Superintendent Conceptions of Institutional Conditions That Impact Teacher Technology Integration

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Abstract

This article describes a study that examined the conceptions of three New Hampshire superintendents as to the institutional conditions they believe impact teachers' ability to integrate technology. Common thinking was found. They agree if integration is to be successful, teachers need a better understanding of how these technologies can be applied in instruction. They believe that multiple levels of leadership are essential, and they see lack of time and the public's hesitation to spend public monies on building teacher capacity as obstacles. (Keywords: technology integration, superintendents, institutional conditions.)

INTRODUCTION

The implementation of computer and telecommunications technologies in schools has long been a national, state, and local educational goal (Glennan & Melmed, 1996; National Task Force on Educational Technology, 1984, as cited in Reiber & Welliver, 1989). American public education has invested dearly in these technologies, wiring buildings and classrooms, and accumulating an impressive computer inventory (Becker, 2000b; Office of Technology Assessment, 1995). This substantial public investment underscores society's expectation that education will successfully integrate technology into the classroom. However, integrating technology into schools and using it in ways that impact student learning is proving more difficult than expected (Scheffler & Logan, 2000, citing Houghton, 1997).

Two pieces of information help inform an understanding of the current state of teacher technology integration in public schools. A snapshot survey by the U.S. Department of Education (National Center for Educational Statistics, Fast Response Survey System, January 1999) revealed that 33% of teachers surveyed self-reported feeling either well (23%) or very well (10%) prepared to teach using technology in their subject area. Fifty-one percent reported feeling "moderately well prepared."

A second indicator is current measurements of teachers' level of technology implementation using Moersch's (1995) LoTi scale. LoTi registers teachers' self-assessed level of technology integration on a scale of 0–6, zero being nonuse. Recent LoTi survey results for New Hampshire teachers (Learning Quest, Inc., 2002, see Figure 1) reveal that 31% of teachers consider their integration skills to be at Level 3 (Infusion) or higher. Nationally, this number is 28%. Level 3 indicates technology use that complements selected instructional activities, is purposefully planned to enrich student learning, and does not merely reproduce written work in digital form. It seems safe to assume that the 33% of teachers who feel either "well" or "very well" prepared to use technology and the 31% of teachers who rate themselves at LoTi Level 3 or higher are one and the same, as it is unlikely that a teacher who does not feel well prepared to integrate technology would then rate their technology use as leaning toward the sophisticated side of the integration continuum.

LoTi Level	0	1	2	3	4A	4B	5	6
National	14%	23%	36%	11%	10%	4%	2%	1%
NH	21%	16%	32%	12%	14%	3%	2%	0%

Figure 1. Levels of Technology Implementation (LoTi)

Viewed through the lens of diffusion theory, these two statistical groups of teachers are the leading edge of the Innovators and Early Adopters (Rogers, 1995, see Figure 2)—and then some. According to diffusion theory, Innovators and Early Adopters are more likely to work to overcome initial obstacles to adoption because they recognize, early on, the inherent positive value of the innovation. Given that these two categories of adopters constitute only 16% of a potential adopting population, these numbers indicate good progress with diffusion into the next large category of potential adopters—the Early Majority.

Although many teachers do feel prepared to use technology, many others do not—or not yet. Sixty-seven percent of teachers do not feel well prepared to utilize technology in their instruction. In New Hampshire, 69% of teachers are distributed across LoTi Levels 0–2. Thirty-two percent reside at LoTi Level 2—poised to adapt—and 21% report non-use at Level 0. Rogers' theory on innovativeness suggests further that these latter groups of potential adopters, who by definition come to innovations late in the game, tend to be more skeptical about innovations, deliberate in their thinking, and downright in their tradition.

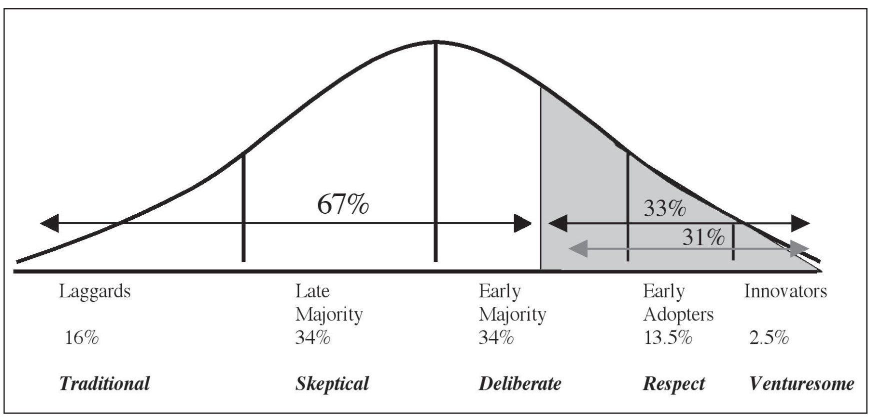

Figure 2: Distribution of adopters over time with innovativeness categories (Rogers, 1995)

Cuban (1986, 2002) reminds us, and rightly so, that many good technologies have failed to penetrate educational instruction and thinking, and that even these new computer and telecommunications-based technologies have been oversold and are underused. A "discrepancy" has been noted "between the level of computer use expected of teachers and its actual use…[and t]he consequence of underutilization is that there may never be the opportunity to realize the expectations for educational computing" (Marcinkiewicz, 1993/94, p. 221). Rogers' (1995) final stage of the *innovation-decision process* (Confirmation) suggests final adoption is never a given. There are always opportunities to reject an innovation.

