

## Knowledge Management and Educational Data Use

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## Introduction

The belief that educators make better decisions when they know more about their students is not something new. What is new, however, is the combination of standards-based accountability policies and new technologies. Taken together and complementarily, they have the potential to change fundamentally the work of education. These considerations help form the foundation of the field of educational data use. Educators now have more data than ever before about their students, even if they are only certain forms of data. Equally important, information technology systems have made this data more accessible, easily analyzed, and easily distributed than ever before.

Although this dynamic may seem straightforward, the real work of implementing effective data practices and of supporting educators has proven challenging. Findings suggest that more can be done to better understand the relationship between professional judgment and "hard" data. For example, despite access to a wealth of data, many educators may have difficulty weaving data into instructional practice (Massel, 2001; Wayman & Cho, 2008). In addition, many effective data practices may occur sporadically or in pockets (Wayman, Cho, & Johnston, 2007), and some educators may have difficulty articulating how evidence or research benefit practice (Coburn & Talbert, 2006).

Additionally, other research suggests that data can be ignored, used for dubious ends, or be interpreted with bias (Coburn, Honig, & Stein, in press; Ingram, Seashore Louis, & Schroeder, 2004; Knapp, Swinnerton, Copland, & Monpas-Hubar, 2006). As such, educational researchers continue to wrestle with the interplay professional judgment and accountability, intuition and analysis. Indeed, researchers and practitioners may benefit from a better

understanding for why craft is so difficult to change, and the conditions under which data effectively support educator practice.

In this analysis of the literature, we review the current research in educational data use and introduce the field of knowledge management (KM)<sup>1</sup>. Although the types of data that are useful to teachers may be considered broadly (Wayman et al., 2007; Wayman & Stringfield, 2006), many continue to focus their attention to standardized test results. To contrast, KM begins with knowledge itself, and not merely data, or any particular form of data. Equally important, expertise, professional values, training, and organizational routines all factor into a more nuanced view of decision making. In this way, KM may serve as an important reference discipline for understanding educator judgment.

Accordingly, our aims are to relate these streams of research and outline how educators might be better supported in their practice. We begin with a review of educational data use, including the field's key concepts and recommendations. Subsequently, we offer a few guideposts to understanding KM, including its unique view of professional practice and its implications for organizational policy. Finally, these streams are synthesized with a focus on future research relating to professional practice, the value and utility of collaboration, the effects of technology, and organizational policies.

### **Educational Data Use**

We use the term *educational data use* to describe the field and its practices broadly. Proponents for educational data use maintain that educators make better decisions when they are better informed about their students. The conventional view is that data leads to information,

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<sup>1</sup> Some readers may be uncomfortable with the import of business terms into education. “Knowledge Management” is a well-established field, now entering its second decade of research. An alternative term, such as “knowledge-based organizational perspective” may be a more palatable, but offer less consistency with the field and its literature.

which leads to knowledge (Knapp et al., 2006). Further, although many forms of data are present in schools, state and federal accountability policies have helped proliferate standardized achievement data (Stecher, Hamilton, & Gonzalez, 2003). While these data have had considerable leverage in how researchers and practitioners commonly perceive data, some findings suggest that not all teachers find these data well-suited to supporting practice (Ingram et al., 2004). Other informative sources may include research-based evidence and programmatic information (Honig & Coburn, 2008), locally-designed assessments (Perie, Marion, & Gong, 2007; Supovitz & Klein, 2003), and educator judgment (Wayman et al., 2007).

Some of the complexity of the field is reflected in its semantic debates, such as the distinction between *data-based* and *data-driven* decision making. Although these terms are non-equivalent, they are also employed inconsistently. Consequently, Knapp et al. (2006) employ the term *data-informed* to acknowledge the influences of values and context in shaping decisions. This further avoids the somewhat oversimplified view of data “driving” decisions. Instead, data may factor in decisions indirectly, such as when creating a sense of awareness or prompting deliberation (Coburn et al., in press). Thus, in their report on the *data-informed district*, Wayman et al. (2007) expand this view to suggest how a district might be data-informed at every level and department, from the classroom up to central office.

Nonetheless, terms like data-based and data-driven continue to persist in common and academic usage, despite their connotations. For this reason, we refer to *educational data use* as a general reference to the field. In this section, we review the literature in relation to five themes: district data use, classroom practices, school-wide data use, the role of leadership, and technology.

*District Data Use*

Refined data practices are only one tool for leveraging student achievement in districts. Many districts implement a variety of programs and initiatives that span numerous schools and goals at once. Accordingly, a variety of data and assessments are beneficial to designing and tracking progress toward long-range or collective goals (Massel, 2001; Perie et al., 2007; Supovitz & Klein, 2003). Examples of programmatic uses may include professional development decisions (Armstrong & Anthes, 2001; Brunner et al., 2005) or improving attendance and recovering drop-outs (Wayman et al., 2007).

