TECHNOLOGY TOOLS FOR DATA-DRIVEN TEACHERS

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Data-driven decision-making (DDDM) can be done without technology, but it is awfully difficult. This companion piece to the Innovative Teachers white paper, *Data-Driven Teachers* (McLeod, 2005), describes a variety of technology tools available for both summative and formative data collection and analysis. The emphasis of this white paper is on tools that need to be made available to teachers and principals if they are to be effective data-driven educators.

Data Management and Analysis Systems

Data management and analysis (DMA) systems, also commonly called data warehouses, are complex technology systems that typically reside at the district, region, or state level. The technical aspects of how DMA systems work are irrelevant for most educators. What teachers and principals need to understand about these systems is that they link all of a school organization's important databases together.

For example, a district or regional educational cooperative may use a student information system (SIS) to store student contact information as well as demographic, attendance, discipline, health, and other student records. The school system also may use electronic grade book software, library management software, and many other software systems or online tools to facilitate such jobs as cafeteria management, course scheduling, transportation management, curriculum mapping, and financial record-keeping. Data warehouses connect all of these disparate data systems together so that teachers and administrators can investigate questions that otherwise would be impossible to answer.

> *Scenario 1.* Roosevelt High School receives a grant to set up an after-school remediation program for disadvantaged students struggling in math. Administrators at the school need the following student information to set up the program: names, math grades, last year's scores on the state math assessment, free/reduced lunch status, ELL status, IEP and/or Section 504 status, and after-school bus route. While schools without a DMA system will find it difficult and time-consuming to get this type of information together in one place, Roosevelt has a data warehouse and, within minutes, the program manager has located and downloaded the information she needs to implement her newest academic intervention.

There currently are at least 25 to 30 different corporate vendors marketing data warehouse solutions to K-12 school clients, including such major market players as TetraData, EDmin, Cognos, and Schoolnet (Sarmiento, 2004; Stein, 2003; Wayman, Stringfield, & Yakimowski, 2004). Microsoft's Learning Gateway Framework allows schools to combine data warehousing technologies with its other tools, such as Microsoft Office, Windows, Class Server, and SharePoint Services (Microsoft, 2005).

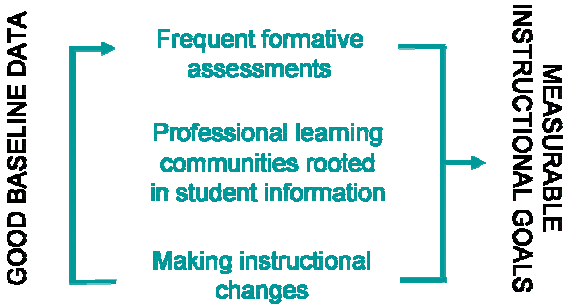
Because these systems vary widely in terms of their analytical interface, ease of use, cost, and other features, teachers and principals should play a key role in the selection and use of a DMA system. Although they do not need to know all of the technological aspects of data warehouse implementation, it is essential that they be given access to the system as soon as possible if they are to make meaningful use of baseline data to establish measurable instructional goals as described in *Data-Driven Teachers*.

Scenario 2. Teachers at River Run Elementary School would like to know the correlation between the scores that their students receive on the state reading assessment and their grades in reading. The school district, like most school systems, maintains two different datasets for these types of data. Before the advent of DMA systems, staff at River Run either would have spent a great deal of time creating a combined data file by hand or would have foregone the analysis altogether. Because River Run educators have access to the district's data warehouse, however, they can quickly and easily correlate the two variables of interest and break down their findings by grade level, classroom, and student demographics. The teachers thus are freed from the task of compiling the data and instead can spend their valuable time answering questions about the strength of the correlation, what to do when students do well in class but not on the state test, and what it means when students are successful on the state assessment but receive low class grades.

DMA systems typically also contain multiple years of data and thus are ideal for identification and analysis of longitudinal trends in student and school performance. Most school systems are using their data warehouse tools to evaluate long-term progress toward the elimination of subgroup achievement gaps. Some school districts also are using their data warehouses to analyze why particular student paths through schools are more successful than others. Some DMA system vendors have formalized partnerships with other technology vendors, facilitating tighter integration of various district- and building-level data systems (see, for example, TetraData's partnerships with Co-nect and Scantron).