A great deal of accumulated evidence has identified obstacles that impede teachers' ability to adopt and integrate technology into their teaching. These include the lack of time, expertise, access, resources, and support (Leggett & Persichitte, 1998, as cited in Wilson, Sherry, Dobrovolny, Batty, & Ryder, 2000). However, other recent evidence indicating classroom teachers' lack of integration understanding (Jerald & Orlofsky, 1999, citing Chambers et al., 1999) is most troubling because the integration literature suggests that technology's greatest impact on student learning appears only after teachers have sufficient skills coupled with an understanding of how various technologies can be used as cognitive tools, and are able to weave technology experiences into their daily practice. It is further suggested that this more robust level of understanding comes over time, as teachers have opportunities to practice with the technology and reflect on how these new tools fit in with their current instructional practices and their notions and beliefs about the nature of learning. No small task!

There is a growing consensus that administrative support and leadership are crucial to successful implementation of instructional technologies, and that the importance of this administrative support is often understated (Gibson, 2001; MacNeil & Delafield, 1998; Mims, 1998; Murphy & Gunter, 1997; OTA, 1995). It has been suggested that administrators "do not appear prepared for their emerging role in technology, and their lack of understanding and resources sometimes creates barriers to change and improvement" (Thomas, 1999, p. 3). It has been observed that "in many districts, … superintendents have remained withdrawn from the technology discussions, leaving to staff the leadership roles of planning and implementing technology" (Radlick, 1998, p. 239). This remoteness can have consequences of its own, especially if technology decisions are left to those with more of an interest and expertise in the technology. "The results of such disregard" writes Wasser (1996), are often costly, and could result in the loss of "control of technology decisions to those parts of the system that do not hold a curricular outlook" (p. xlix).

Although there is the occasional study that focuses the spotlight on superintendent thinking, behavior, and leadership (see, for example, Petersen, 1999), there is, overall, little research on the superintendency (Grogan, 2000; Mullen & Keedy, 1998) and less still on superintendents and technology. With an eye on the continued growth and development of teachers' technology skills and understanding, this study inquired into the thinking of three New Hampshire superintendents, asking the questions: (1) What are superintendents' conceptions of the institutional conditions that facilitate or impede the process of teacher technology integration? and (2) How do these conceptions align with the research literature that suggests certain institutional conditions impact teacher technology integration?

CONCEPTUAL FRAMEWORKS

Whole bodies of literature have developed within the context of diffusion theory in response to the difficulty public education is having integrating technology. One strand of literature (Hall & Hord, 1987; Hooper & Reiber, 1995; Marcinkiewicz & Welliver, 1993; Reiber & Welliver, 1989; Rogers, 1995; Sandholtz, Ringstaff, & Dwyer, 1997; Sherry, 1998) suggests several multi-stage models of technology integration that broadly describe the process as a developmental continuum of knowledge, skills, and use, ranging from the naïve to the sophisticated. These models also identify teachers' needs and concerns as they move through various suggested stages. A second strand of research has identified institutional conditions that may facilitate this very integration process by helping to resolve barriers from teachers' experiences (Becker, 1994; Ely, 1990, 1999a, 1999b). Taken together, these strands provide a comprehensive picture of the process teachers go through as they adopt and integrate technology, barriers and concerns that impact their integration, and the conditions that may facilitate that process, were they in place. The picture that emerges speaks to the importance of superintendents themselves having robust conceptions with regards to technology and education, as it is ultimately their decisions and policies as CEO of the district that determines whether technology integration succeeds or fails, district-wide, at the teacher level, where research and common sense suggest it will have the most impact on student learning.

TEACHER TECHNOLOGY INTEGRATION

When teachers actually begin using technology in their instruction they enter the implementation phase suggested in Rogers' (1995) innovation-decision process. Everything up to the point of implementation is characterized strictly as a mental exercise (p. 172), one in which each individual adopter weighs the costs and benefits of various attributes of the innovation in relation to one's existing instructional practice and/or beliefs about the nature of how people learn.

Rogers' theory on the rate of adoption suggests that potential adopters—teachers—will adopt an innovation—technology—over time, in a pattern that is consistent with a standard curve, and that further, each category of adopters, classified by their level of innovativeness, exhibits a propensity to view an innovation in a particular way. (See Figure 1.) Innovators and Early Adopters, for example, tend to need less support and encouragement since they often see the inherent positive attributes of an innovation and how, in this case, its use can impact student learning. Later adopters tend to need more information, more convincing, and greater levels and kinds of support.

