Keeping Teachers in the Center: A Framework of Data-Driven Decision-Making

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Abstract: The Education Development Center's Center for Children and Technology (CCT) conducted a three year study of a large-scale data reporting system, developed by the Grow Network for New York City's Department of Education. This paper presents a framework based on two years of research exploring the intersection of decision-support technologies, educators, and the process of transforming data into knowledge. The model looks at three dimensions: the process by which raw data becomes useable information; the effect of the data-reporting tool in shaping that process; and the role of prior knowledge of the decision-maker. The model keeps the teacher at the center of the process and supports the hypothesis that, in order, for data-driven decision-making to change teaching and learning practices, the focus of professional development should be on teaching and learning, rather than on data analysis.

Introduction

Urban districts have faced the intense external scrutiny of a high-stakes accountability climate for some time (Fullan 2000), but the shift in the funding and regulatory environment caused by the *No Child Left Behind Act* (NCLB) is prompting district and school administrators to think differently about the potential data has to inform classroom decision-making aimed at raising student achievement. The exploration of how data can inform instructional decisions is increasingly becoming a main topic of educational policy (Salpeter 2004; Secada 2001). Several technical advancements enabling innovative reporting mechanisms have brought data-supported decision-making to the classroom level, however, as CRESST researchers note, "Despite both the mandates and the rhetoric, schools are woefully under-prepared to engage in such inquiry. The practice of applying large-scale data to classroom practice is virtually nonexistent" (Herman & Gribbons 2001).

This paper presents a conceptual framework that highlights the intersection of decision-support technologies, educators, and the process of transforming data into knowledge. This framework connects research and insights from three different bodies of literature with our own research on teachers' use of a data reporting tool in New York City. First, it draws on organizational research on Management Information Systems (MIS), and application of this perspective to education by the Wisconsin Center for Education Research at the University of Wisconsin-Madison. Second, it considers the factors educators bring to the process of synthesizing and understanding data. Last, it includes findings from our own research around technological affordances and socio-technical relations to understand the data tool itself (Light et al 2004). Key to understanding data-driven decision-making is the understanding that data should be used to inform decisions, not replace them (Secada 2001). Therefore, our intention is that this framework keeps the teacher at the center of the decision-making process.

The Grow Reports® in New York City Schools

The current experience of the New York City Department of Education in conjunction with the Grow Network, an education company that helps to "transform assessment results into instructional tools for teachers, principals, and parents" (Grow Network 2004) is a prime example of how newly emerging tools that use standardized testing data have the potential to bring coherency to this process of alignment. With support from the Carnegie Corporation, the Education Development Center, Inc.'s Center for Children and Technology (EDC/CCT) conducted a two-year study of the New York City teachers' experience with Grow Reports® (Light et al. 2005).

New York City uses the Grow Network's web-based reporting system to provide 30,000 fourth to eighth grade educators access to assessment data for 400,000 students. Through the Grow Reports, teachers are able to see the previous years' test results, overall scores, and scores by each standard tested for each one of their current students. For teachers, the reports provide overviews of class-wide priorities, group students in accordance with the state performance standards, and support teachers in focusing on the strengths and weaknesses of individual students. For the administrators, the reports provide an overview of the school, and present class and teacher-level data. For the parents, the report explains the goals of the test, how their child performed, and what parents can do to help their child improve their score. Each Grow Report, which is delivered both online and in print, summarizes the data into rankings by score and groups students according to New York State performance levels.

While several technical advancements enabling innovative reporting mechanisms have brought data-supported decision-making to the classroom level, questions about how teachers understand and use standardized test data for instructional purposes remain unanswered. Some preliminary work on the experiences of different design sites that are developing data-systems are seen in: the Quality School Portfolio (QSP) developed at CRESST (Mitchell 1998), and IBM Reinventing Education data projects in Broward County Florida (Spielvogel, Brunner, Pasnik, et al. 2001), the Texas Education Agency, and the South Carolina Department of Education (Spielvogel & Pasnik 1999). Research on the role of data systems and applications in practice is also being done in Minneapolis (Heistad & Spicuzza 2003), Boston (Sharkey & Murnane 2003), and on the implementation of QSP in Milwaukee (Thorn 2002; Webb 2002). Still, the New York City school system's partnership with the Grow Network is possibly the largest project of its kind.