Put together, districts are composed of many interrelated and moving parts. Some may be programmatic, while others political or cultural. One model for describing this complexity is the “data-informed district” (Wayman et al., 2007). In such a district, the work of education is integrated and supported at every district level, from the classroom to the school, to the throughout the district. As such, *calibration* activities around data can play a central role to ensuring coherency among these many processes, such as when developing consensus about teaching and learning (Wayman, Midgley, & Stringfield, 2006).

Calibration is seen as one step to building a district-wide, collective sense of direction and procedure (Wayman et al., 2007). This notion is not new. In the presence of collective vision, “to not do [something] is almost incomprehensible to them because it would so contradict their sense of *who they are* and *why they are here*” (Senge, 2005, p. 29). Similarly, Elmore (2003) uses the term *internal accountability* to describe how effective schools have coherent expectations about teaching, learning, and supporting struggling students. Likewise, the literature relating to professional learning communities (DuFour, Eaker, & DuFour, 2005), distributed leadership (Copland, 2003), and high-reliability schools (Stringfield & Datnow, 2002) echoes

these concepts. What the educational data use literature brings to the table, however, is the insight that data can give educators a common language for collaboration (Brunner et al., 2005; Wayman et al., 2006). Without this common language, ideas about practice, student needs, and learning outcomes can be difficult to share or connect.

Equally important, the task of integrating initiatives, routines, and departments district-wide or toward a common purpose is difficult without information technology systems. Such systems help standardize, integrate, and analyze disparate sources of data. Further, they help share information quickly and sensibly. For example, Wayman, Conoly, Gasko, and Stringfield (2008) describe how such systems helped support a district challenged by high rates of student mobility and diverse learning needs. District-wide technologies helped teachers analyze many data together, while also giving them a timely starting point for dealing with new students. Without such technology, bridging the traditional divides between teachers and schools can be much more difficult. Other considerations relating to technology are further discussed later in this review.

### *Classroom Practices*

Teachers find a wide variety of information sources useful to their work. Some are locally-designed and classroom-based, such as grades or portfolios, while others are more standardized, such as those used on a school-wide basis or mandated from outside of the school (Supovitz & Klein, 2003). Additionally, Wayman, Cho, and Johnston (2007) describe how such assessments can be considered as part of a larger picture that includes longitudinal performance, student demographics, anecdotal information, and professional judgment

These various data have many applications and benefits. Many are still emerging, but one important trend involves the use of data formatively (Armstrong & Anthes, 2001; Black & Wiliam, 1998) For instance, data can help educators develop a fuller understanding of the “whole” student (Lachat & Smith, 2005; Supovitz & Klein, 2003; Wayman & Stringfield, 2006). This bolsters responsiveness in teaching and assisting students, such as when setting short-term, intermediate, and long-term goals in schools and classrooms (Perie et al., 2007; Supovitz & Klein, 2003).

Indeed, teachers can use this data to adjust their lessons, adjust student grouping, develop interventions for struggling learners, or communicate with parents (Brunner et al., 2005; Supovitz & Klein, 2003; Wayman et al., 2007; Wayman & Stringfield, 2006). In environments where students may be highly mobile or face particular learning needs, data systems can help teachers pick up where others have left off (Wayman et al., 2008). Further still, data can be used to celebrate student achievement or guide teachers’ professional learning (Supovitz & Klein, 2003; Wayman et al., 2007).

Even so, a number of questions and challenges remain. For instance, many teachers struggle with the challenge of trying to figuring out how to weave data into practice (Ingram et al., 2004; Wayman & Cho, 2008; Wayman et al., 2007). Huberman (1985) describes how teachers find a variety of inputs useful to adjusting and improving their craft, many of which are not assessment based. Similarly, teachers may have first-hand knowledge about student learning that isn’t articulated in any report, but influential and informative nonetheless. These teachers may have a sense for student performance even without explicit data (Supovitz & Klein, 2003).

*School-wide Data Use*

Propagating best practices at the school-wide level entails a variety of social factors, including teachers' values, norms, and expectations around data use. As such, bringing coherence to expectations and routines can help promote the sustainability of school-wide data use (Copland, 2003; Elmore, 2003; Wayman et al., 2007; Wayman et al., 2006). Indeed, findings regarding teachers' acceptance of data have been mixed.

