Using Actionable Data to Personalize Math Learning

REDEFINING DATA USE TO DRIVE MATH SUCCESS

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Introduction

Increasingly stringent accountability standards, testing, teacher and principal evaluation policies, and a competitive global economy are driving the need to leverage data to inform math instruction.

Consequently, districts across the country are now implementing data-driven decision-making processes to not only analyze summative test scores, but also to focus on ways to accelerate student achievement by using the ongoing formative assessment made possible by advanced educational technology. “Assessment for learning” uses actionable data, technology tools, and blended online learning to unlock every student’s mathematics learning potential.

This paper will look at the leadership role school administrators can take to form a data-driven culture, and how that data can be used to determine strengths, weaknesses, and next steps in math programs at scale. Math teachers are then empowered in the classroom to adopt a systematic process for using common school-wide and in-class formative assessment data to inform teaching decisions and deeply personalize instruction.

It simply makes sense to use the power of data coupled with adaptive tools to achieve what parents and educators want: continuous improvement to build successful mathematics learners.

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Enculturating data for continuous improvement

Enculturation is based on the notion that inquiry is an essential component of professional practices, with a goal of sharing a mutual vision and understanding of objectives and strategies. The creation of a data culture means that educators will assume internal responsibility for data use, and employ collaborative inquiry for continuous improvement.

The enculturation process includes the need for explicit norms and expectations—with measurable objectives which assume that decisions will be data-derived. Further, school staff must develop an understanding of how data can be used to inform practice. Through iterative inquiry cycles, educators must use data-informed questions to stimulate the process of continuous improvement—it is about matching the right solutions to the right questions regarding student learning. Another part of the enculturation process is the sharing of data and strategies between teachers and even between schools within a developed culture of trust and security.

SIX-STEP SCHOOL DATA ENCULTURATION PROCESS

1. Lay a foundation for data-driven decision-making
2. Maintain an emphasis on continuous improvement
3. Incorporate the use of an information management system
4. Select the right data
5. Build capacity
6. Analyze and act on data to improve performance
To ensure that the vision becomes a reality, it is useful to establish an overall framework that makes the ability to use data to form actionable insights a core goal.

Actionable insights to personalize math learning

There are many ways to collect and use data, and indeed, many educators feel crushed by the mountain of available data. The key is to convert information about math students into actionable insights to inform overall programs and in-the-moment instruction in the classroom. This takes creating a sensible continuous improvement framework led by administrators, the full collaboration and participation of everyone in the learning ecosystem, and online math programs that constantly collect data.

Leaders share a clear vision for a more enlightened culture. Studies have documented that the absence of a clear vision can be a barrier or challenge to effective data use. So it is the role of senior district and school leaders to provide a clear vision for educators’ data use. To ensure that the vision becomes a reality, it is useful to establish an overall framework that makes the ability to use data to form actionable insights a core goal. The critical framework contains four elements to facilitate more informed practices, accelerate overall school performance, and improve student achievement through personalization.

Data coaches integrate and model school data use. The data coach, also referred to as a facilitator or mentor, is perhaps the most important person within a school to make data use a reality. A data coach is the knowledgeable “go to” person who takes responsibility for integrating data and modeling school data use. About two-thirds of schools currently have a data coach whose responsibilities may include: creating a data team; facilitating data use; helping to collect, analyze, and interpret data; and providing training to other school staff members to build a team model of professional development.

The data coach may be a lead teacher, a content specialist, or an administrator. The data coach may even be a retired educator, rehired to work with existing staff. Whatever the data coach’s background, in addition to data knowledge, the individual should be someone who works easily with others and can help translate numbers into actionable pedagogical knowledge.
Researchers have identified these specific guidelines to help data coaches engage and lead:

1. **Build** a foundation by understanding school needs and how data can be applied to those needs.
2. **Identify** the problems or student learning issues to which data can be applied.
3. **Verify** the possible causes of problems.
4. **Facilitate** the development of possible solutions.
5. **Implement** the solutions and monitor outcomes.

**Data teams share findings with teachers and administrators.** Even the best data coach cannot do it alone. Using data in the classroom is essential, but equally important is allotting time for teachers to learn from one another. Collaboration is a vital component in the implementation of data-driven practices, such as discussing pressing problems around student learning, or working together to find possible instructional strategies to remediate student-learning concerns. Surprisingly, while 90 percent of schools report that educators feel comfortable collaborating in this way, only 59 percent actually understand how to work with colleagues in practice.

