

Creating an Evaluation Framework for Data-Driven Decision-Making

Ellen B. Mandinach, Margaret Honey, Daniel Light, Cricket Heinze, Luz Rivas
EDC Center for Children and Technology, USA

One of the hallmarks of the No Child Left Behind Act (NCLB, 2001) in the United States is the requirement that states develop annual assessments to measure school and student progress and that educators use data to help improve the learning of all students. As a result, the administrators and teachers are being confronted with complex and diverse sources of data from which they must make informed instructional decisions.

Increasingly school districts are turning toward technology-based solutions that they believe will help them to use data more effectively and there are a growing number of technology-based products that enable districts to provide data to many levels of the system—the teachers, administrators, parents, and policy makers—as a means to improve instruction, student learning, and communication.

Examining how technology-based tools can facilitate decision-making, and how administrators and teachers use such tools and data to enhance instruction is therefore essential if we are to understand how assessment data can be used effectively to inform educational decision-making. This project brings together complimentary evaluation techniques, using systems thinking as the primary theoretical and methodological perspective, to examine the implementation and use of data-driven applications in school settings. The project has two goals: (a) to build a knowledge base about how schools use data and technology tools to make informed decisions about instruction and assessment; and (b) to develop an evaluation framework to examine the complexities of dynamic phenomena that will inform the field and serve as a knowledge building enterprise (Mandinach, in press; Mandinach & Cline, 1994).

Theoretical Framework

Research on Systemic Reform Research and Data Systems

One consequence of the standards and accountability movement is that district and school administrators are being asked to think very differently about educational decision-making, and are beginning to use data to inform everything from resource allocation to instructional practice. As researchers at the UCLA Center for Research on Evaluation, Standards, and Student Testing (CRESST) note, "Data-based decision-making and use of data for continuous improvement are the operating concepts of the day. School leaders are expected to chart the effectiveness of their strategies and use complex and often conflicting state, district, and local assessments to monitor and assure progress. These new expectations, that schools monitor their efforts to enable all students to achieve, assume that school leaders and teachers are ready and able to use data to understand where students are academically and why, and to establish improvement plans that are targeted, responsive, and flexible" (Mitchell, Lee, & Herman, 2000, p. 22).

The literature on systemic efforts to improve schools has been principally focused on the role of data for accountability in developing, guiding, and sustaining organizational change that leads to improvements in student learning (Fullan & Stiegelbauer, 1991;

Massell, 1998; Schmoker 1996). However, the research literature on data to support instructional decision-making is still limited. Some of the first research in this area was done in the 1980 s (Popham, Cruse, Rankin, Sandifer, & Williams, 1985; Shepard 1991); however, as a whole the field did not gain traction, especially at the classroom level, due to the technical limitations in assembling and disseminating data across complex systems.

Recently, the education community has again become interested in data-driven instructional decision-making, largely because growing numbers of school systems and states have the capacity to process and disseminate data in an efficient and timely manner (Ackley 2001, Thorn 2002). This trend has been further accelerated by the requirements of NCLB to use data to improve school performance (Hamilton, Stecher, & Klein, 2002). Of the nascent but growing body of literature on the use of data systems, tools, and warehouses to support decision-making processes in schools, research indicates that a host of complicated factors need to be addressed if these tools are to be used to support instructional improvement. There are a number of initiatives being implemented across the country for which research is only in the most formative stages. These projects include the Quality School Portfolio (QSP) developed at CRESST (Mitchell & Lee, 1998), IBM s Reinventing Education initiative in Broward County Florida (Spielvogel, Brunner, Pasnik, Keane, Friedman, Jeffers, John, & Hermos, 2001), the Texas Education Agency and the South Carolina Department of Education (Spielvogel & Pasnik 1999). There is ongoing work being conducted on data-driven tools in New York, (Educational Development Center, in press; Honey, 2001; Honey, Brunner, Light, Kim, McDermott, Heinze, Breiter, & Mandinach, 2002), Minneapolis (Heistad & Spicuzza, 2003), Boston (Sharkey & Murnane, 2003), and Milwaukee (Mason, 2002; Thorn 2002; Webb 2002). Stringfield, Wayman, and Yakimowski-Srebnick (2005; Wayman, Stringfield, & Yakimowski, 2004) and Sarmiento (n.d.) provide some of the first comprehensive reviews of the tools available, identifying some of the technical and usability issues districts face when selecting a data application to support instructional planning. Technical challenges include data storage, data entry, analysis, and presentation. Other challenges include the quality and interpretation of data, and the relationship between data and instructional practices (Cromey, 2000). Work done on the QSP in Milwaukee indicates that educators are hesitant to base decisions that affect students on data they do not necessarily believe are reliable and accurate (Choppin, 2002). The standardized test data provided in many of these data systems were often not originally intended for diagnostic purposes (Popham, 1999; Schmoker, 2000). Educators knowledge and training in the use of data is also a confounding factor. While teachers and administrators need not be experts in psychometrics, they must have some level of assessment literacy (Webb 2002). However, most educators are not trained in testing and measurement and assessment literacy is therefore a major concern (Popham, 1999).