Instructional Management and Assessment Systems

Educators' use of DMA systems alone can positively influence student academic achievement. The increased use of these systems in many districts attests to the power of easy linkage and analysis of disparate sources of student performance and school program data. Schools that wish to fully realize the power of data-driven decision-making, however, will move beyond the simple use of baseline data for goal-setting and also will implement three other major elements of data-driven instruction: frequent formative assessment, professional learning communities, and focused instructional interventions (Schmoker, 1999; DuFour, Eaker, & Eaker, 2005; McLeod, 2005).



As noted in *Data-Driven Teachers,* these latter elements are the true engines that drive significant gains in student achievement. However, if teachers and principals are to effectively implement formative assessment practices, they must have tools that allow them to easily collect and analyze formative data. Because data warehouses are not designed to handle frequent teacher-level input of formative assessment data (nor should they be), many school districts are increasingly turning to instructional management and assessment (IMA) systems to facilitate teachers' frequent assessment of students. These technology systems typically reside side-by-side with districts' data warehouses, although it is becoming more common for districts to integrate the two types of systems.

IMA systems typically come in two flavors: 1) those that come with pre-made assessments or are modeled on existing psychometric assessments, and 2) those that include item banks of questions that can be used to automatically or manually configure classroom-level assessments. Examples of the first type include the computerized assessments from the Northwest Evaluation Association (NWEA), the curriculum-based

measurements (CBMs) from AIMSweb, and Wireless Generation's handheld computer versions of DIBELS and the TPRI. A number of vendors offer systems that include question item banks, including Renaissance Learning, Scantron, Pearson Digital Learning, Compass Learning, PLATO Learning, and McGraw-Hill.

> *Scenario 3*. Westwood Middle School students take yearly state assessments in reading, math, and science. Because it was dissatisfied with the timeliness and frequency of the state's data collection and reporting, Westwood also has implemented a comprehensive formative assessment system to monitor its students' progress throughout the year. Teachers like the supplemental formative data system because it is easy to use and produces data that is more closely aligned to their daily instructional needs. The teachers also are pleased that the formative assessments can be taken quickly, (which allows them to be administered frequently without negatively impacting classroom instructional time), and appreciate the ability to use the question item banks to create modified assessments that still are aligned with state standards.

IMA systems also vary by periodicity. Some systems are designed to be administered periodically (for example, quarterly), such as NWEA's Measures of Academic Progress or Renaissance Learning's STAR Reading/ Math and StandardsMaster product lines. Other systems, such as Wireless Generation's DIBELS assessment or Princeton Review's Low-Stakes Formative Assessment, are designed to be given as frequently as daily or weekly. Some vendors offer several different assessment products that cover the full range of delivery possibilities, while others focus on either periodic or frequent assessment. IMA systems also vary by their use of technology to deliver the assessments, with some systems requiring teacher input of data, others using scannable student test forms, and yet others that are completely computerized and/or online. Many IMA systems align their item banks of questions with state curriculum standards.

Just as building-level educators should have input into their district's data warehouse selection and implementation process, so too should teachers and principals be involved with their organization's purchase of formative assessment technology tools. Implementation of formative assessment software, hardware, peripherals, and/or online tools will be severely hindered if meaningful building-level input is not incorporated by central office administrators. It also is imperative that district administrators remember that it is not enough to simply purchase formative assessment solutions. Adequate training, frequent opportunities for teachers to meet to make sense of their ongoing formative data, and appropriate curricular and instructional support all are vital for the long-term success of any formative assessment initiative.

Creating Your Own Systems

While DMA and IMA systems can be powerful tools for district-, building-, and classroom-level decision-making, they also can be fairly costly. As a result, some districts, particularly smaller ones, are asking district technology staff to utilize relational database tools such as Microsoft Access or FileMaker Pro to link databases together. A major disadvantage of this approach is the time that it takes district technology staff to manually connect various data sources. Many small districts have found it more economical to band together and cooperatively purchase a DMA or IMA system. Such a system must support differentiated password protection to ensure student and employee data confidentiality. A few districts have utilized in-house expertise to create their own DMA systems from scratch.