For instance, poorly designed policies may unintentionally provoke a distrust for data among teachers (Ingram et al., 2004; Valli & Buese, 2007). To contrast, effective policies may nurture positive attitudes (Feldman & Tung, 2001; Lachat & Smith, 2005; Supovitz & Klein, 2003; Wayman & Stringfield, 2006). In the positive cases, teachers describe the benefits of having a more robust picture of the "whole student." Adding further complexity, even in schools with regular and effective data practices, this work can be time consuming and difficult to replicate (Supovitz & Klein, 2003). Accordingly, careful thought and technology may be necessary to ensure that teachers are not overburdened by data use (Knapp et al., 2006; Wayman & Stringfield, 2006).

An overarching theoretical explanation for how and why social factors influence school-wide data use is still emerging. For example, developing a shared vision for teaching and learning (Wayman et al., 2007), cultures of inquiry (Copland, 2003; Knapp et al., 2006), and professional learning communities (DuFour et al., 2005) are all indications of this connection between practice and social factors. Thus, a number of insights relating to school administration emerge. For instance, ensuring that access to data is user-friendly and robust, such as via information technology, can positively affect teachers' perceptions about data (Wayman et al., 2008; Wayman & Stringfield, 2006). Similarly, providing teachers with adequate time and

guidance helps foster a meaningful and sustained inquiry (Copland, 2003; Feldman & Tung, 2001; Wayman et al., 2006). What's more, improving data literacy can help bring alignment and improved capacity to school practices (Knapp et al., 2006; Supovitz & Klein, 2003), especially if educators train and collaborate around use of educational technology systems (Wayman & Cho, 2008).

### *Leadership*

Leaders are also important to educational data use. Schools that embrace data use often have committed and engaged leaders, either supporting teachers in data use or using data themselves. This support can take many forms, including fostering distributed leadership models (Copland, 2003), developing consensus regarding teaching and learning (Knapp et al., 2006; Wayman et al., 2007), and supporting collaborative inquiry (Copland, 2003; Knapp et al., 2006; Lachat & Smith, 2005). Indeed, although data can be useful to school management, some administrators may use data on a student-by-student level, monitoring and adjusting programmatic decisions on their behalf (Brunner et al., 2005; Wayman et al., 2007). In addition, other administrators may use data directly with teachers, helping them to analyze data, set learning goals, or plan lessons (Supovitz & Klein, 2003). Further still, other administrators may use data to identify teachers' needs for professional development or prioritize instructional programming (Brunner et al., 2005).

In shepherding the success of data initiatives, school leaders may need to attend to schools' norms, expectations, and routines. For instance, leaders can help guide conversations about teaching and learning and help structure collaborative inquiry (Brunner et al., 2005; Feldman & Tung, 2001; Knapp et al., 2006; Wayman et al., 2007; Wayman et al., 2006).

Similarly, distributed leadership models can help foster the sustainability of data initiatives and cultures of inquiry, especially when there is little turnover of faculty or leadership (Copland, 2003). Finally, leadership capacity can also be influenced by having preparation to analyze and use data effectively (Knapp et al., 2006; Wayman et al., 2007).

### *Technology*

Many technological tools for assessing student progress, storing records, or other personalized student information abound, and districts face a vast array of choices. Until recently, many of the technologies available to districts stood alone. Today, however, data warehousing systems and other ways of creating “one-stop shops” are able to link disparate student information, including assessment, demographic, and anecdotal information. This provides a powerful starting point for educators to process and analyze data. Detailed explanations of these systems and their potential have been conducted elsewhere (Wayman, 2007; Wayman, Stringfield, & Yakimowski, 2004), and the aim of this review is to emphasize the role of technology in changing how educators go about their jobs.

Although a number of data practices may be attempted without the assistance of information technology systems, this is often inadvisable (Wayman et al., 2004). Without effective technology, data use can be burdensome, overwhelming, or difficult to replicate (Lachat & Smith, 2005). This capacity to integrate a broad assortment of data longitudinally and deliver it directly to decision makers is unprecedented, and the resulting affects of technology on districts and schools is still emerging.

Currently, much of the literature has assumed that technology serves more as a tool for removing burdens or increasing productivity. As such, technology is associated with improved

teacher collaboration, better acuity for student needs, and increased efficiency (Wayman et al., 2008; Wayman et al., 2006; Wayman & Stringfield, 2006). Still emerging are ways in which technology can change the very work of education, student-teacher interactions, and school organization. For instance, Wayman et al. (2007) highlights how a data warehouse can help remedy information bottlenecks and silos, while supporting collaborative action and decision making. What's more, advancements in mobile technologies have the potential to change how students interact with content and each other, as well as how teachers deliver interventions or process data about their students (Schuler, 2009).

### *Summary*

In this section, we have reviewed the field of educational data use in terms of three levels of analysis and two forms of support. Although these various categories may seem distinct, it is important to recognize that districts, schools, and classrooms are in fact interrelated. Moreover, we described ways in which effective leadership and technology have been found to unite and support educators throughout these levels. Although districts have many moving parts, formal processes for using data may help align and synchronize these complexities. In schools themselves, data can help set goals, coordinate classroom practices, and leverage school culture. In turn, this can help teachers be more responsive to student needs.