While debate about the merits of using state mandated testing data for diagnostic purposes continues, responding to accountability requirements remains a daily challenge that schools and districts must address now (Pellegrino, Chudowsky, & Glaser, 2001; Stiggins, 2002). Although high-stakes accountability mandates are not new, the NCLB legislation places public schools under intensified external scrutiny that has real consequences (Fullan, 2000). Not only are failing schools identified, but parents are given the option of removing their children from such schools or using school resources

to hire tutors and other forms of educational support. District and school administrators are struggling to respond to these heightened expectations, which by design call for different thinking about the potential of accountability data to inform improvements in teaching and learning. It is clear that NCLB is requiring schools to give new weight to accountability information and to develop intervention strategies that can target the children most in need. The growing interest in data-driven decision-making tools is no doubt a direct response to these mounting pressures (Hayes, 2004; Stringfield et al., 2005).

The Research

The purpose of this work is to examine technology-based, data-driven instructional decision-making tools, their implementation, and impact on different levels of school systems (i.e., administrative and classroom). Examining different tools in diverse settings enables us to develop and validate an evaluation framework that will be sensitive to the dynamic and interacting factors that influence the structure and functioning of schools as complex systems (Mandinach, in press; Mandinach & Cline, 1994). The framework includes: (a) the use of a systems perspective; (b) examining the system with multiple methodologies at multiple levels; and (c) recognizing its complex nature, and the need for the technology tools to become instantiated so that both formative and summative methods can be used. The research not only examines a methodological framework using systems thinking, but also presents a theoretical framework on how data-driven decision-making occurs in school settings, and a structural framework that outlines the functionality of the tools that either facilitate or impede data-driven decision-making.

The Technology-Based Tools

The project is focusing on three tools – a test reporting system, data warehouses, and diagnostic assessments delivered via handhelds. The first application, the Grow Network uses a mix of print and web-based reporting systems. The print materials, called Grow Reports™, deliver well-designed, highly customized print reports to teachers, principals, and parents. The data displays in the printed reports mirror those used on the website, a strategy that has proved highly effective in reaching Internet-wary educators. Grow Reports™ for teachers give a concise, balanced overview of class-wide priorities, group students in accordance with their learning needs, and enable teachers to focus in on the strengths and weaknesses of individual students. The principal report provides an overview of the school, presenting class and teacher-level data; and the parent reports provide easy-to-interpret information that explains the goals of the test, how their student performed, and what they can do to help. Each report is grounded in local standards of learning (e.g., mathematical reasoning, number and numeration, operations, modeling/multiple representations, measurement, uncertainty, patterns and functions) that encourage teachers to act on the information they receive and to promote standards-based learning in their classrooms. When teachers view their Grow Reports on the web, these standards of learning link to teaching tools that not only help to explain the standards, but also are solidly grounded in cognitive and learning sciences research about effective math and literacy learning.