Although Rogers' focus was on the innovation and its attributes, the introduction of the Concerns-Based Adoption Model (CBAM) (Hall & Hord, 1987) “brought about a psychological shift from properties of an innovation to the concerns of its users” (Sherry, Billig, Tavalin, & Gibson, 2000, Background section, ¶2); people who have made the decision to engage in the implementation process. Moving beyond the consideration of attributes, CBAM places the individual at the center of the process and characterizes early or beginning users of an innovation as consumed with uncertainty and self-doubt. Gradually, these self-concerns evolve through task-concerns—how will the innovation affect their instructional practices—to impact-concerns—how will the innovation impact student learning?

Rogers’ theories addresses all innovations. Nine percent of the over four thousand studies Rogers’ used in the development of his diffusion theory were about innovations in education. CBAM is specific to the adoption of innovations in education. The remaining models (See Figure 3)—the Apple Classrooms of Tomorrow’s (ACOT) model of instructional evolution (Sandholtz et al., 1997), the model of instructional transformation (Reiber & Welliver, 1989), and Sherry’s learning/adoption trajectory (1998)—are specific to teachers and the implementation of computer-based educational technology innovations.

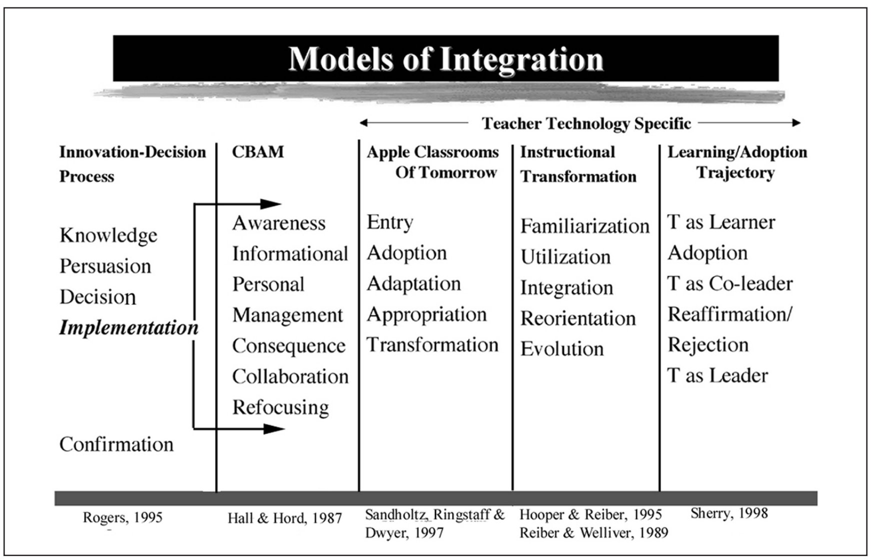

Figure 3: Models of teacher technology integration.

When painted with a broad brush these models suggest a continuum of knowledge and skills that range from naïve to sophisticated. (See Figure 4.) Early or naïve technology use tends to mirror traditional practice, that is, it adheres very closely to, and is compatible with, a teacher’s established style of teaching (Reiber & Welliver, 1989; Salomon & Almog, 1998; Sandholtz et al., 1997). Diffusion theory (Rogers, 1995) views compatibility as a positive attribute of an innovation and as a lure for the use of technology. However, achieving a level of compatible use does not equal integrative success. It has been suggested that compatible use by itself may not be transformative enough of the educational experience to result in positive student learning (Salomon & Almog, 1998; Reiber & Welliver, 1989). The later stages of integration describe a teacher with a more comprehensive definition and understanding of technology, i.e., someone who is flexible and capable of designing daily curricula using various combinations of technologies in combination with a variety of teaching strategies and activities. The power of technology in this vision "is not its potential to replicate existing educational practice, but in its ability to combine idea and product technologies"—i.e., instructional concepts and strategies, and hardware and software—"to encourage students to engage in deeper cognitive activity" (Hooper & Reiber, 1995, p. 9).

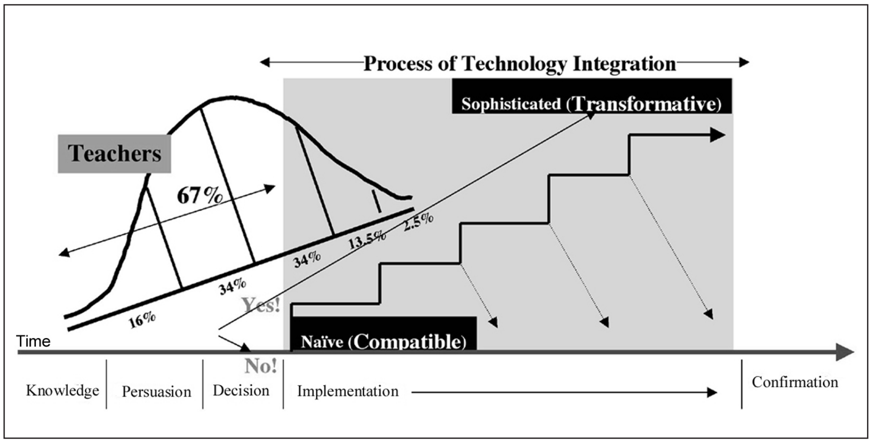

Figure 4: Teacher technology integration process.

