

# Teachers Using Data to Improve Instruction: Exemplary Practices in Using Data Warehouse and Reporting Systems

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## **Introduction**

Student data (e.g., assessment scores, student histories, demographic information) are an untapped resource in helping educators diagnose student learning needs, and accountability policies such as NCLB have brought attention to the use of student data. These policies carry the implicit assumption that the availability of data will inform and initiate changes in educational practice, but mechanisms for helping educators use data are lacking in these policies. Further, there is never mention of involving teachers in using data for everyday inquiry into their practice.

Many researchers (e.g., Black and Wiliam, 1998) have argued for classroom-focused policies because of the access teachers have to students and their performance. Although teachers are often critical of accountability data, preliminary evidence suggests that teachers will embrace a data initiative when it is soundly implemented and responds to the learning needs of their students (Chen, Heritage, & Lee, in press; Lachat & Smith, in press; Massell, 2001).

While the notion of involving teachers in data use is attractive, it is easier said than done – many schools have found the analysis of data to entail a great deal of labor because data are often stored in ways that frustrate flexible analyses (Stringfield, Reynolds, & Schaffer, 2001). In response to this problem, new computer technologies have been developed that offer unprecedented, efficient access along with user-friendly interfaces that facilitate use by all types of users (Wayman, Stringfield, & Yakimowski, 2004).

These technologies are necessary to create sustainable school data initiative, but they are not sufficient. Data initiatives are new to most faculties, and most educators lack the preparation to efficiently use data to inform educational practice. Further, schools are moving quickly to implement these technologies in response to increased accountability pressure. Consequently, it is necessary to provide studies about best practices in the use of these systems to engage teachers in reflective inquiry for improved practice and achievement.

The present study addresses this need by providing research on three schools exhibiting exemplary practices in involving faculties in the use of student data systems for instructional improvement. The intent of this paper is to provide preliminary data from this project, describing practices and methods learned from these schools that inform efficient support of a data initiative.

### **Computer Systems for Accessing Student Data**

An increasing number of computer systems are being marketed for the purpose of efficiently delivering student data to educators and these systems provide many different functions. Unfortunately, no system provides comprehensive access to solutions to educational problems, so districts must choose between many types of data systems. Common types of systems include (a) student information systems (SIS) that provide real-time accounting of daily school function (e.g., attendance, schedules) but are typically not designed to provide analysis or access to data beyond the current school year; (b) assessment systems that rapidly organize and analyze frequent benchmark assessments but are typically not designed to provide access to such data over time; and (c) data warehousing systems that provide access to historical data of all types but are typically not designed for immediate turnaround of new data (Wayman, in press).

The types of functions available in today's computer systems are nearly mutually exclusive; that is, it is uncommon to find one type of system that incorporates the functionalities of another type of system. These lines are rapidly blurring and it is likely that technology will advance to the point where one system can perform all functions. Until then, school personnel need to choose the type of system that best fits their needs.

Many types of data systems are useful for schools. The schools in this study were chosen for their practice in using data warehousing and presentation tools. These systems offer unprecedented access to a wide range of historic data, with the capacity to retrieve a student's entire history for one analysis. Further, these tools provide user-friendly presentation interfaces that can provide data in an efficient, easily understood format and greatly reduce the amount of software training needed to use the system (Wayman et al., 2004).

In education, the term data warehousing is often used to refer to the collection and organization of all data into one electronic repository. Data warehousing integrates data that are often stored in disconnected areas (e.g., student discipline data or achievement test data), thus allowing examination of relationships across a variety of domains. While the concept may sound simple, organizing large, disparate databases into one common store is a complex task. Recent technological gains have resulted in tools and models that efficiently warehouse data for the examination of relationships commonly explored in the education arena. Data warehouse and presentation systems can be built using local talent or can be purchased commercially.