Conceptual Framework

The theoretical framework that guided our research highlights three key components: the process by which raw data becomes useable information, the role of prior knowledge of the decision-maker, and the effect of the data-reporting tool in shaping that process. We will discuss each of these dimensions in more detail below.

From Data to Knowledge: A Management Information Systems Perspective

Organization and management theory has been examining data-driven decision-making in the business world for many years. In order to understand the process by which teachers understand and interpret standardized test data, we used a knowledge management framework borrowed from management theory and organizational psychology and sociology (Ackoff 1989; Choo 2002; Thorn 2002).

Most theories of information management draw distinctions among data, information, and knowledge. They are explicit that data by themselves are not immediately useable, they must become knowledge. But knowledge, unlike data, is regarded in management literature as being embedded in people, and knowledge creation occurs in the process of social interaction about information (e.g. Sveiby 1997). This perspective is supported by Nonaka and Takeuchi (1995): "information is a flow of messages, while knowledge is created by that very flow of information anchored in the beliefs and commitment of its holder. This […] emphasizes that knowledge is essentially related to human action." Likewise, Drucker (1989) claims "knowledge is information that changes something or somebody – either by becoming grounds for actions, or by making an individual (or an institution) capable of different or more effective action." Therefore, data, prior to becoming information, is in a raw state and is not connected in a meaningful way to a context or situation.

Borrowing from Ackoff's (1989) work in the field of organization and management theory, in collaboration with Dr. Andreas Breiter (2003), we adapted a simplified version of Ackoff's conceptual framework that links data, information and knowledge. Within the framework, there are three "phases" of the continuum that begins with raw data and ends with meaningful knowledge that is used to make decisions. They are the following:

- **Data** exist in a raw state. They do not have meaning in and of themselves, and therefore, can exist in any form, usable or not. Whether or not data become information depends on the understanding of the person looking at the data.
- **Information** is data that is given meaning when connected to a context. Information is data used to comprehend and organize our environment, unveiling an understanding of relations between data and context. Alone, however, it does not carry any implications for future action.
- **Knowledge** is the collection of information deemed useful, and eventually used to guide action. Knowledge is created through a sequential process. In relation to test information, the teacher's ability to see connections between students' scores on different item-skills analysis and classroom instruction, and then act on them, represents knowledge.