All of these various processes entail coordination and integration. Accordingly, leadership and technology are integral to the success of data initiatives. Leaders help make initiatives sustainable, widespread, and well-focused. Technology helps open up access to valuable information, combining an unprecedented amount of longitudinal and disparate student data. In this way, educators develop shared understandings, a common language, and better ways to work

more collaboratively. In what follows, we introduce and explain some considerations from the field of knowledge management that are particularly relevant to research and practice in educational data use.

### **Knowledge Management**

Knowledge Management (KM) researchers investigate a variety of topics relating to knowledge creation, sharing, and application. This focus makes KM distinct not only from the research educational data use, but also from the research in organizational learning (OL) (Pasteur, Pettit, & van Schagen, 2006). Generally, KM attends to issues of how knowledge at the individual level can be unlocked organizationally; how it flows throughout organizations or is retained as organizational memory; and how it improves performance or innovation. On the other hand, OL attends to the processes by which organizations become self aware, processing and reflecting upon their experiences.

Especially important in KM, and relevant to educational data use, are notions about knowledge itself, and its relationship with individual practice. In what follows, we review a selection of guideposts to the field of knowledge management. Our goal is to provide a sense for how KM may be informative to the conventional wisdom in educational data use.

#### *Knowledge as a Resource*

As much as organizations may be brimming with knowledge, a great portion of that knowledge is often left unused or untapped (Shuppel, Muller-Stewens, & Gomez, 1998). This concern is of central importance to knowledge management. KM's roots are in the resource-

based view of organizational performance, which attends to how certain assets and capabilities help some organizations outperform others.

More specifically, resources help organizations exploit their strengths, remedy their weaknesses, or otherwise be more responsive to changing conditions, and may include physical capital, human capital, or organizational structures (Barney, 1991). Managerial and technical skills may also serve as resources (Mata, Fuerst, & Barney, 2001), and there is evidence that technology can help support organizations in developing external relationships, improving their planning, and supplementing workers' skills (Wade & Hulland, 2004). This highlights the importance of managing organizations in careful ways that unlock and amplify knowledge. Indeed, knowledge is deeply tied to the people that bear, shape, and apply it. Unlike other resources, knowledge often walks out the door at the close of day.

Further, knowledge has unique properties. While its scarcity often makes knowledge valuable, the things that make knowledge valuable also make it easily transmitted (Boisot & Cox, 1999). At the same time, knowledge is not always depleted when given away. For instance, in sharing knowledge, sometimes we sometimes know more than when we first began (Nonaka, Umemoto, & Sasaki, 1998). Accordingly, these dimensions underline the importance of careful knowledge management. Without deliberate consideration, organizations may enact policies that unintentionally limit knowledge application (Brown & Duguid, 1991; Davenport, 2005), even to the point of unintentionally fostering behaviors injurious to organizational performance (Pfeffer & Sutton, 2000, 2006).

*Individual and Organizational Knowledge*

The term *knowledge worker* (Davenport, 2005) helps illustrate KM's unique perspective. Knowledge workers rely heavily on their education, expertise, and real-life experience to get their jobs done. In addition, much of their work may involve professional judgment, intuition, or innovation. In fact, they often know more about their jobs than the people who manage them. Examples may include educators, lawyers, engineers, and those that work in the healthcare or social services.

Moreover, organizational knowledge is the aggregate of individual knowledge and the knowledge that is embedded in collective action (Shuppel et al., 1998). How, then, can organizations better unlock individual knowledge? One piece of this puzzle is organizational structure. Different models of organization are better suited for transmitting different kinds of knowledge than others (Boisot & Cox, 1999). Take, for example, how bureaucracies, clans, and markets all transmit different kinds of knowledge differently. Another factor in organizational management are policies that support the sharing and creation of new knowledge. Knowledge management attends to the individual knowledge and its effective transfer throughout the organization and its practices (Alavi & Leidner, 2001; Nonaka, 1994; Shuppel et al., 1998).

Further, organizational knowledge is more than data to be accessed or stored. It is also dispositional. Its presence influences the incorporation of new knowledge and shapes future decisions or actions throughout the organization (Boisot & Cox, 1999). Equally important is the role of narrative and the social dimensions of knowledge. As narratives are shared, revisited, and combined with experience, this knowledge also shapes how new problems and challenges are resolved (Brown & Duguid, 1991; Carlile, 2002). For example, even water cooler conversations

help promote the organization's accumulated wisdom and reinforce important knowledge about how to get things done (Davenport & Prusak, 1998).