Guidelines to help create an effective data team:

**Select team members.** Tasked with collaborating to collect, analyze, and interpret data, data teams can take different forms. They can be content, grade, or course-based, or take form centered on established goals. Data teams can also function across schools within a district.

**Set expectations.** Teams develop common formative and summative assessments and build data-supported action plans. Based on findings, teams supply administrators with the quality data needed for communication with parents and the community, and respond to data requests from fellow staff members.

**Designate meeting times and provide support.** To be most productive, data teams should meet at least 45 minutes per week, and this designated time should be supported and protected by the school administration. Also, there should be an agreement that no topics are out of bounds—an important way to achieve continuous improvement. Educators need to know it is appropriate and safe for them to share information without the possibility of negative consequences.
Data analysis meeting process and protocol. For more effective collaborative inquiry and action planning, data team sessions can be facilitated with a seven-stage data analysis meeting.

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<th>PROCESS</th>
<th>DATA ANALYSIS MEETING PROTOCOL</th>
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| 1. Focused questions | How are your students performing by subject level?  
- What are the trends in student performance over time?  
- How are subgroups performing over time?  
- What are your strengths and weaknesses in teaching and learning?  
- Can you evaluate the effectiveness of the curriculum, teaching, student learning, professional development, programs, and instructional strategies? |
| 2. Interpret data and identify gaps | Analyze mastery differences between student groups and individual students  
- Analyze commonly missed items  
- Analyze common wrong answer choices on assessments  
- Examine student work to reveal discrepancies in expectations and content coverage  
- Does the problem reside in the:  
  - content or subject matter to be learned?  
  - teachers and teaching processes used?  
  - learners and the learning processes used?  
  - context or setting in which the learning was to occur? |
| 3. Analyze root causes for gaps | Data team members can suggest many different hypotheses  
- Hypotheses will be considered if they can be corroborated with data  
- Data can be previously acquired or recently collected  
- Theories-of-cause remain in potentially valid category only while data supports the hypothesis  
- Examine the most recent assessment  
  - Pay specific attention to variability in student scores  
  - Brainstorm explanations for the performance of the lowest-achieving third of the class  
  - Describe data that can be used to determine whether a hypothesis is true  
  - Brainstorm why the valid hypotheses are true  
- Interpret data and develop a hypothesis about how to improve student learning  
  - Identify a promising intervention or instructional modification  
  - Ensure that the effect can be measured  
  - Compare multiple sources of data across classrooms  
  - Determine supporting data to verify evidence of the hypothesis |
| 4. Rules for root cause analysis process | Identify comparison data to determine instructional effectiveness of the intervention  
- Gather classroom-level data to quickly evaluate student performance after the intervention  
- Consider the extent to which student learning did or did not improve in response to the intervention |
| 5. Root cause analysis process |  
| 6. Developing a testable hypothesis |  
| 7. Determine effect of instructional intervention |  

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Use an inquiry cycle for consistency and continuous improvement. Data teams should implement a cycle of inquiry that becomes a consistent component of school procedures. This seven-step inquiry cycle is a means to test assumptions and construct an understanding of student learning gaps.

Enhancing the knowledge and skills of teachers and administrators requires continuous collaborative professional learning opportunities, with easy access to intelligent adaptive online learning systems, assessment systems, data systems, and technological tools.

Teachers need to acquire the data literacy skills and ability to translate collected data into actionable instructional knowledge, which is the foundation of data enculturation.
Professional Development for data literacy that leads to actionable insights

Educators should have access to technology, professional development opportunities to build their capacity to use data, and online adaptive learning tools for mathematics powered by real-time formative "assessments for learning" data that surface teachable moments and change the way educators connect with each and every student. These tools are vital to the successful implementation of data-driven practices, as they help identify gaps in student learning and provide personalized learning paths that change the way students learn.