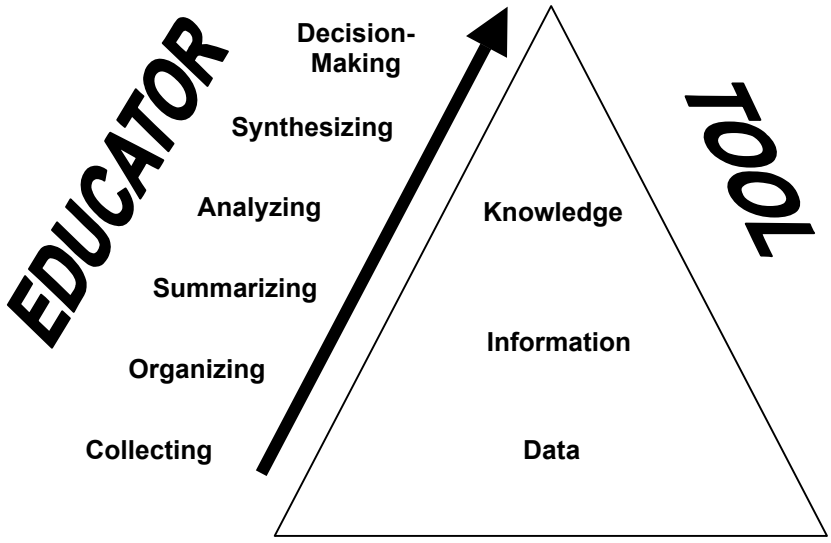

Figure 1: The process of transforming data into knowledge

The literature identifies six broad steps (Fig. 1) that a person goes through to transform data into knowledge (Ackoff 1989; Drucker 1989). The transformation entails collecting and organizing data, along with summarizing, analyzing, and synthesizing information prior to acting (decision-making). Through this process, raw data are made meaningful, by being related to the context or situation that produced it; consequently, human action underlies all decision-making. In the sections that follow, we show that what the educator and the tool bring to this process, informs our understanding of how teachers interact with data.

What the Educator Brings to the Transformation Process

Based on the perspective that knowledge is embedded in people (Nonaka & Takeuchi 1995; Sveiby 1997, Secada 2001), the central element in data-driven decision-making is the educator and what he or she brings to this process. Based on our research we found that there are two important elements of the school context. The first is the leaderships' vision for using data in classroom-level accountability pressures set by the larger policy context and the school's progress making adequate yearly progress (AYP) on test performance. The second is teachers' current pedagogical beliefs and practices. This second element is important because teachers synthesize this information into their worldview, which is shaped by their teaching style and pedagogy. Relevant dimensions of prior knowledge are represented in teachers' experience in classroom management and lesson planning, their level assessment literacy, and their knowledge of the learning process and knowledge acquisition.

Throughout the survey and in the interviews, teachers across New York City reported using the Grow Reports® in various ways to meet their overall classes' as well as their diverse students' academic needs. In interviews, the teachers reported using Grow to support their current practices and to help decide how to allocate their own resources of time, attention, practice and homework. Teachers use the testing data provided in the Grow Reports® to plan activities, lessons and units. They sometimes use it as a starting point for conversations with students,

parents, specialists, and administrators. Some teachers plan their own professional development, based on test data, to focus on areas where they think their students need more help.

The decisions the teachers spoke about can be grouped within several specific areas of their instructional practice: (1) targeting instruction, with decisions about class priorities, lesson plans, and the academic year; (2) meeting the needs of diverse learners, seen in strategies such as grouping, creating Individualized Education Plans (IEPs), and giving individualized assignments and materials appropriate to the students' levels; (3) supporting conversations with parents, students, fellow teachers and administrators about students' learning; (4) shaping teachers' professional development by reflecting on their own practice; and , (5) encouraging self-directed learning by giving the data to students.

The accountability environment also played a role in teachers' decisions about the data. No matter how teachers viewed state-mandated, standardized testing, whether skeptically or acceptingly, they recognized, across the board, that part of their job is to prepare students to take the test. But they have questions about the test. The majority of teachers questioned the test's accuracy in measuring students' academic abilities and in measuring the "life skills" that students need to succeed as well as the test's cultural sensitivity or developmental appropriateness to all students. Based on these concerns, teachers frequently seek to monitor student learning and triangulate assessment data in a variety of different ways. All of the teachers surveyed reported using multiple assessment strategies, either always, often, or sometimes. When interviewed, the teachers discussed mixing various assessment strategies to provide a fuller picture of student understanding and learning.

How Data Technologies Shape the Transformation Process

The MIS literature contends that the design of decision support systems affects the process of transforming data into knowledge. Minimally, the tools require that the data be collected and organized, but most tools also summarize and analyze data. Basic decisions about how to aggregate raw numbers and present them shape the flow of information. All software has built-in assumptions that shape the final product (Lehmann 1990) and in relation to data decision systems, these assumptions effect utility (Sarmiento n.d.; Wayman, Stringfield, & Yakimowski 2004). For example, data warehouse technologies play a first step in collecting and organizing data. The way a data warehouse collects data and structures the database influences the next steps in the process. Reporting and retrieval technologies shape the organization and summarization of data into information. Potentially simple things like interface and visual presentation can make the information understandable to the end user. There are also data analysis tools and technologies that shape the process of summarization, analysis and synthesis of data. Basic issues of access (like passwords or Internet connections) influence who can use the data or information.

