, was originally developed by IBM, the New York City department of education and the City University of New York. Sarah E. Goode is now one of eight P-Tech schools in New York City and Chicago. Building on the achievements of these pioneering students and educators, 25 more P-Tech schools are set to open in the near future.

1. Measuring and monitoring student achievement

The logical first step is getting a clear picture of how students are doing and where they stand in relation to their peers both locally and globally. Analytics let schools view the performance data of students and groups across multiple testing events. They can compare student, school, district or board and national marks, and view and track progress by class, cohort, teacher, course or program. Better insight into student performance is the first step in unlocking student potential.

Educators are also starting to create individual student records that follow a student through life, containing all information from results to attendance, which can also be viewed by students and parents.

Using analytics to set balanced benchmarks

Gwinnett County Public Schools (GCPS), located in the metro Atlanta area, has undergone enormous change over the past few decades, transforming from a rural school system to a large urban school system. To improve student outcomes, GCPS needed better insight into school performance. In particular, the organization wanted to adjust results to account for economic and demographic disparities among schools, in order to reveal which were truly adding value and which were under-performing. It also wanted the ability to benchmark performance figures against other high-performing large school districts nationally.

GCPS deployed IBM Business Analytics to provide insight into student and school performance, normalized to take into account the negative effects of indicators such as the proportion of economically disadvantaged students at a given school. The solution enables fair comparisons between schools with radically different student populations, ending the historical tendency to treat schools as "good" or "bad" based purely on test results.

When teachers and administrators can access the lifetime picture of a student's progress, performance against cohort, trends and most and least proficient subjects, they can ensure students will consistently progress and reach potential.

2. Spotting outliers for early intervention

One of the most effective tools at hand for schools to improve overall performance is early intervention for outliers: both at-risk students and very high-performing students.

Catching and supporting low performers

Teachers have no trouble spotting students who are struggling to keep up and providing the extra help needed. More difficult for busy educators is spotting the average or excellent students who suddenly find themselves in a downward spiral, as a result of circumstances at school or at home. Both kinds of underperformers need help.

The trick is to spot low or falling performance early enough to do something about it. Schools often lack the resources to follow an individual student's progress across subjects from year to year. Strong measurement of student performance year after year, combined with predictive analytics, can help highlight factors indicating a downward turn in performance. This combination of past- and future-looking visibility supports early intervention for underperforming students.

Because test scores alone may not tell the whole story, predictive analytics can forecast likely results based on individual past performance and generalized trends. For students lagging behind predictions or minimum success standards, analysts can delve into factors that may be affecting the student's performance, such as their teacher or feeder school.

Boosting top performers

Schools focus heavily on students falling behind, but they should also look out for students excelling beyond their level. Top performers are always in danger of getting bored and falling behind or dropping out. Outperformers need to remain motivated and maintain a continued interest in learning.

Monitoring performance thresholds for these exceptions at the district or board level can help back up teacher instinct to intervene to ensure these students do not fall through the cracks. Analytics can also help educators measure how well their interventions worked—with an individual or across a school, cohort or region.

3. Predicting potential

It is natural that schools focus on the outliers, but what about the average student? Educators want to see all students fulfill their potential and prepare for their post-secondary stage. Predictive analytics uses student data to reveal patterns that suggest how individual students should be performing. If a student is achieving below their predicted level, teachers and parents can proactively intervene to uncover causes and offer encouragement to focus harder.

4. Preventing dropout

Students who finish high school and finish a degree can double their earning potential.[1] But despite the obvious benefits of graduation, one million US students are projected to drop out during the 2013–2014 school year.[2]

The high correlation between school abandonment, reduced income and criminal activity has prompted educators to look for causes and plan solutions. Theorists have identified a range of warning signs that can point to the need for intervention. Grades, attendance and involvement in school activities are all indicators.

To increase graduation rates, many schools and school districts are making better use of student data. When brought together and made available for analysis, these data can contribute to an understanding not just of what happened in the past, but, based on patterns, of what is likely to happen in the future. Predictive analytics can help school, district and state employees analyze student data—such as test scores, behavior records and academic information—and uncover hidden correlations with advanced algorithms to:

• Identify the key indicators that impact graduation rate
• Proactively reach at-risk students before it's too late
• Improve student performance and increase graduation rates

Once schools identify the risks for dropout, they can intervene with the appropriate counselling or promotion of extracurricular activities, which are known to build school community and strengthen relationships between teachers and students.

5. Identifying and developing key attributes of good teachers

Analytics can help educational institutions identify, recruit and retain the best teachers and improve instructional practices across the board. Plotting grades against demographic data can highlight the teachers who are getting the highest performance out of the most disadvantaged students. Faculty can also improve teaching and learning opportunities for students by using analytics.[4]

Student satisfaction with their teachers also directly correlates to student success. Student feedback data can reveal satisfaction or more subjective insights into the classroom experience. Analytics with text mining can help reveal attitudes toward and feelings about the teacher, which can then be linked to student performance.

Understanding the key attributes of a great teacher can help a school board set standards for teacher performance and use that information to develop, recruit and retain the best teachers. Once identified, exceptional teachers can share their practical techniques for classroom management, discipline, motivation, encouragement and teaching practices with their colleagues and their management to help all teachers achieve the best outcomes.

6. Testing and evolving curricula

Curricula continue to evolve in an ongoing effort to teach the best subjects in the best way. As boards introduce new elements into a curriculum, monitoring student performance and teacher acceptance of the new curricula over key periods following the introduction can help evaluate the success of the changes.

Statistical evaluation helps school boards effectively test and develop new curricula in a smaller deployment and avoid pitfalls in a larger segment. As educators have discovered that different methods work for different groups of students, predictive analytics can forecast what kind of math program will be optimal for particular groups of students and how long adoption will take. Evaluating the right fit for curriculum elements can save time and ensure achievement change to growth through customized curricula.