The data warehousing process begins with an inventory of available data (if a district has contracted with a commercial vendor to implement a data system, the vendor usually offers help with the data inventory). After data identification is completed, school and/or vendor personnel begin the task of populating the data warehouse, often from a variety of locations and data systems (e.g., a student information system, Excel spreadsheets, paper records). Data warehouses serve as a common store of data, but usually do not replace a school's other electronic data systems, such as the student information system (SIS). School personnel typically continue to maintain these systems for daily management and upload information from these systems into the data warehouse on a regular basis.

Once the data are available, user-friendly data presentation interfaces may be launched. These interfaces connect the user to the database and are the intermediaries through which users may examine relationships within the data. These systems typically offer the user two types of data access: preformatted reports or query tools.

Preformatted reports are previously compiled summaries of data that are available for viewing or printing with one click and require no specifications, alterations, or input from the user. For instance, a teacher might click on a link to view a report on the achievement test scores of his or her students, broken down by ethnicity and gender. Query tools allow ad hoc data specification, permitting the user to browse data or create customized reports. For instance, a teacher might use a query tool to explore achievement test histories of the students in his or her class, compose summaries of these histories based on desired groups, or simply browse available data.

Besides unprecedented data access, the promise held by these systems is the ease of use that facilitates examination of student histories and learning tendencies. The data presentation interfaces offered by most commercial vendors are easy to learn and use,

employing familiar web-form elements such as check boxes and pull-down menus. Through these user-friendly systems, data are accessible to all educators of all levels of technical expertise: Most users who can check the weather or shop on the internet can easily learn how to access student data using these interfaces.

While these technologies show promise, there is little in the research literature about best practices in applying them to promote faculty-wide use of student data. Wayman (in press) outlined conditions that would promote faculty use of these tools; Chen, Heritage, and Lee (in press), and Lachat and Smith (in press) both provided studies of more isolated faculty use supported by this technology. We are unaware of any empirical research of best practices in using these technologies to involve entire faculties in employing student data to inform classroom practice. With the present study, we provide such research.

### **Exemplary Practices in Using a Data Warehouse and Reporting System**

We recruited three schools that were demonstrating exemplary practices in involving teachers in using commercially-available data warehouse and reporting software packages to access student data to inform instruction. These schools represented three varied settings: one school was in a small district in the northeast United States, another from a small suburban district in the northern United States, and another from a moderate-sized district in the southern United States. Two districts used SchoolNet ([www.schoolnet.com](http://www.schoolnet.com)) and one district used EDsmart ([www.edsmartinc.com](http://www.edsmartinc.com)) for student data warehousing and reporting.

Focus groups and interviews were conducted with district administrators and with principals and teachers in the study schools, designed to answer four research questions:

1. *What practices are effective in teacher use of these software tools?*
2. *What forms of educational improvement are emerging as a result of student data use with these tools?*
3. *How has the culture of the school changed as a result of the data initiatives implemented by these schools?*
4. *What software and data features were most useful to teachers?*

Wayman (2005) offered a framework to guide data use throughout a district that offers insight into faculty-wide data use. This framework consists of three critical elements that a district must address to implement a sustainable data initiative:

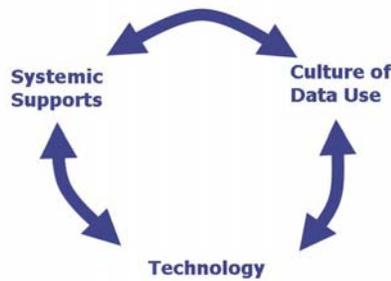
*Systemic Supports:* Data initiatives at the building level are more efficient when the district has established precursory supports, such as alignment of goals and practices, structured time for data exploration, and focused professional development.

*Culture of Data Use:* It is important to build a climate that encourages educators to use data rather than be used by data, where teachers rely not only on professional judgment, but on professional collaboration and informed, reflective practice.

*Technology:* No data initiative is sustainable or scalable without fast, efficient delivery of relevant student data.

Each of these factors is equally important, and each affects the other two. Figure 1 illustrates this framework graphically.