The transitional stages between early and later use are crucial. They have been called a "turning point" (Reiber & Welliver, 1989) or a "breakthrough" (Hooper and Reiber, 1995) in the model of instructional transformation, and "less a phase and more a milestone" in the ACOT model of instructional evolution (Sandholtz et al, 1997) "Teachers at this level … have made a choice about instructional delivery that is most appropriately handled by a computer" (Rogers, 1999, p. 6). Marcinkiewicz and Welliver (1993) offer the notion of expendability as a benchmark at this point. "Expendability describes the relationship of computer technology to a teacher's planned instruction—whether or not instruction would be able to continue in the hypothetical event of, say, the absence of computer technology" (p. 2). At this stage one becomes more dependent on things outside of one's control such as the ability of the district to offer access to technology, support services, and guarantee its reliability—in other words, institutional conditions.

INSTITUTIONAL CONDITIONS

Traditionally, researchers have identified barriers that impede teachers' adoption of technology (Evans-Andris, 1995). The basic argument for identifying "resistance factors that thwart diffusion and implementation efforts" has been "if we knew what types of resistance exist, perhaps we could design strategies to combat them" (Ely, 1999a, p. 24). Ely reframed the picture. Rather than identifying more, or the same, obstacles, Ely looked at a variety of sites where implementation had already been successful and identified emerging themes in the environment that were common to all. In doing so, his question became: "where innovations have been adopted and implemented, what [are] the conditions that appear[ed] to facilitate the process?" (p. 24). Ely's research (1990a, 1990b, 1999a, 1999b) has identified eight such conditions that were present across multiple sites. They are, as Ely himself suggests, in no particular order: availability of resources, dissatisfaction with the status quo, existence of knowledge and skills, availability of time, rewards or incentives, participation, commitment, and leadership.

Technology integration requires individual as well as systemic change. In order for change to come about, Ely suggests there must first be a reason or a desire for change—a desire that is driven by someone's dissatisfaction with the status quo. This dissatisfaction may come from any corner of the community.

On a most basic level, if districts expect teachers and students to adopt technology as a core instructional tool, then clearly access to availability of instructional technology resources is not a condition, but a precondition. Without them, there is no chance of success. However, having them is no guarantee of success either. Ely's (1999b) broad definition of resources as those "things that are required to make implementation work" (p. 4) implies the inclusion of hardware, software, and the "peopleware" (Ronnkvist et al., 2000, p. 5) that deliver technical and instructional technology support.

Prime among the conditions for successful integration must be the presence of knowledge and skills. Ely simply states the obvious. "The people who will ultimately implement an innovation must possess sufficient knowledge and skills to do the job" (Ely, 1990a, p. 300). Placing aside the question of whether it is now the responsibility of districts to educate teachers as well as students, the issue of ensuring that teachers possess sufficient knowledge and skills speaks to the need for professional development, instructional technology support, and other opportunities that would help teachers increase their skills and understanding. In this regard, Ely suggests the presence of a system of rewards and incentives—incentives to move individuals to action and rewards for participation (1999a, p. 25)—can be a contributing factor in encouraging more teachers to enter the integration process and participate in the professional development.

The lack of time has consistently been cited as an obstacle to integration. The time Ely refers to is time for teachers to participate in these professional development offerings, time to practice new skills, time to plan, and time to reflect on how these new skills can be integrated into their current practices. It is clear he means contractual time, i.e., "company time, paid time arranged for by the organization where the innovation will be implemented" (1999b, p. 4). It is important to acknowledge that Ely recognizes that individuals must also be willing to contribute some of their own personal time to the process (1999a, p. 25).

Ely (1990a, citing Fullan, 1985) suggests that in order for an implementation to have any ring of "fidelity and enthusiasm," the people most affected by the innovation must have a voice in the decision making process. Being encouraged to participate could be interpreted as one sign of commitment by an administration wishing to see successful implementation. The presence or strength of commitment, as Ely (1999a) suggests, "is measured by the perceptions of the implementers rather than public acknowledgement of policy" (p. 25). In other words, it is the teachers who will decide whether there is administrative commitment behind a push for integration. If teachers perceive that their needs are being met they will believe there is true commitment. All of which comes down to leadership. Ely speaks of a two-pronged conception of leadership: one at the executive level of the organization that creates a culture that cultivates the innovation, and the other at the day-to-day level of project management. In this sense, "successful programs do not just happen, they are orchestrated" (Bauder, 1993, p. 29).