Enhancing teachers’ and administrators’ knowledge and skills requires continuous customized blended professional learning opportunities, with easy access to dashboards and adaptive learning tools for mathematics. Personalizing instruction for students requires the kind of professional learning for educators that is engaging, relevant, and job-embedded to support teacher practice. Instead of teaching to the “average” student, teachers need to be able to use online adaptive technology tools, dashboards, and blended learning opportunities to determine student learning needs with pinpoint-accuracy against the standards, and to facilitate more meaningful data-use conversations about accelerating mathematics learning for all students.

There have been more than 1,300 studies identifying the effect of teacher professional development on student achievement. The report finds that teachers who receive substantial professional development—an average of 49 hours per school year—can boost student achievement by about 21 percentile points.
Data use at the school level

In Mapping a Course for Improved Student Learning: How Innovative Schools Systematically Use Student Performance Data to Guide Improvement, authors Supovitz and Klein state, “One of the most potentially powerful resources for informing instructional and school improvement—school-wide data—is enormously underutilized. The distinguishing characteristics of school-wide data are that they are frequently and systematically collected across a grade level or content area about an important student outcome and quickly aggregated and examined for patterns that can help inform next steps.” By taking advantage of evidence-based decision-making, educators can accelerate math achievement school-wide.

As data use becomes enculturated into a school, two issues dominate. The first concerns the kinds of data that educators want to use and have available. The second is the skill set that is required as part of the inquiry cycle of data use. The data analysis inquiry process reveals patterns, trends, and opportunities for student learning and school growth.

Use multiple sources to verify analysis. Assessments—formative, benchmark, and summative scheduled assessments—provide valuable, measurable data. However, data other than assessments can also help form a more comprehensive picture of a student’s performance. For example, a data warehouse that holds a variety of demographic information can help more fully inform decision-making. Data might include attendance, absences, behavioral transgressions, health-related information, and familial circumstances. Knowing if the student has extended absences, suspensions, illnesses, or problems at home can provide valuable contextual information. Another use for multiple data sources is to assist in resolving data conflicts. Teachers are often confronted with data sources that tell different stories—perhaps the state summative test and more local assessments do not agree. Taken separately, no simple measure gives an adequate picture of the student. The triangulation, or bringing together of these multiple sources of data, is an effective data-use strategy.
**Short feedback times are critical.** The most critical factor in data utility is timeliness; the feedback loop should be as short as possible between when an assessment is administered and when data is delivered back to inform teacher instruction. For example, state summative tests are completed in the spring and the data reports aren’t delivered until the fall of the next school year. This substantial delay in the feedback loop makes the data less informative and useful to teachers. In contrast, some diagnostic data can be delivered to the teacher immediately so that instructional strategies can be modified on the spot. Online adaptive learning tools for mathematics can more efficiently identify the root causes of student learning problems, and provide differentiated content.

**Data-informed instruction in the personalized learning classroom**

Good teachers are constantly assessing student learning in both formal and informal ways, and all of this information can be classified as data. Student performance can be accelerated by having teachers adopt a methodology—a data-use inquiry cycle—to bring evidence to bear on instructional decisions. It improves the ability to identify patterns that can help inform instructional strategies. The addition of adaptive learning math programs that collect in-the-moment data further enhance teaching practice and better enable personalization.

An inquiry cycle using data to answer a specific question often leads to further questions and actions that make a difference in outcomes because they uncover the depth of student understanding and how to tailor lessons to students’ individual needs.

**Learning analytics and blended learning to accelerate personalization.** The adaptive technology businesses use to analyze commercial activities, identify spending trends, and predict consumer behavior is now being used in education in the form of learning analytics.

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Source: National Center for Education Evaluation and Regional Assistance, Institute of Education Science, U.S. Department of Education
In the educational realm, individualized student interactions are gathered and analyzed in online learning activities to build better pedagogies and empower students to take an active part in their learning, target at-risk student populations, and assess factors affecting completion and student success. For learners, educators, and researchers, learning analytics are already providing crucial insights into student progress and interaction with online texts, courseware, and learning environments used to deliver instruction.

**Learners and teachers reap benefits.** For students, learning analytics as they engage with mobile and online adaptive learning tools that track data means they have responsive, engaging, and personalized learning experiences. Teachers use data from the interactions within blended learning environments to drive instruction and monitor student learning progression. They can assess the understanding of learning objectives with embedded assessments, create and facilitate group discussions, develop group projects, make regular adjustments to course resources based on student learning data, and respond to students’ individual learning needs and questions—all through the virtual environment.