Figure 1  
From Superintendent to Teachers: A Model for District-Wide Data Use



The importance of the factors in this framework in affecting teacher use of student data in these schools was underscored in the results from this study. In the following narrative, we provide preliminary data in response to the four research questions outlined above.

#### Effective practices in teacher use of computer data systems

In promoting widespread faculty use of a data system to inform classroom practice, it became clear that principal leadership was key. The principals of all three schools were individuals invested in the vision that data should be used to inform all decisions in their schools, and they communicated this expectation in every aspect of their business.

Stringfield et al. (2001) described that data initiatives often succeed because of an extraordinary amount time and effort spent by one or more individuals. Understandably, a data initiative often dies when these individuals leave because it is entirely dependent on them. We did not find the principals in this study implementing this “hero model.” Rather, these principals led, involved, and expected their faculty to participate in the data initiative as full partners. These principals exhibited many of the skills advanced by Copland (2003) in describing distributed leadership for inquiry. By leading in this fashion, the principals were rapidly changing the culture of their schools to one where data use was prevalent practice.

One component of leading faculty in data use is to structure time, collaboration, and preparation into the initiative. Teacher schedules are already overburdened; these principals recognized that the initiative would not succeed without time set aside to focus on and explore the data, and organized opportunities to meet with other faculty within and across grade levels and disciplines. Further, the premise that educators have little preparation in efficient use of student data was unanimous among our interviewees. Accordingly, all three principals described numerous occasions of helping individuals or groups with the task of turning data into information. These principals also recognized technology to be crucial to teacher data use, so much of the time, collaboration, and preparation was structured around their computer data systems.

Building-level supports such as these are essential, but district-level supports also facilitate a data initiative. In promoting teacher use, we observed varying forms and degrees of support at the district level. Two of the districts are specifically offering various forms of development opportunities for teachers and principals. In one district, this has taken the form of numerous classes and one-on-one sessions with district staff.

This district has made these opportunities available to all educators but has taken the extra step of targeting specific teachers who show interest in the initiative, hoping to build faculty leadership in different areas of the district. In addition to providing support opportunities, the other district has outlined a focused and aggressive plan for involving teachers. This plan involves preparing and certifying certain educators who then are responsible for preparing groups of colleagues, and this plan is very specific in terms of timeline and responsibilities. The administration of the third district is supportive of data use in their schools, but is only in the very early stages of the forms and number of developmental opportunities offered. The administrators in this district were very supportive of the principal in the study school. This district provided a large amount of technological support, which the principal leveraged to the fullest extent.

Another emerging theme in these schools was non-threatening triangulation of information. This theme incorporates two realities: data are best used for positive instructional purposes, and no one source of information tells a complete story about a student. Teachers are suspicious of data initiatives (Ingram, Louis, & Schroeder., 2004), and rightfully so – historically, data have been used mostly to punish and embarrass educators. The principals in this study all took care to describe methods that help teachers *use* data rather than *be used* by data. Further, some teachers in our study were suspicious that the intent of accountability policies was to discount or replace the professional judgment that educators rely heavily upon to evaluate student learning. All pieces of information on the student, whether it be assessment data, demographic data, or teacher judgment, should be treated as a data point that describe the state of student learning. All the principals in our study described how student data were used to begin and further conversations and evaluations about student learning between teachers, administrators, and parents. Data took much of the tension out of these interactions, because they were used as non-threatening evidence to begin discussion about improving student outcomes. Our interviews indicated that efforts toward non-threatening triangulation of information were essential in building trust among the faculty, winning over skeptics, and promoting the deep inquiry around specific problems necessary to get the most information out of student data.

One principal explicitly made what we are calling “non-threatening triangulation” a cornerstone of the school’s data initiative. This school has chosen to focus heavily on early literacy, and decisions made about student learning in this area require three data points, one of which is teacher professional judgment. The school implements a variety of literacy measures, so there are often more than three data points involved. Additionally, this principal was very proactive in communicating that data in this school would never be used against teachers. This approach seemed to be working, as it came up often in interviews with teachers from this school.