Building from the literature on information management systems and data-driven decision-making, we have identified six continuums that illuminate how a data support system affects the process of understanding and using data in an educational context. These dimensions encompass tool functionality, data collection, data entry and organization as well as to how the tool enables the user to interact with the data. Each dimension identifies key traits, or clusters of traits, that can shape how educators use the tool. There is no value implied by being higher or lower on any given dimension. They are:

- Access and ease of use. This dimension encompasses the degree to which the tool is easy to use and accessible. The tool can vary on ease of use from being very intuitive to requiring more training. Access is not defined only by the technological infrastructure but issues of authorization and passwords. Given the sensitive nature of certain data in the education system, access issues are complicated by issues of privacy and accountability.
- Length of feedback loop. The feedback loop stretches from data collection to reporting it back out. The utility of the tool is mediated by the utility of the data when at the time the user accesses it. Some data is time sensitive and has declining value. Other data may not, or may become more valuable within a longitudinal perspective (Gorry & Scott Morton 1971).
- Comprehensibility of the data. The tool can help support the ends users' comprehension of the data. Reporting strategies, like graphic representations, supporting data, grouping and aggregating data, can help the user make inferences from the data. The tool can also include other information, like explanations or background information that can help the user understand the data. Comprehensibility embodies a tension between supporting interpretation of the data and dictating an understanding of the data.

- Manipulation of the data. In our view, this dimension covers two levels of flexibility. First, the flexibility of the tool to help the user to ask and solve different problems with the data. By allowing the user to manipulating the data, the tool can handle different problems (Arnott 1998).
- Utility and quality of the data. There are literally thousands of variables that schools could enter into a data system, but not all may be aligned with the objectives and goals of the end users. This dimension refers to what extent the data provided to the educators aligns with their needs. It also encompasses questions about the scope and accuracy of data provided and do these correspond to the types of decisions envisioned (Feldman and March 1988; Gorry & Scott Morton 1971).
- Links to instruction. This dimension is specific to educational decision support systems. Does the tool bridge information (either physically or conceptually) and practice?

It is important to keep in mind that these dimensions interact with each other in both positive and negative ways. For example, creating a tool that allows the user to do complex manipulations of the data would mostly likely decrease ease of use by creating more complex tool, and also affect the level of analytical knowledge a user would need to understand the results. Or, creating a more accessible data tool may require omitting private data from the system.

Conclusions

The framework for understanding data-driven decision-making presented here illuminates the interrelationship between the data-tool and the educator in supporting the decision-making process. In understanding the role of the Grow Reports, the framework allowed us to identify how the tool supports the creation of knowledge by collecting , organizing, and summarizing the data. The ease with which most teachers were able to understand the reports perhaps indicates that the *data* are now at the level of *information*.

The framework also highlights the critical role that the educator plays in the data-knowledge process and the wealth of practitioner knowledge in that respect. The transformation process identifies that the last few steps in generating knowledge, are analyzing and synthesizing. In order to do this, teachers connect the information about test performance to their prior knowledge of teaching and their students, thereby shaping this connection to their pedagogy, their context, and their level of understanding of the test. The decisions being made from the Grow Reports were not driven by the data as much as by teachers' pedagogy. As teachers stated, the data helped them develop a clearer picture of their students, but they still had to integrate this data into their broader understanding of their classroom. In the final stages of the data-knowledge process, teachers rely more on their knowledge of teaching and learning than on their assessment literacy. This is perhaps the crux of the relationship between the data-tool and the educator where the Grow Network has effectively transformed the test data so that the educator can more easily use them to make classroom-level decisions.

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