### *Explicit and Tacit Knowledge*

Especially important to this review are the tacit and explicit dimensions of knowledge. This taxonomy, along with others, help provide foundation to the thinking and research in KM (Alavi & Leidner, 2001). Tacit and explicit knowledge can be thought of as complementary sides of the same coin. Explicit knowledge is that knowledge which is easily codified, stored, and transmitted (Nonaka, 1994). Examples include an owner's manual to a product (Alavi & Liedner, 2001) or traditional computer system data (Stenmark, 2000). To contrast, tacit knowledge consists of unarticulated mental models, intuition, and technical skills (Nonaka et al., 1998). Tacit knowledge is a clear, if sometimes difficult to verbalize, sensibility for how to get things done (Nonaka, 1994). Examples include a craftsman's sense for fabricating a product (Nonaka et al., 1998) or a salesperson's finesse for handling a customer (Alavi & Leidner, 2001).

The properties of tacit and explicit knowledge are important, because they speak to the organizational policies and practices that best support knowledge creation and transfer. At times, knowledge may be passed along without changing forms, such as when tacit knowledge is passed along as tacit knowledge. Known as *socialization*, examples include apprenticeships, modeling, and other on the job experiences (Nonaka et al., 1998). In this way, even informal office conversations can communicate subtle, but powerful messages how to get things done (Davenport & Prusak, 1998). At other times, explicit knowledge can be passed along as explicit knowledge. Known as *combination*, this may occur in a telephone conversation, formal meeting, or via accessing computer data (Nonaka, 1994).

The divide between tacit and explicit knowledge, however, can often make the conversion of one into another difficult. *Externalization*, the conversion from tacit to explicit, is the challenging task of attempting to articulate the ineffable (Nonaka, 1994). In such cases, metaphors are particularly valuable. Additionally, dialogue and collective reflection help bring tacit knowledge to the surface (Brown & Duguid, 1991; Nonaka et al., 1998). Conversely, *internalization* is the conversion from explicit to tacit knowledge (Nonaka, 1994). Examples include traditional book-learning or training. Although they may be familiar to many, so are instances in which codified knowledge fails to become a part of everyday practice, despite our having “learned” it. For that matter, depending on the individual, many a cookbook or do-it-yourself manual has failed to produce its promised outcomes.

### *KM's Implications for Organizations*

To sum, effective KM involves amplifying individual expertise, supporting its flow throughout the collective and ensuring its application. The examples below take into account the various dimensions of knowledge and help illustrate a KM perspective to leading and managing organizations.

For example, organizations can redefine what they mean by “real work” to also include informal talk. Davenport and Prusak (1998) describe how simple, informal interactions, such as water cooler conversations, can offer profound opportunities for learning and reflection. Indeed, workplace narratives communicate powerful but subtle messages about work, practice, behavior, and problem-solving (Brown & Duguid, 1991; Nonaka, 1994; Thomas, Sussman, & Henderson, 2001). Policies that take away knowledge workers’ discretion and autonomy may hinder organizational productivity (Davenport, 2005). In fact, Brown and Duguid (1991) describe how

over-scripting decision processes and other interactions can unintentionally stymie an organization's effectiveness and workers' doing what they know is best.

In this sense, professional learning and collaborative events can be seen as a complex churning of tacit and explicit knowledge (Nonaka, 1994; Nonaka et al., 1998; Shuppel et al., 1998). This highlights the need for strategic approaches, and a wide variety of strategies help support the sharing and application of tacit and explicit knowledge (Alavi & Leidner, 2001; Shuppel et al., 1998). For instance, first-hand, audiovisual accounts and case studies can be effective at transferring best practices and unspoken insights (Thomas et al., 2001). Other approaches, such as the rotation of collaborative team members help s institutionalize tacit and explicit knowledge (Davenport & Prusak, 1998; Nonaka et al., 1998).

Although similar, these approaches differ from the conventional view of collaboration. This is more than just sharing work-related tasks or duties. With the right mix of redundant and heterogeneous expertise, collaborative activities become spirals of socialization, combination, externalization, and internalization (Nonaka, 1994; Nonaka et al., 1998; Shuppel et al., 1998). In this way, organizations can find ways to leverage the improvisational sparks that result from formal and informal interactions (Brown & Duguid, 1991).

What's more, organizations must choose their technologies carefully. Effective technologies provide access to stored knowledge, connect experts to their peers, and support knowledge application (Silver, 2000). Nonaka et al. (1998) describes how technologies can attend to both tacit and explicit knowledge. For example, some use novel methods to capture tacit knowledge (Stenmark, 2000), while others externalize it or assist in craft fabrication. Yet other technologies can capture and analyze explicit knowledge, using data to help make instant changes to business practice (Nonaka et al., 1998). Finally, multimedia and other advanced

communication technologies can help capture and share knowledge while also preserving context (Thomas et al., 2001).