A good example is DreamBox Learning’s Intelligent Adaptive Learning engine, which delivers millions of individualized learning paths to tailor every math lesson to meet each student’s unique needs. The DreamBox adaptive online learning environment ensures that students are always working in their optimal learning zone. It recognizes more than just their “yes” or “no” answers—with every mouse click it evaluates student strategies and immediately adjusts the lesson. DreamBox can adapt the level of difficulty, scaffolding, sequencing, the number of hints, and the pacing—all in real time—allowing students at all levels to progress at a pace that suits them. It also provides real-time information about math student progress at the district, school, classroom, and individual level with Insight Dashboards that enable the personalization at scale to meet math learning goals. Teachers spend less time accessing and analyzing data, and more time focused on meeting the needs of each student.

With this new paradigm of personalized instruction, educators have an unprecedented opportunity to redefine their roles into those of learning guides, and scale personalized education as never before.

**Enable student engagement with technology.** Teaching students to learn how to learn should be foundational to instruction. Math learning programs like DreamBox that use adaptive technology provide students with immediate personalized assistance that challenges them appropriately. Adaptive technology used on mobile devices also increases engagement and provides a familiar and meaningful opportunity to communicate and collaborate both inside and outside of school. Learning programs that offer a rewarding gaming environment that students play with on their own time is a good way to engage learners by making their learning work feel like play. In any case, techno-fluency is important to the development of 21st century skills to ensure a successful academic and work life.
It is now contingent upon educators to harness these tools—and the data they provide—for blended personalized learning that enables students of all abilities to enjoy learning, enjoy mathematics, and become lifelong learners.

Seizing the logical opportunity of data-driven math learning for personalization

Why is data-driven decision-making for continuous improvement important at this moment? Schools and teachers need credible evidence to provide direction to help them solve pressing student learning problems and keep making the decisions that move both educators and learners forward in their mathematics achievement. The time is right for sustained institutionalization and transformation to data-driven decision-making in mathematics education.

Technology provides invaluable resources and tools for educators at all levels of the educational system. It is now contingent upon educators to harness these tools—and the data they provide—for blended personalized learning that enables students of all abilities to enjoy learning, enjoy mathematics, and become lifelong learners.

Carpe diem!

Read more about taking advantage of and creating data-driven learning environments for continuous improvement in my blog series.

ABOUT SHARNELL S. JACKSON

Jackson is an educational leader with over 37 years of exceptional results in data-driven decision-making and in education innovation as a classroom teacher, building administrator, district administrator, state administrator, and consultant.

As former Chief eLearning Officer of Chicago Public Schools, Jackson and her team implemented innovative systems to inform teacher instruction for instructional management, online assessments, texts, courses, tutors, and gradebook, digital media, videoconferencing, blended learning, personalized student learning, and accelerated learning outcomes.

Jackson is a noted co-author of Transforming Teaching and Learning Through Data-Driven Decision Making. She has been an adviser to the U.S. Department of Education’s Regional Educational Laboratories, state departments, the national superintendents association, administrator associations, and teacher associations, school districts, foundations, and corporations.

Jackson is focused on helping educators transform quantitative and qualitative data into actionable knowledge to help students develop the critical thinking skills necessary for college and career success through the use of transformative innovative technology systems that effectively personalize the learning experience.
REFERENCES


DreamBox Learning, Inc. was founded in Bellevue, Washington, and launched its first online learning product in January 2009. DreamBox Learning® Math has won more than 42 top education and technology industry awards and is in use in all 50 states and throughout Canada. The DreamBox® platform offers a groundbreaking combination of Intelligent Adaptive Learning technology, a rigorous K–8 mathematics curriculum, and a highly motivating learning environment. DreamBox in English and Spanish captures every decision a student makes while working in the program and adjusts the student’s learning path appropriately, providing millions of individualized learning paths, each one tailored to the student’s unique needs. DreamBox supports teachers and their practice in every type of learning environment. For more information about DreamBox Learning Math and the DreamBox Math for iPad® app, please visit DreamBox.com.

Learn about the DreamBox Educator Experience and the Insight Dashboards that turn data into actionable insights. For a demo, call 877.451.7845