The matrix in Figure 5 illustrates the linkages between the conditions as acknowledged by Ely (1999b) himself. He suggests there is no emerging hierarchy to these conditions. "The relative strength and importance of each condition, when considered together, has not been determined" (p. 8). He suggests that their importance emerges as a function of the context and the innovation. Although most of these conditions are interrelated, leadership is related to the most.

Ely's conditions have been used as a framework in numerous studies on the implementation of various innovations in varying educational contexts (See Bauder, 1993; Ellsworth, 1998; Haryono, 1990; Jeffrey, 1993; Marovitz, 1994; Ravitz, 1999; Read, 1996; Riley, 1997; Stein, 1996). Ely (1999a, 1999b) also reports considerable corroborative qualitative evidence across a broad range of educational cultures that support these conditions as well. It has been suggested that these conditions may serve as a potential roadmap to facilitate integration by providing useful guidance to those responsible for technology adoption in schools (Wilson et al, 2000).

Becker (1994, 2000a, 2000b) also considered institutional conditions. His question was "How does the teaching environment of exemplary computer-using teachers differ from the teaching environment of other computer-using teachers in the same subject?" This research found that these schools have both technology and pedagogic support, a full-time technology coordinator, teachers with an above average level of technology expertise, as well as formal staff development, access to computer resources, time, and authentic or consequential use

Conditions	Dissatisfaction	Knowledge	Resources	Time	Rewards & Incentives	Participation	Commitment	Leadership
Dissatisfaction								x
Knowledge			x		x		x	x
Resources available					x		x	x
Time is available					x	x	x	x
Rewards&Incentives	x		x	x		x		
Participation		x		x	x		x	
Commitment			x	x	x			
Leadership			x	x	x	x	x	

Figure 5. Conditional linkages as identified by Ely (1999b).

of technology. Exemplary technology-using teachers tend to work in schools that invest heavily in building teachers' knowledge and skill level.

Becker (2000a) cites early ACOT research as suggesting "that inexperience was the main impediment to exemplary use of computers" and that time "was the main ingredient to improving teachers computer use" (p. 1). If the major difference between exemplary and typical computer-using teachers is simply more years of experience using computers in their teaching, then, as Becker says, "we can all relax because we know that eventually better practices will diffuse to more teachers" (1994, p. 292). If however, the major difference between the two is organizational, that is, exemplary teachers receive support from their building and district administrators, "then the development of additional expertise among computer-using teachers is something that administration and policy can influence" (p. 1). Becker goes on to suggest it is unclear whether exemplary technology-using teachers are exemplary because they "believe far more strongly than do typical teachers in organizing classrooms around exploration and discovery-based learning" (1994, p. 292). Becker's own more recent research (2000b) suggests that this is the case. Computer using teachers "are distinctly more constructivist than non-using teachers" (p. 12), which further suggests the need for an institutional response to make time and opportunities available for teachers to learn new knowledge and skills, practice and gain confidence in these new skills, and reflect on how this new information integrates with their already held conceptions.

The superintendent's role and requisite skill set in systemic technology integration is just emerging (Reitz, 2000; TSSA Collaborative, 2001). It has been suggested that "the people who make decisions about policies and finances in schools have little or no training in educational technology and few resources to make informed decisions. School administrators do not appear to be prepared for their emerging role in technology, and their lack of understanding and resources sometimes creates barriers to change and improvement" (Thomas, 1999, p. 3). Regardless of whether school administrators are prepared, as Thomas suggests, they are nevertheless "still faced with the increased responsibilities of infusing technology into the schools under their charge" (Schoeny et al., 1999, p. 2).

METHODOLOGY

Superintendents clearly have a key role to play in facilitating technology integration, as it is the policies that flow from their decisions that creates the community's culture. The implications their conceptions have on the policies that create the institutional conditions and structures in which teachers work are substantial. It was for these reasons that superintendents were chosen as the unit of study. This inquiry was a multiple case study of three superintendents intent on beginning to understand superintendent thinking with regards to the conditions they believe teachers need in order to be effective users of technology.

Sample selection and description

Merriam (1991) suggests that if one is interested in understanding or gaining insight into a particular issue, "one needs to select a sample from which one can learn the most" (p. 48). For precisely this reason, this study chose a purposeful sample of superintendents recommended by an informant from the New Hampshire State Department of Education for their grasp of technology integration issues and their potential to offer insight into understanding systemic technology integration, not because their districts exhibited exemplary practices. Fifteen superintendents divided into two tiers were recommended. The first tier of five were particularly singled out for their grasp of technology issues. The second tier of ten were to serve as backup. The three cases in this study all came from the first tier of five recommended superintendents.