Ultimately, the failure to implement effective policies, structures, or technologies can have dire consequences. For instance, the problem of lost knowledge can be seen at the Los Alamos National Laboratory, where high rates of retirement threaten to drain the organization of its bomb and warhead experts (Silver, 2000). A second problem involves sustaining innovation. Thomas et al. (2001) describe how the military has designed policies to rapidly learn from new discoveries and distribute them organizationally. Finally, another persistent problem is ensuring that knowledge becomes action and sound decision making (Pfeffer & Sutton, 2000, 2006). In these cases, the careful and effective use of evidence can help moderate the rule of bias and untested assumptions.

### *Summary*

In this section I have presented some guideposts to understanding knowledge management. A variety of strategies can help support the accumulation and application of knowledge in organizations. Some strategies ensure that knowledge is shared collectively. Others attend to the data-based and experience-based nature of knowledge. Indeed, collaborative events, even informal ones, are a complex churning of tacit and explicit knowledge. As such, they shape decision making, practice, and organizational knowledge. This highlights the importance of effective policies, structures, and technologies in KM. In the subsequent section, I relate how insights in KM can be informative to the research and practices in educational data use.

### **Contributions to Research and Practice**

Although KM and educational data use are not equivalent, KM sheds new light on some of the current questions in educational data use. In what follows, I describe four ways in which KM may serve as a reference discipline for future research and theory building. First, a large step in the right direction may be to rethink and reconceptualize the notion of practice. Resulting from this step are additional insights relating to collaboration, the relationship between technology and organizational practices, and policies relating to measurement.

#### *Rethinking Practice*

One of the persistent challenges in educational data use involves the issue of changing instructional practice. While data may be used for a variety of purposes, some educators find it difficult to translate data seamlessly into precise actions and strategies (Ingram et al., 2004; Supovitz & Klein, 2003; Wayman et al., 2007). The result is a spectrum of uses and frequencies of use. For instance, a simple use of data is regrouping students periodically based upon overall proficiencies. A more intensive approach would target specific skills or objectives, frequently adjusting practice or reshuffling students based upon data. Such responsive approach is often difficult without technology (Wayman et al., 2004).

In some instances, finely tuned and regular data practices may occur only in pockets or sporadically (Wayman et al., 2007). Accordingly, educational researchers have suggested remedies such as better professional development, improved and timely access to data, and committed leadership (Knapp et al., 2006; Supovitz & Klein, 2003; Wayman et al., 2007). In this way, the challenge is assumed to be educators' skill, capacity, or investment. Other factors, however, may also be worthy of consideration.

Until now, little attention has been given to developing a knowledge-oriented view of educator judgment. Such an alternative perspective would acknowledge that professional decisions are tied to both tacit and explicit knowledge (Brown & Duguid, 1991; Davenport, 2005; Nonaka, 1994). Whereas many of the current practices in educational data use focus on explicit data, this knowledge-oriented approach would acknowledge the localized, embedded, and invested nature of knowledge (Carlile, 2002). Specifically, knowledge is often *localized* around certain kinds of problems; knowledge is often *embedded* in the particulars of practice; and knowledge is *invested* in how workers come to esteem their talents and themselves. This observation has implications for understanding how educators problem-solve and apply their craft-knowledge.

In addition, context, experience, and professional relationships can also help shape the emergence of professional practice (Davenport, 2005; Nonaka, 1994). Without attention to these factors, it may be difficult to find practical meaning in data. Brown and Duguid (1991) describe the difference between *becoming* a practitioner versus merely learning *about* the practice. Like other professions, teacher practice and decision making is shaped by these experiential and pragmatic factors (Huberman, 1985; Ingram et al., 2004; Weick & McDaniel, 1989), and what emerges is a contextually-rich, craft-based sense for how to get things done. In turn, this speaks to findings that educators may have difficulty articulating how evidence or research benefit practice (Coburn & Talbert, 2006). In order for researchers in educational data use to better grasp these tacit dimensions of knowledge and practice, ethnographic and other qualitatively-rich methods may be particularly informative.

*Collaboration*

Researchers in educational data use have highlighted how data and collaboration can be mutually supportive. For instance, collaboration helps in the analysis of data, while data can also provide a common language for collaboration (Wayman & Cho, 2008; Wayman et al., 2006; Wayman & Stringfield, 2006). In this way, shared inquiry, collegiality, and data can work in complementary ways (Feldman & Tung, 2001; Knapp et al., 2006). Exactly how collaboration, sharing a common language, and practice interrelate, however, may be more complex than nuanced than might at first appear.