Second, are two data-warehouses, both locally grown initiatives that enable school administrators, teachers, and parents to gain access to a broad range of data. The systems store a diverse array of information on students enrolled in the districts public school

systems including attendance information, the effectiveness of disciplinary measures, test and grade performance. This information is available to an increasingly larger set of stakeholders in a growing number of formats for use in various contexts. After refocusing attention to school administrators, designers of the tools began to work closely with many of these administrators in order to understand what the schools' needs were regarding data and design. The end results are that the data warehouse systems have accommodated new kinds of data, has created multiple mechanisms for making that data available in different formats, and is continuing to work with school-based users to further address their needs. With the availability of data to schools has come an understanding on the part of the district that administrators and teachers need support not only in accessing, but in interpreting information in order to make informed decisions regarding their students. The third application consists of handheld technologies to conduct ongoing diagnostic assessments of students' mathematics learning and early literacy. In this system the teacher at the classroom level collects data on a handheld computer. Teachers upload their information from the handhelds to a Web-based reporting system, where they can obtain richer details about each student. They can follow each student's progress along a series of metrics, identify when extra support may be necessary, and compare each student's performance to the entire class. Customized web-based reports can be shared with mathematics and literacy coaches, instructional leaders, principals, curriculum supervisors, district administrators, and parents. The handhelds are: (a) built upon what we know from research about the key areas of mathematical knowledge and early literacy; (b) address real instructional challenges that teachers are facing and make the task of assessing student learning easy and practical to accomplish; and (c) tools to be applicable across multiple contexts and multiple curricula by addressing core learning challenges, not curriculum-specific skills and tasks.

The Research Sites and Data Collection

Two sets of sites were used for each application. The sites for Year 1 were the original sites and the Year 2 sites were used for validating the initial findings. The New York City Public Schools and Chicago Public Schools served as the sites for the Grow Reports. The Broward County Public Schools in Florida and Tucson Unified School District in Arizona served as the sites for the data warehouses. Albuquerque, NM and Mamaroneck, NY served as the sites for the handheld diagnostics. Three of these sites represented the first, third, and fifth largest school districts in the United States.

Research was conducted through interviews with administrators across all levels of the school districts and through interviews and focus groups with teachers and students. Surveys also were given to teachers and administrators. Analyses are continuing as staff is using data to construct systems-based models of the interrelationships among important variables that influence the implementation of the tools and data-driven decision-making in each of the sites. Data also are being analyzed in terms of the construction and validation of the theoretical framework for data-driven decision-making and the structural functionality framework for the tools.

Results

The Development of Three Initial Frameworks

The project is developing three frameworks: a methodological framework based on systems thinking; a conceptual framework for focused inquiry and exploration of data based on both theory and practice; and a structural functionality framework for the data-

driven decision-making technology-based applications. These frameworks are works in progress that are being refined over the course of the project.

The methodological framework is founded on three principles. First, there is the need to recognize the dynamic nature of school systems in order to capture their complexity.

Second, the methodology must account for the interconnections among the many variables that impact a school system. Third, the methodology also must account for the different levels of stakeholders within a school system. The goal, by the end of the project will be to have a systems model of each of the six sites, taking into account the dynamic nature of school, the interconnectedness among important factors, and the multiple levels at which schools must function. It is our hope that from these models, we will be able to draw parallels to other districts with similar characteristics and contexts, and providing a level of generalizability from the data.

The conceptual framework approaches data-driven decision-making as a continuum from data to information, to knowledge. Figure 1 depicts the model that reflects our current theoretical thinking. Key variables include collecting, organizing, analyzing, summarizing, synthesizing, and prioritizing. These variables are manifested differently, based on who the decision makers are and where in the school structure they are situated. The types of questions to be addressed are influenced not only by the location within the school hierarchy (i.e., class, school, district), but where along the data- information-knowledge continuum the focused inquiry falls. This conceptual framework further posits a continuum of cognitive complexity in data a decision-making begins with data, transforms those data into information, and then ultimately into actionable knowledge. The data skills are collecting and organizing. The information skills are analyzing and summarizing, and the knowledge skills are synthesizing and prioritizing. Decision-makers probably will not engage these skills in a linear, step-by-step manner. Instead, there will be iterations through the steps, depending on the context, the decision, the outcomes, and the interpretations of the outcomes.