The sample consisted of two women and one man: Roberta, Natalie, and Matthew. All were Caucasian. Natalie has a doctoral degree in special education. Roberta and Natalie both hold Certificates of Advanced Graduate Study (CAGS), which is the minimum state educational requirement to be a superintendent in New Hampshire. All but one attended public schools through high school. All have been in their current district for at least fifteen, and in two cases more than twenty, years. All were new to the superintendency within eighteen months prior to the time of this study (2002), and were educated before computer-based technologies were a concern to education. They have all worked their way up through various administrative positions from principal to assistant superintendent to superintendent. They have all witnessed the growth of computers and telecommunications technologies in education, and have been instrumental, if not pivotal, in shaping how technology is organized and delivered in their respective districts.

Roberta (Borough Park, NH) believes that technology is a core value in the future of the enterprise, admitting that "frankly, we'd be lost without it." She sees technology as a possible way to reinvigorate education, to more deeply engage students with their teachers in the content, and sees technology as facilitating the "independence" piece of helping students to become independent lifelong learners. Above all else, she believes that technology must bring something to the teaching and learning process, otherwise it is a waste of time.

Natalie admits to having a clear conception of the culture a successful learning environment requires in a traditional setting using traditional tools. Many of the conditions she believes are important for good schooling without technology are equally good with technology. She appreciates the amount of knowledge and level of skill and comfort teachers must have in order to be effective users of technology, and realizes they are not there yet. Natalie has her reservations about the value technology brings to a traditional education.

Matthew (Sheepshead Bay, NH) views technology as a vehicle that enables other things to happen. He believes teachers are paid to use their judgment as to how best to teach. If they are to use this judgment with regards to integrating technology, he suggests, then they must be clear in their understanding of technology on many levels. He believes teachers have the responsibility to be informed and competent, and the district has the responsibility to ensure the technology is capable of allowing teachers to do what the administration expects of them. He has concerns about the districts integration efforts, and sees where students have the tendency to embrace technology, teachers are uneasy and hesitant.

The student population sizes of these three districts ranged between fifteen hundred and five thousand students. The districts all had one middle and one high school. The number of elementary schools in each district ranged from two to nine. Total annual school budgets ranged from 12 million to 46 million dollars.

Data Collection and Analysis

This inquiry was designed around a four-phase protocol, which was applied to each case. The two early phases concentrated on data collection for the purpose of constructing a sufficient understanding of how the district organized its technology resources in order to engage in an informed conversation with the superintendent. Using a combination of interview, observation, and document data, this study began by gathering information about how these three districts organized, managed, and delivered their technology resources and services. This non-superintendent interview data consisted of three to four hours of both face-to-face and telephone conversations with a wide variety of personnel. In one district, this included the technology coordinator and one technology teacher. In another, the list of interviewees included the director of library services and the high school principal. From these interviews, coupled with two half-day observations conducted mostly in computer labs, a detailed descriptive technology profile emerged for each district, constructed around three questions that school districts confront as they integrate technology: (1) How does the district address the many issues of infrastructure, technology management, maintenance, and support? (2) How has the district organized its resources to address teaching technology skills to students? And, (3) how has the district organized its resources to facilitate the acquisition and integration of technology knowledge and skills by their teachers? Each technology profile grew richer as more data were gathered.

Document data in this study—which included the district's technology plan, filed and approved by the New Hampshire Department of Education; technology grant applications; online materials from the district's own Web site; documents collected during observations, including student assignment handouts, as well as demographic information from the state's Department of Education Web site (www.measuredprogress.org/nhprofile/)—were primarily used in the construction of the technology profiles. This early data helped triangulate and substantiate later superintendent interview data. Field notes were descriptive and reflective, and contained information gathered through informal conversations with technology personnel, librarians, and classroom teachers during observations. These informal teacher conversations took place in the computer lab while their students were engaged with the technology teacher. In one district this included the former technology coordinator who had since gone back to the classroom.

Superintendent interviews followed a semi-structured protocol, consisting of two sessions lasting between sixty and ninety minutes each. Questions for the superintendent interviews were informed by the literature on institutional conditions and the individual context reflected in the technology profile. All interviews (superintendents and others) were audio taped and transcribed. Transcripts of superintendent interviews were sent to each subject to allow them to check for accuracy and/ or clarification. No changes or clarifications were suggested.

Data collection and data analysis were overlapping simultaneous processes (Merriam, 1991). In the early study phases, data collection and data analysis resulted in each district's individual technology profile. In the later phases, superintendent interviews were descriptively summarized and coded by broad topics such as professional development, resources, infrastructure, and time, for example. Much of the superintendent thinking seemed to naturally cluster around Ely's (1990a, 1999a, 1999b) conditional headings. The findings were grouped and discussed under these conditional headings. Doing so created less terminology clutter, thereby aiding the broader integration discussion. Wilson et al. (2000) have suggested that many conditional research studies can be made to fit Ely's framework quite comfortably. Some of the detailed descriptive findings in this study also lend operational clarity to Ely's conditional categories, some of which Ely himself has suggested may be a bit ambiguous.