For instance, some findings suggest that “go-to” people for data or assistance can facilitate data initiatives (Armstrong & Anthes, 2001; Feldman & Tung, 2001). Further, Copland (2003) suggests that distributing leadership, such that expertise determines the allocation of authority can also be beneficial. To contrast, findings in KM suggest that knowledge can be difficult to share, even when organizations have the best of intentions. While this may be due to a variety of other factors, it is worth considering that in those cases where knowledge is associated with empowerment or leverage, sharing it freely would seem contrary to one’s best interest (Boisot & Cox, 1999). No doubt, many educators have had anecdotal experiences with school secretaries or department chairs that collaborated only reluctantly, carefully guarding their knowledge and status.

What’s more, while the presence of a common language has been found to benefit teachers (Wayman et al., 2006; Wayman & Stringfield, 2006), it may also be worth examining whether this is true across job functions. For instance, Coburn and Ta lbert (2006) find that differences among job functions and personal experience can affect how educators use and interpret data. This echoes findings in KM that suggest that a common language can strengthen

understandings within communities of practice, such as within particular job functions or professions (Carlile, 2002). These same findings, however, suggest that because knowledge then becomes localized, embedded, and invested within a particular set of experiences or professional world view, this can also limit collaboration across various job functions or sets of experiences.

Take, for example, the new school administrator who has developed a wealth of knowledge, much of it bound to specific grade levels, content areas, or student populations. How does this administrator fare in new settings? How is he or she perceived by the new faculty? Many seasoned educators are familiar with the frictions that come with the new administrator whose values and sense of practice is so different from their own. Worthy of continued investigation then, are questions relating to the right mix of redundancy and heterogeneity of knowledge in collaborative teams (Nonaka, 1994; Nonaka et al., 1998). KM offers a variety of first steps in attending to these matters, including organizational routines that ensure that expertise is rotated and learning experiences are shared.

### *Technology and Organizations*

Although some educational researchers have begun to suggest the importance of knowledge management technology (Petrides & Nodine, 2003; Shear & Gorges, 2008; Thorn, 2001), there has been little attention to the relationship between technology and organizational structures (Wayman & Cho, 2008). Further, more can be done to examine how technology integration can benefit districts, how tacit knowledge can be supported via technology, and how technology can support professional relationships.

The matter of technology integration is an important one. Integrated technologies that facilitate the analysis of disparate longitudinal data, such as data warehouses, may help remedy district divisions or barriers to collaboration (Wayman et al., 2007). Indeed, the research in KM

suggests that technology integration can substantially improve organizational performance (Malone, Yates, & Benjamin, 1987). Whether this integration effect is supported in educational settings has yet to be studied.

What's more, multimodal uses of technology (Kane & Alavi, 2008), where users access information via many systems and many collegial users, have yet to be fully explored in education. Indeed, although some have suggested that "go-to" people for data or assistance can provide much needed support to educators (Armstrong & Anthes, 2001; Feldman & Tung, 2001), Wayman and Cho (2008) suggest that relying upon "go-to" people for school data can produce mixed results. In some cases, they may be overwhelmed by requests for assistance (Lachat & Smith, 2005). As such, it may be worthwhile to continue research in this area, as well as to examine how teachers may function as "go-to" people for their students.

In studying the influence of technology on schools and districts, data use researchers may benefit from new perspectives and methodologies. All too often, "technologies are depicted as implanting or removing skills much as a surgeon would insert a pacemaker or remove a gall bladder" (Barley, 1990). Indeed, much of the educational research has taken an instrumental view of data systems, assuming them to simply replace or speed conventional data practices. Little attention has been given to technology systems as artifacts (Orlikowski & Iacano, 2001). As much as technologies facilitate work, they also influence individuals' world-views, expectations, and approaches to problem-solving. In turn, this can have profound repercussions on organizational structures and relationships (Barley, 1990). As such, how technology gets used, and what consequences it has for organizations, is often an unpredictable result of social interactions (Markus & Robey, 1998). In fact, some organizational changes can be seen as an interaction of technology and policy environments (Davidson & Chismar, 2007).

What will be the face of tomorrow's technologies in education? If they are designed with knowledge and practice in mind, KM may offer some important insights. For instance, today's technologies have come increasingly mobile, user-friendly, and easily integrated into classroom life (Shuler, 2009). This has implications for bringing data closer to the craft of teaching, and ensuring that educators do what they know. It is not far-fetched to imagine advancements that combine analytical power with instant or automatic reminders about things like intervention strategies, needs for differentiation, or previous performance on learning objectives.