Unfortunately, vendors typically have paid little attention to the needs of educators that wish to create, store, and analyze their own assessments. Many schools are creating common assessments, facilitating teacher-created classroom assessment, using homegrown rubrics, or implementing authentic, alternative, performance, and/or portfolio assessments. While a few recent corporate formative assessment products, such as Goldstar Learning's Mastery Manager or Pearson Education's Prosper Assessment System, give teachers a limited ability to create and analyze their own multiple-choice test items, educators in schools that are implementing teacher-created formative assessments generally have few options for data storage and analysis.

One possible solution to the lack of viable corporate products for teacher-created assessments is to train educators to create their own data collection and analysis tools. Current electronic spreadsheet software products, such as Microsoft Excel, have a number of powerful capabilities that largely go untapped by classroom teachers and principals. Spreadsheet tools such as sorting, filtering, conditional formatting, graphing, and pivot tables can easily be taught to educators and can empower their ability to analyze raw data instead of being dependent on preformatted reports from states and/or testing companies. This solution typically consumes more educator time, however, than do corporate assessment products, since teachers must now not only input and analyze the data but also spend time creating the data collection and analysis template itself.

> *Scenario 4*. The Minnehaha school district realizes that it needs the capacity in each of its high schools to organize and analyze raw student and school data. The district invests in advanced, DDDM-oriented spreadsheet and relational database training for three to eight staff members from each school building. These teachers, media specialists, guidance counselors, technology integration specialists, and assistant principals form the core of each school's data team. These data managers work with other staff in their buildings to download and analyze data from the district data warehouse, combine district data with school data absent from the warehouse, and/or create customized data collection and analysis tools.

The School Technology Leadership Initiative (STLI) at the University of Minnesota has created a set of self-paced electronic tutorials, similar to those provided by Atomic Learning, that are intended to teach educators many of the tools in Microsoft Excel that are useful for analyzing raw student data. These free tutorials utilize customized, school-oriented training files to teach essential concepts and are available at www.schooldatatutorials.org.

Another solution for educators who wish to implement their own formative assessment systems is to give teachers and principals generic data templates that can be used in a variety of ways for data collection and analysis. For example, a Microsoft Excel spreadsheet can be created that includes columns for student name, teacher name, and student demographic characteristics, as well as one column per month. That spreadsheet also can include a pre-designed pivot chart that automatically refreshes itself when a teacher inputs his or her latest round of data. Once the teacher, secretary, or school district inputs students' names and demographics, a grade-level team only has to input one data item per student per month and then, with just a few minutes of training, can immediately track long-term student progress trends on the selected indicator. Examples of indicators might be scores on a formative assessment, attendance or discipline statistics, or classroom engagement items. Student progress data also can be easily disaggregated by teacher name or student demographic characteristics.

> *Scenario 5*. Guided by their students' results on the September iteration of the district's periodic standardized assessment, the fifth-grade teachers at Woodland Elementary decide to focus on math computation for the year. The teachers alternate creating a 20-question common math assessment that is taken by every fifth-grade student each month. The monthly assessment, which takes eight minutes to administer, has five questions each related to addition, subtraction, multiplication, and division. Student results are entered once per month into a pre-designed Excel data template. The team of teachers then analyzes its students' monthly progress and utilizes the pivot chart's drop-down buttons and drag-and-drop capabilities to disaggregate the data by teacher, student, or student minority status. See example data template.

The STLI is working with the Osseo Area Schools in Minnesota to create a comprehensive set of generic data templates that will meet the majority of educators' non-standardized data collection and analysis needs. Links to three example data templates are included here. These data templates include setup instructions and may be freely used by any K-12 educator.

- Example data template - track 1 data item per month (up to 400 students)
- Example data template - track 2 data items per month (up to 400 students)
- Example data template - track 3 data items per month (up to 400 students)

Conclusion

This white paper has outlined a number of different technologies that can be used by teachers and principals to facilitate data-driven instructional practices. When combined with the educational and assessment principles described in *Data-Driven Teachers*, these technologies can help educators achieve significant improvements in student learning outcomes and enhance professional engagement and satisfaction.