FINDINGS

This study found that the thinking of this purposeful sample of three "technology-informed" New Hampshire superintendents conforms rather well to the institutional conditions suggested in the research literature. Topping their conceptions were leadership, knowledge and skills, and time. In addition, they see lack of time and the public's hesitation to spend public monies on building teacher capacity as obstacles.

Multiple Levels of Leadership

To a person, these three superintendents believe that three levels of leadership are essential to successful technology integration, including their own involvement, principal and administrative leadership, and effective technology leadership This suggests a leadership requirement beyond Ely's two-pronged suggestion. For their part, they believe that a clearly defined and articulated technology message, coming from them, understood by their administrative team, and used to build broad community and school board support, is necessary to secure funding, goodwill, and buy-in. However, they have not all crafted a clearly defined and articulate message because they are not all convinced of the value technology adds to a traditional education. Natalie commented, "We don't know yet what value it adds to [a] traditional education. To the reading. Writing. The traditional skills. We're making assumptions that it can enhance them." She does however, remain open to the possibility that it might, and has exhibited a commitment and a willingness to try new technology initiatives when they make good sense to her.

The type and level of superintendent involvement across the three cases varied. Examples included active participation on the district's technology committee—often as chair (Roberta); engagement in active discussions with technology personnel to smooth out and clarify lines of responsibility, authority, and overlapping interests (Natalie); the creation of site-based technology committees to ensure active engagement by principals (Matthew); redefinition of technology teacher positions and the creation of technology curriculum coordinator positions (Roberta); the use of the persuasive power of the superintendency to help a technology coordinator evolve middle school reading specialists into full-time technology integrators and to infuse the district Tech Ed faculty with technology skills (Natalie); assisting in the establishment of free evening technology classes for adults (Roberta)—an initiative Roberta admits was "probably the best thing that we have done to get technology support in our district"; facilitating a project that has middle school students teaching e-mail technology to senior citizens (Roberta); and actively engaging other locally-elected civic boards into the district technology discussion to build broader community support (Matthew).

All three superintendents have demonstrated the depth of their commitment to successful integration by their willingness to use the office of the superintendency to make substantive changes in organizational and teaching structures to better accommodate the integration of technology. Natalie, for example, exerted pressure on her middle school reading specialists to implement her technology coordinator's idea of teaching the specialists technology skills and expanding their instructional role to include teaching the technology curriculum as an integral member of the grade-level team. In another example, Roberta persuaded her school board to ensure that the district's new elementary technology teacher position and program were configured in a way that she believed was more likely to enhance a teacher's level of technology skill and understanding.

These superintendents believe there can be no effective system-wide integration without the direct involvement and leadership of the building principal. Although they believe it is their responsibility to ensure that their principals understand and implement the vision, they expect their principals to take the lead in ensuring that all teachers in their building work towards adopting technology. In two cases, the superintendents encouraged their principals to make sure that their teachers included technology goals in their individual professional development plans. In another case, recognizing that the district technology committee recommendations did not match what principals were saying they really wanted led one superintendent (Matthew) to create site-based, principal-led technology committees to better ensure their participation, buy-in, and ownership. This in turn led to greater principal participation on the district technology committee.

Lastly, these superintendents all believe there must be some form of oversight and management of the district's technology resources and efforts, both technological and instructional. There is surprisingly wide variance, given the sample size of three, in how these districts have organized their technology resources. There is no emerging pattern of preferred oversight or organization. How this leadership component plays out varies and is often determined by the local context. No two districts define the position of technology coordinator in the same way. In fact, not every district had a person or position responsible for technology management and oversight. In Natalie's district, for example, the technology coordinator sits squarely in charge of all aspects of both the district's technology infrastructure and instruction, where decisions are the result of one-on-one superintendent-to-technology coordinator conversations. In Roberta's district the responsibilities are split. There is a technology coordinator who oversees the technology and chairs the district technology committee, and an elementary technology teacher/technology curriculum coordinator who oversees and coordinates curriculum integration of technology for grades K–8. Technology decisions in this district are the result of active engagement in the district's technology committee across all levels of the district's educational community. Matthew's district had no technology management piece in place at the time of the study. He acknowledged this as an issue and was leaning towards hiring both a network administrator and a director of technology. In this district, each building-level technology teacher was responsible for the maintenance and repair of the hardware, software, and infrastructure in their building, either through their own ability or an outsourced vendor—in addition to a full schedule of teaching responsibilities.

Knowledge and Skills

These superintendents agree that teachers need greater technology skill and understanding than they presently have, and that no learning outcomes of any consequence will be seen as a result of teachers' use of technology until teachers have more experience and attain a greater personal level of comfort, confidence, and skill. They believe that addressing this deficit is important, and that it requires their attention and personal involvement.