At the same time, new technologies may emerge or be combined with these mobile technologies to better support practice-based, tacit knowledge (Alavi & Leidner, 2001; Stenmark, 2000). Moreover, social networking, wiki-style resources, and "intelligent" or "push" technologies that intuitively recommend resources are familiar to many already. Such systems go beyond merely storing and retrieving explicit data, while also avoiding the prodigious task of attempting to externalize embedded, tacit knowledge. The benefits of social interaction (Brown & Duguid, 1991; Davenport & Prusak, 1998), as well as the connection of users based upon their expertise (Alavi & Leidner, 2001; Malone et al., 1987) may benefit educators greatly. Not only would such technologies open the door to the collegial sharing, review, and design of lessons electronically, they may also strengthen professional ties, district vision, and off-line collaboration.

### *Policy, Measurement, and Knowledge*

Current accountability policies are designed around goals, standards, and incentives (Massel, 2001; Stecher et al., 2003), and much of the data currently used in schools has resulted from these policies. Implicitly, this has assumed that schools and teachers are handily knowledgeable about the best ways to use accountability data. Accordingly, a KM view of these

policies takes into account two perspectives. On one hand, more can be done to consider what data are most important to practice, and whether teachers are being provided the right data to adjust practice. On the other hand, new technologies, which offer unprecedented advancements in measurement and analysis, may further change the design of accountability requirements.

Many teachers and administrators may need additional support or find it difficult to weave accountability data into practice (Massel, 2001; Wayman & Cho, 2008), especially when data are perceived as ill-suited to supporting practice (Ingram et al., 2004). On balance, a number of teachers do use standardized accountability data formatively (Armstrong & Anthes, 2001; Brunner et al., 2005; Feldman & Tung, 2001), if sometimes sporadically (Wayman et al., 2007). Accordingly, the conventional response has included professional development and the use of multiple data sources, including but not limited to data from state tests (Knapp et al., 2006; Massel, 2001; Supovitz & Klein, 2003; Wayman & Stringfield, 2006).

A knowledge-oriented approach to measurement can be responsive to these challenges, because it is more directed at contributing to professional practice. Effective measurement practices take into account the core values and mission of the organization, especially as they relate specific processes (Pfeffer & Sutton, 2006). In this way, they support the coaching, learning, and refinement of practices. Further, such policies apply measurements in ways that recognize tacit knowledge and support professional learning (Nonaka et al., 1998). This is especially important, because "what gets measured gets done," and it is in the interest of schooling to ensure that data bring focus to the work of education appropriately (Massel, 2001).

Additionally, new technologies may change even the accountability landscape. Today's technologies now offer the ability to assess students more thoroughly and on more complex sets of skills than ever before (Tucker, 2009). These assessments create dynamic simulations where

students must judge the value of information, plan and conduct experiments, and organize or interpret their results. The amount of data collected about students' performance in these realistic scenarios is unprecedented, and technologies enable them to be analyzed and linked to instruction. Consequently, the "next generation" of technology-enabled assessment may result in more appropriate data for changing educational practice, as well as more dynamic approaches to measurement for accountability purposes that preclude the old-fashioned testing day. Better data, presented in more sensible ways, and related to actionable policies, is an important step to ensuring that individuals have the presence of mind to do what they already know (Gawande, 2007; Sutton & Rao, 2008).

In the end, these potential advancements to accountability policies are effective because they have a more informed view of practitioner knowledge and judgment. Until now, the conventional assumption has been that educators start with data, develop information, and eventually arrive at knowledge (Knapp et al., 2006). To contrast, KM recognizes that knowledge can come first (Tuomi, 1999). From there we determine what information will be needed and what data points will get us to where we want to go.

### **Conclusion**

Knowledge management has the potential to serve as an important reference discipline for future research in educational data use, especially given its robust view of professional judgment and practice. This perspective begins not merely with data, but with the dynamics and qualities of knowledge itself. The distinction between explicit and tacit knowledge sheds light on the different kinds of strategies that best support the sharing, retrieval, and application of organizational knowledge. Further, recognizing the localized, embedded, and invested nature of knowledge helps recast approaches to supporting professional practice. On one hand,

contextually rich experiences, group narratives, and professional values shape what we know and "the way we do our jobs." On the other hand, technology and organizational structures shape the nature of our work and who we depend upon to get our jobs done.

In brief, the next and most fruitful streams of research for educators may be related to collaboration, technology, and organizational policies. What kinds of collaboration are most meaningful to educators or beneficial to schools? How do current technologies shape districts, and how do formal and informal district structures shape their use? How might the emergence of new, dynamic technology-based assessments affect measurement accountability in schools? The kinds of data available today, and the manners in which they are used, are not set in stone.

These and other considerations will contribute greatly to a comprehensive understanding of schools, districts, and the many moving parts that help shape educator practice. Finally, educators and policy makers might be well served to think in terms of innovation, and not merely data. This would give educators permission to try new strategies, report their results, and most importantly, learn from error.

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