Table 1. Theoretical Framework for Data-Driven Decision-Making

The structural functionality framework identifies six characteristics of technology-based tools that influence how they are used and by whom. The first is accessibility. Accessibility deals with how accessible are the tools, and how do the tools support access to the data or information. The second is the length of the feedback loop. Feedback focuses on how much time passes between the time the data are generated and when results are reported to the end-user. The concern is that the data are still relevant by the time they are reported. The third is comprehensibility. It deals with: how understandable the functioning of the tool is; how clear the presentation of the data are; and how easy it is to make reasonable inferences from the information presented. Flexibility is the fourth component. This component focuses on whether there are multiple ways to use the tool and the extent to which the tool allows the user to manipulate the data. Alignment is the fifth functionality. It focuses on the extent to which the data align with what is happening in the classroom, the alignment with the standards, and to the curriculum. The final component is the link to instruction. It focuses on how the tool bridges information (either physically or conceptually) and practice. This paper has described preliminary results on two of the applications in the first year sites. The project will continue to explore how these characteristics are manifested in the applications across sites.

Data collected from the first and second year of the project continue to be analyzed in relation to the three frameworks. Once the data have been fully analyzed, our goal is to produce systems models for each of the six participating districts, identifying the key factors that relate to the infusion of data-driven decision-making and how the particular applications influence decision-making across the various levels of the school system. These models, will inform the refinement of the three frameworks. The ultimate objectives from the development of these three frameworks is to provide a means by which to generalize our findings so that other districts forays into data-driven decision-making can be examined and better understood. The methodological framework will enable us to examine more systemically the use of the technology-based applications as they are infused into the organizational complexities of school districts. The conceptual framework will help us to understand the decision-making process and the cognitive processes by which individuals make educational and instructional decisions. The structural framework will enable us to examine the applications more specifically, focusing on particular characteristics that may facilitate or impede use and integration.

Observations from the Sites

We will summarize data that fall into two overarching topics. First, we will describe findings that relate to school issues. These include such factors as accountability and assessment, professional development and training, leadership, and data use. The second focus is on the affordances of the technology. We examine how the six characteristics that form the structural functionality framework impact the use of data.

School Issues. Accountability pressures by and large are one of the most important factors influencing the use of data and the tools. In the United States, there is increasing pressure at the local, state, and federal levels for schools to achieve performance mandates, as assessed by high-stakes tests. The more tests, the more pressures that are felt by the practitioners, and therefore the need to use data to make informed decisions about instructional practice that may lead to improving achievement, especially given the punitive consequences associated with failure. Because of this increase in testing, schools are faced with an explosion of data. The data need to be mined in different ways, and in particular, must be disaggregated. Simply put, there is so much data that educators are forced to use technological applications to deal with the wealth of data. As many educators say, they are data rich, but information poor. By this they mean that there is far too much information with which they must deal, but those data are not easily translatable into information and actionable knowledge. One goal of using the tools is to facilitate the mining of data from multiple perspectives that ultimately will provide the user with information from which they can make decisions.

A byproduct of the increase in testing is what happens in the classroom in terms of time allocation. As more testing occurs, teachers are forced to devote less time to instruction. Teachers report that they must teach to the tests, and in doing so many important topics get omitted. Teachers feel that they are not teaching as much as they are doing test preparation. Teachers also feel that their typical classroom practices are being changed by these pressures. Teachers know their students and tend to use multiple assessment strategies, quantitative and qualitative, summative and formative, to measure student progress. These strategies translate into a wealth of classroom data that needs to be collected and analyzed. Thus the applications play a critical role in helping educators to manage and examine the plethora of data.

Many teachers feel frustrated by the accountability pressures. Many see the use of data to make informed decisions a necessary survival strategy. Thus the applications by which data can be mined are key tools. Other teachers, however, are taking a more fatalistic approach. They feel that the pressures are just another passing fad and will fade in time, using a strategy to continue practice as usual. While yet another group of teachers are luddites who feel threatened by technology and balk at mining the data, entrusting that task to someone else in their school.