### Educational Improvement

While improvements in student learning are ultimately the goal of a data initiative, these changes are often preceded by improvements in educational attitude and practice. Such changes were occurring in the study schools, and much of it was attributed to school data initiatives supported by a computer data system.

The overarching theme was that these faculties were becoming more efficient and professional in the way they diagnosed student learning needs. Because of the rapid and

broad access to student data, educators in these schools are able to more quickly focus on student learning problems. Further, this data has enabled these educators to gain more precise knowledge about their students, making them better able to respond to the entire student situation.

Teachers and principals reported changes in classroom practice as a result of these data initiatives. We heard numerous examples of how educators throughout these schools were questioning varied aspects of their practice in positive ways. Through efficient questioning, educators were rethinking and reinventing teaching techniques large and small. Many interviewees reported that student data provided also validation of practice and previously formed understanding about student learning.

Also common were descriptions about how instruction had become more differentiated as a result of data use. Forms of differentiation were varied, ranging from one example of team teaching where two teachers combined classes for certain lessons, then formed subgroups of students, to many examples of providing differentiation for individual students.

Teachers in these schools were also being helped to better make the connection between assessment and instruction. One unfortunate byproduct of accountability policies is a dissonance caused by ignoring the lack of preparation given educators in understanding formal assessments. Many teachers form a nearly total separation between the two. We saw the study schools helping teachers make this connection, with some teachers explicitly stating that preparation in this area helped them connect assessment results to their own practice. One principal was particularly proactive in this area. Not surprisingly, the teachers on this faculty indicated the most growth in this area.

### Changes in School Culture

Although some studies have explored the relationship of school culture to data use (Ingram et al., 2004; Sutherland, 2004), this relationship is more often overlooked. School culture is marked by autonomy because teachers are often solely responsible for the learning of a group of students. This, combined with the mistrust many teachers have for data initiatives, makes attention to issues of school culture vital to the health of a data initiative. We observed changes in faculty culture as a result of the increased emphasis on student data; conversely, the proactive attention given to cultural issues by school leaders vastly contributed to the success of these initiatives.

We believe collaboration to be essential to efficient use of technology for student data (Wayman, in press) and have suggested that collaborative data teams are a useful mechanism for promoting a data initiative (Wayman, Midgley, & Stringfield, 2005). In all three study schools, teachers and principals reported greatly increased collaboration as a result of a focus on student data, and we believe collaboration contributed to healthy data cultures in these schools. One principal described a culture only five years ago where educators rarely consulted one another about student learning, contrasted with the current climate of information sharing in that school. Many forms of collaboration were described in interviews, varying across and within schools. For instance, some teachers in one school were meeting within subjects across grades, to better assess the learning trajectory of students over time. Another school required data to be at the heart of individual student improvement meetings involving the student's teachers, counselor,

principal, and other stakeholders. Perhaps most striking, we heard descriptions of spontaneous, informal meetings of teachers to discuss data and student learning.

As described above, the principals in these schools worked to help advance teachers along the continuum of data use. We observed particular sensitivity to the lack of preparation provided teachers for examining data, and we believe the positive focus of these efforts contributed to healthy school cultures about data use. Teachers reported increased learning about data use, instances where they helped pull each other along, and examples of previously skeptical individuals who currently support the data initiative.

We heard examples of changes in attitudes among faculty members. One teacher was eloquent in describing how the easy access to student data, and the knowledge to use it, had helped her feel more professional and efficient as an educator. One principal described changes in the reactions teachers had to student data: where teachers initially asked, “what do we do with these data,” they now ask “what do these data mean?” We have stated elsewhere that a goal of a faculty engaged in data use should be to become a professional community of informed, reflective practitioners (Wayman et al., 2004). We believe these cultural changes are evidence that these schools are becoming such a community.