While the focus of this white paper has been on systems for managing and analyzing student assessment data, there are a number of other technology solutions that can help enable effective data-driven education. For example, teachers now have the ability to utilize student response systems like ETS Discourse and Turning Technologies' TurningPoint software to obtain fine-grained detail about student learning during the class period (Johnson & McLeod, 2004). Online survey tools such as Zoomerang, KeySurvey, or vivED can be used to collect original data from students, parents, and staff. Software products like mVal from Media-X can significantly reduce the amount of time spent on teacher observation and appraisal and can provide extremely useful information that can be integrated into a data warehouse. Other software systems and online tools, such as curriculum management systems and professional development tracking systems, also can generate student and/or employee data to inform district-level decision-making. Teachers and principals should encourage their data system providers to actively pursue partnerships with other corporations in order to maximize access to useful information.

Additional Resources

Additional resources are listed below. Please contact the author if you have further questions or comments about this white paper.

General

DuFour, R., Eaker, R., & DuFour, R. (Eds.). (2005). *On common ground: The power of professional learning communities*. Bloomington, IN: National Educational Service. [available at http://www.nesonline.com]

Johnson, D., & McLeod, S. (2004). Get answers: Using student response systems to see students' thinking. *Learning & Leading With Technology, 32*(3), 2-8. Retrieved June 1, 2005 from http://www.schooltechleadership.org/page.cfm?p=24

McLeod, S. (2005). *Data-driven teachers*. Microsoft Innovative Teachers Program. Retrieved June 1, 2005 from http://www.microsoft.com/Education/ThoughtLeadersDDDM.aspx.

Schmoker, M. (1999). *Results: The key to continuous school improvement* (2nd ed.). Alexandria, VA: Association for Supervision and Curriculum Development. [particularly pages 1-55; available at http://shop.ascd.org]

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Microsoft. (2005). *Learning Gateway Framework for schools*. Retrieved June 1, 2005 from http://www.microsoft.com/education/learninggateway.aspx.

Sarmiento, J. W. (2004). *Technology tools for the analysis of achievement data: An introductory guide for educational leaders.* Philadelphia, PA: Mid-Atlantic Laboratory for Student Success.

Stein, M. (2003, November). *Making sense of the data: Overview of the K-12 data management and analysis market*. Boston, MA: Eduventures, Inc.

Wayman, J. C., Stringfield, S., & Yakimowski, M. (2004). *Software enabling school improvement through analysis of student data*. Baltimore, MD: Center for Research on the Education of Students Placed At Risk, Johns Hopkins University.

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McIntire, T. (2003). Buying an assessment system: Five considerations. *Technology & Learning, 24*(4). Retrieved June 1, 2005 from http://www.techlearning.com/shared/printableArticle.jhtml?articleID=16000696

Pierce, D. (2005). *Formative assessment rates high at FETC*. eSchoolNews Online. Retrieved June 1, 2005 from http://www.eschoolnews.com/news/PFshowstory.cfm?ArticleID=5511.

Microsoft and Other Corporate Resources

Microsoft offers a number of DDDM-related technology solutions, including Microsoft Office (particularly Excel) and the Microsoft Learning Gateway Framework. Microsoft also has been a significant supporter of the Schools Interoperability Framework (SIF) initiative and works with a number of partners on DDDM issues.

Information about corporations and products mentioned in this white paper is available at the companies' web sites.

About the Author

Scott McLeod, J.D., Ph.D., is Co-Director of the University of Minnesota School Technology Leadership Initiative (STLI), the leading K-12 technology leadership preparation program in the country, and its Center for the Advanced Study of Technology Leadership in Education (CASTLE), a program center of the University Council for Educational Administration. The only academic program in the nation based on the National Educational Technology Standards for Administrators (NETS-A), the STLI has been shown to have statistically-significant impacts on its participants' technology leadership knowledge, skills, and abilities. More information on the STLI, its technology leadership courses, and other resources for educators is available at *www.schooltechleadership.org*. Dr. McLeod gratefully acknowledges the tremendous influence of the cited authors' work on this article, as well as the opportunities provided him by Minnesota and Illinois educators to help implement these concepts and practices in their schools.