Some teachers' reluctance to use data the tools is grounded in a lack of training or a mistrust of data. Two kinds of training are salient here. First, there is a need for training on the use and understanding of data. Second, there is the need for appropriate and timely training on the tools. Teachers rarely receive preservice or inservice training. There are relatively few courses offered in teacher training institutions on data, and only recently have such inservice workshops begun to emerge. While teachers need to understand data, they also need to know how to use the technology that makes data mining possible. Again, only recently have professional development opportunities become available.

Leadership is the last major of the major school issues. Leadership makes a difference in terms of the message administrators communicate to their staff. In our experience, building leadership appears to be more important in facilitating or impeding the use of data and the tools. Although superintendents set the tone for a district's philosophy, principals have more direct contact with the faculty and therefore more influence on what they do. A principal who is data-driven or technically savvy can exert substantial influence on the faculty, communicating the importance and thereby stimulating use. In contrast, principals who are luddites communicate that technology and data are not important. They may not be impediments but they certainly do not urge their teachers to make use of the data and technology.

Affordances of Technology

As mentioned above, we have identified six functions of the tools that contribute to their use. These characteristics play out differently across our three applications as well as other tools. It is clear that the more easily accessible, the more likely the tools will be used. The handhelds are easily accessible, even with minimal training. Teachers access data on the devices and almost as easily online with the downloaded data that allow for deeper data mining. In contrast, the interface of the data warehouses are much more difficult to negotiate and therefore far fewer teachers make effective use of the tool. Had the interfaces been more user-friendly, it is clear that many more practitioners would take advantage of the wealth of data that resides on the warehouses. The feedback loop is perhaps one of the biggest motivators for or impediments to use. The functionality involves both the form of assessment or data and the tool. The Grow Reports are seen as static data with less utility because of the five-month delay between testing to the delivery of the data. In contrast, the handhelds provide immediate data to teachers from which they can make informed instructional decisions. The warehouses are somewhere in between, depending on the type of data entered and mined, as well as who is accessing the data (the end user or the data inquiry specialist). The tighter the feedback loop, the more immediately useful that data appear to be. Comprehensibility deals with the understandability of the information. The more understandable, the more likely the tool will be used. Parts of the Grow Reports are highly comprehensible, while other parts are

open to misinterpretation and ambiguity even by trained specialists. The handheld data are fairly easy to understand.

Flexibility refers to the extent to which the tool can be used in multiple ways to examine data. The more flexibility, the more useful the tool will be. However, the more options a user has, the more opportunity for confusion. Looking at data in a variety of ways generally will help the user to understand more deeply the meaning of the information. This includes having a variety of visual displays such as tables, graphs, and charts, and presenting data at different levels of aggregation. Take for example the two data warehouses. One warehouse presents data at the individual student level. If an inquiry is made at the level of the class, a special data run must be made to aggregate the data at the class level. The other warehouse flexibly moves across different levels of aggregation and units of analysis—student, class, teacher, school, and district levels. Alignment refers to how well the data can be matched to standards, instructional goals, and classroom practices. The Grow Reports are customized to state standards and display student and class performance categorized into quartiles. Teachers can go to the Grow website to obtain instructional resources that may help to remediate particular performance deficits. In a similar manner, the sixth component, link to instruction, is manifested differently in the tools. The Grow Reports' indication of how the class performed in relation to the standards and the online resources are intended to help teachers plan instruction. Perhaps the most aligned to instruction are the handhelds. The diagnostic assessments administered via the handhelds are intended to be translated immediately into instructional remediation, thereby blurring the distinction between assessment and instruction. The handhelds can truly be a powerful instructional tool, not just an assessment device. The data warehouses have less direct links to instruction, requiring the teachers to develop links to classroom practice based on the data they have accessed.

Summary

These data only touch the surface of how three technology-based tools impact how educators use data to make informed decisions. It is clear that the characteristics of the tools, as well as a host of school variables affect use. The three frameworks posited here are works in progress based on nearly two years of intensive data collection in six school districts. As we continue to examine the data, we will construct the systems models for each of the sites, attempting to draw parallels within and across tools. These data will help us to further refine the theoretical model as well as the structural functionality framework. Our goal is to take our data and ultimately transform them to information and knowledge, just as we have posited in our theoretical framework.

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