#### Useful Software and Data Features

There are many features of a data warehouse and presentation system that users find appealing. Not only does the system provide access to an abundance of previously inaccessible data, but should contain a user-friendly interface that encourages use. Elsewhere, we have provided a discussion of optimal software and data features (Wayman et al., 2004); many of these features were supported empirically in this study.

Many teachers cited user-friendliness as promoting use of the data system. These teachers described the ability to easily organize data, print reports, and perform other data queries as reasons to use the system.

Speed of access was a topic of strong discussion. It was clear that when the system provided data with little wait, users used the system. If not, they reported frustration and often gave up. There are various factors involved with access speed, involving any combination of district, building, and vendor factors. The learning for educators and vendors alike is that teachers are overburdened and are unlikely to use a slow system.

One feature provided by a data warehouse is access to previous years of data that give a longitudinal picture of individual student learning. We found longitudinal data employed in all the study schools, and promoted by teachers as an important component of their data use. One school used less longitudinal data than the other schools, frustrated by the user-friendliness of their interface. This school was having great success with a computer system that provided real-time, but not longitudinal, assessment data. Still, teachers in this school expressed a desire to see results over time.

The tradeoff between a data warehousing system and a real-time assessment system can be generally described as longitudinal data vs. more timely data. While teachers love historical data, they are often frustrated with data that are not recent. Two of the schools in the present study are augmenting historical data with assessment

systems that deliver real-time data. Teachers were positive about this use, but expressed regret that the two systems could not be combined<sup>1</sup>.

In one school, teachers were making avid use of a new software feature that enabled and sharing of planning information for individual students. Use of shared planning information was one of the first software tasks undertaken in the school and proved very popular in teacher interviews. Through this feature, teachers are able to make notes on learning strategies for particular students, and these notes are available to the teachers for each student. In schools without this technology, such information is typically shared informally in face-to-face conversations. By sharing this information electronically, educators at this school reported much-increased interaction of this type.

Student profiles, similar to a student permanent record and containing elements such as student demographic information, test histories, free lunch status, were in widespread use in the study schools. These profiles were among the most touted data by teachers because of the holistic breadth of information they provide about a student that help teachers understand particular student situations. Many teachers also reported that these profiles facilitated day-to-day tasks such as finding parental phone numbers. In fact, one teacher reported making more parental contact as a result of better information access. The use of these student profiles helps illustrate the varied uses of student data. While much is written about assessment data, teachers make efficient use of a variety of information to improve student learning, some of it in simple forms.

### **Conclusion**

We have presented preliminary data from three schools that are exhibiting exemplary practices in widespread involvement of teachers to use data for educational improvement. We have argued (e.g., Wayman, in press; Wayman et al., 2004) that data initiatives such as NCLB are incomplete without the downward flow of data to the classroom level, where learning is most proximally impacted. Further, we have argued that new technologies are necessary to offer the best and most efficient use of such data.

While widespread classroom use of student data and student data technology such as that described here is still not common, the message from the present study is clear: it can be done. Further, it can be done without the unreasonable amount of personal investment that mark – and later doom – many data initiatives. The data from these three schools also indicate that implementing a data initiative is not a trivial task. Still, it is an attainable goal for nearly any school or district, and is likely a cost-effective method of improving education for impoverished and overburdened systems. With proper planning, it is feasible that systemic supports, a positive culture for data use, and technology can be put in place that support a scalable and sustainable data initiative.

The data from these schools give quality insight into the workings of successful initiatives. It should also be noted that these schools continue to encounter problems, just as any school will. Our intent in writing this paper is to highlight positive actions that these schools have taken to promote widespread faculty use of student data systems. It is instructive to note that even schools such as these, singled out for their exemplary practices in using student data, continue to struggle with growing pains.

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<sup>1</sup> SchoolNet, one of the software providers in this study, has recently released a software version with the capacity to incorporate real-time assessment data through a partnership with ScanTron.

The data presented from this study thus contribute to a growing body of literature regarding “what works” in using student data for educational improvement. It is our hope that this information is helpful to researchers, policymakers, and educators looking to advance this new and exciting aspect of education.

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