7. Reporting results

Reporting student achievement is a common requirement for educational organizations of all levels. Whether a function of law, funding or public relations, school boards and districts must be able to gather results data and report on it at various levels, often by demographic slices such as gender, economic status and language proficiency.

Analytics lets educators drill into special population segments, explore individual attributes and understand factors in the success or failure of an educational initiative. Analytics helps make mandatory compliance reporting significantly easier, especially as it relates to obtaining public funding.

Improved reporting secures resources for Waterbury Public Schools

With up to 22,000 students transferring in and out of its district each year, Waterbury Public Schools in Connecticut, US, struggled to gain the accurate view of the student body it needs to tackle under-performance.

The district embarked on an analytics journey enabled by IBM Business Analytics, gaining unprecedented insight into student performance and making the data available to key decision makers. The solution drives timelier intervention for students at risk and ensures that the district receives all the state funding to which it is entitled.

Roadmap to high achievement

Moving from paper and spreadsheet records to an analytics-driven education system does not happen overnight. Organizations are advised to take small, manageable steps toward a complete system of analytics for educational institutions. When dependable data is made accessible to all stakeholders, they can start with the necessary stage of compiling student results to build a baseline. Along the way, data users must have training on how to use and analyze data to build effective interventions.

Step One: Measure current state of achievement

The first step in any improvement effort is setting a baseline: knowing how your students are doing and where they stand in relation to peers. Using analytics, educators can measure and continue to monitor student achievement by combining standardized or regional tests and class grades. They may also measure and monitor soft skills such as problem-solving ability, independence and teamwork. Analytics also helps you report your current situation to your stakeholders.

Districts working together to support at-risk students

To help several school districts around Canada gain access to valuable business analytics resources, Compass for Success created a cooperative among more than 30 Canadian school boards to provide them with a centralized data warehouse and analytics tools to measure student, teacher and school performance. By pooling resources, school districts large and small can now analyze historical data from their school records systems to more correctly report to provincial and federal governments on educational progress and compliance with educational initiatives.

"We're able to help our users—who are educators, not analysts—feel that they are really gaining insight into their students rather than just looking at statistics."—Diane Findlay, Compass for Success

Step Two: Set achievement goals

Where do you need to go? Could you strive for a five percent increase in grades over five years? Do your students have the potential to be the top performers in your region? Do you need to cut your dropout rate in half by the end of the decade? Analytics help you create strategy maps to record ambitious but achievable goals and the steps to reach them.

Business Analytics   7

Step Three: Determine strategies for reaching goals
Deciding how to influence success is the most challenging element. What levers will you adjust to ensure that all your students live up to their potential? Will factors outside of your influence—such as socio-economic background and home life—hold back achievement, or can interventions level the playing field?

Multidimensional analysis can help you track and influence other variables such as class or school size, teacher certification and salary, per-pupil funding, attendance rates, discipline events, instructional evaluations and curriculum.

Predictive analytics helps you identify critical patterns in data to spot anomalies, intervene early and improve performance. Your action plan may include adjusting curriculum, creating special programs, changing the teaching approach or implementing larger-scale strategies that tie into national testing.

Step Four: Measure progress and evaluate strategy
Follow your progress toward results through scorecarding and understand how interventions are affecting students both in terms of academic performance and high school completion. Prioritize and calibrate your interventions to drive student achievement.

Analytics for Education
Student achievement is just a part of an educational organization's overall analytics strategy, which includes:

• Mission goals
— Tie long-term goals to executable, measurable strategy
— Translate strategy to specific objectives
— Link all programs and budgets together with goals and strategy

• Academic performance
— Measure and monitor student progress
— Measure and monitor teaching progress
— Manage curriculum and other learning activities

• Financial objectives
— Align budgets and resources
— Redeploy dollars to meet critical objectives
— Manage operational and IT costs

• Operational requirements
— Reduce data uncertainty, increase transparency
— Link strategies, goals and outcomes together
— Demonstrate transparency and accountability

An analytics-driven organization can ensure that operations and funding support both student achievement and the strategic mission.

Conclusion
Institutions are feeling pressure from many different directions to improve student performance. Primary and secondary education organizations face legal and statutory demands for better performance, as well as pressure from parents. Dropouts and undereducated graduates can hurt not only an institution's reputation, but also, in today's results-oriented funding climate, its bottom line.

Creating a roadmap to analytics is the first step in becoming a data-driven education organization. Analytics can help educators understand how their students are performing and why, as well as how to get better. Teachers can make the most of the time they have with students, and organizations can fine-tune methods to build on success. Students can fulfill their potential and make a meaningful contribution in their field of choice.

About IBM Business Analytics

IBM Business Analytics software delivers complete, consistent and accurate information that decision makers trust to improve business performance. A comprehensive portfolio of business intelligence, advanced analytics, financial performance and strategy management and analytic applications gives you clear, immediate and actionable insights into current performance and the ability to predict future outcomes. Combined with rich industry solutions, proven practices and professional services, IBM Business Analytics software can help organizations of every size drive the highest IT productivity and deliver better results. Go to http://bit.ly/EducationAnalytics or call 1.800.543.2185 for more information.

[1] *"Earnings and unemployment rates by educational attainment,"* United States Department of Labor Bureau of Labor Statistics, March 2014.

[2] *"Nation's Graduation Rate Nears a Milestone,"* Education Week, May 31, 2013.

[3] Beth Deitz-Uhler and Janet E. Hurn, *"Using Analytics to Predict (and Improve) Student Success: A Faculty Perspective,"* Journal of Interactive Online Learning 12, No. 1 (Spring 2013): 17-26.

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