In the superintendent thinking reflected here, professional development is an important, if not critical, component of their district's integration strategy. Access to professional development—technology-oriented and not—in each district is wide and varied, employing a broad range of traditional strategies to accommodate the diversity of adult learning styles. These include both after-school workshops and hands-on summer institutes. Although professional development is often touted as the most promising avenue to address this deficit of knowledge and skills, if not "the single most influential contributor to computer integration in classroom practice," as Reinen and Plomp (1993) suggest, all three superintendents agree that professional development, by itself, at least in its current form, is not sufficient to ensure success. They believe that in concert with professional development, classroom teachers need more opportunities that offer regular contact with the technology itself and with someone who has greater knowledge, experience, and expertise in teaching with technology than they do. Although they are not all sure how to accomplish this, this study gives some indication of the extent to which some superintendents are willing to go to address this knowledge deficit—approaches that involve both grade-level, and in some cases, district-wide organizational and teaching structural changes.

For example, Natalie, the same superintendent who was the most unconvinced of technology's impact on traditional skills, believes the best hope for technology lies in its use as an asynchronous tool for communication that allows teachers to engage and collaborate with one another within a building and across the district. Encouraging online discussion amongst teachers in study groups is a core feature of her district's professional development strategy. One poignant episode had a particular hand in convincing Natalie of the potential of online asynchronous discussion as a tool for engaging teachers in serious communication and conversation. On an electronic bulletin board, which the technology coordinator set up without her permission and which teachers primarily used as a vehicle for swapping or selling personal items, one teacher posted a request for information concerning her mother's degenerative progression of Alzheimer's disease. This posting prompted a flood of support from teachers and administrators throughout the district who had been through similar ordeals. Natalie realized that online communication had real potential for adding value to the educational enterprise. The question she now asks is "how do we get that kind of communication around reading?" It was this experience that led to the integration of asynchronous online communication as an integral component of the district's professional development strategy. In addition, she allowed two high school classes to experiment with the use of online communication. Her technology coordinator has characterized the level of online discussion as slowly evolving from one of information exchange to a bona fide platform for discussion, conversation, and dialogue.

Time

In searching for ways to create various opportunities for classroom teachers to have regular contact with technology and technology expertise, superintendents run up against the constraints of time. Professional development and other opportunities both require time—and the time they require is often in conflict with other, equally worthwhile, uses for that same time. However, not only is professional development by itself not sufficient, but time by itself is also not sufficient to ensure integrative success. How the precious commodity of time is used may be more important.

When it comes to considering various strategies for fostering greater teacher technology skill and understanding, all three superintendents distinguish between a teachers' own time and contractual time. Ely (1990a, 1999a, 1999b) speaks of the need for contractual time, and so do they. The notion of needing more contractual days for teachers without students was mentioned more than once by these superintendents. Matthew views professional development as part of the district's responsibility, suggesting that one cannot expect teachers to learn technology by themselves on their own time. His district has three full days of professional development time set aside and recently requested, and received approval for, an extra four half-days. When parents got wind of the new request, they forced the school board to renege on its commitment.

Roberta's district currently has eight contractual days throughout the school year for professional development, some of which are taken up by what she refers to as "administrivia." She believes that, in the ideal, the district would be well served by twenty extra contractual days without students as a way to ensure that teachers are engaged. However, short of actually having twenty extra days, Roberta offers one solution that uses teacher contractual time in a way that directly links teachers to the technology knowledge, skills, and expertise they need. When Roberta had the opportunity to establish an elementary technology program and hire an elementary technology teacher, she believed that in this new arrangement, it would be important for classroom teachers to remain with their students in the computer lab as a way to both expose them to the technology on a regular basis and to increase their individual skills and understanding. In what was both a political and an instructional victory, Roberta established a co-teaching dynamic in the computer lab between the elementary classroom teacher and the elementary technology teacher.

"It was clear to me that we needed somebody at the elementary level. But it was [also] clear to me that we didn't simply need that person for the students. If we really want to bring about using technology as a seamless tool we had to have the classroom teacher in there with the students, otherwise they would be dropping [them] off as they do for gym, PE, and art, saying, 'This is my time off. You do your technology magic with them and I'll pick them up in 45 minutes.' In that model we're missing the teacher. We're missing the team-teaching that the classroom teacher and the technology teacher can be doing. That's not fair to the technology teacher, number one. And it's not fair to the students. And the classroom teacher doesn't gain by it other than the time. They don't gain knowledge."

In the other districts in this study, it was customary practice for teachers to drop their students off at the computer lab, much like many do for music, art, or physical education. In exchange, the teachers received a contractually negotiated professional planning period. It is easy to see how the establishment of a technology curriculum, creation of computer labs, and the creation and hiring of a technology teacher position in exchange for teacher professional time was viewed as an all around win by the superintendent, principals, school board, and teachers. The district created a technology curriculum, the schools got new computer labs, the students received the technology skills society and their parents expect they will need to have in order to succeed, and teachers got their time. However, the opportunity to use the precious commodity of time in ways that encourage this co-teaching dynamic to further teacher technology understanding is lost. Finding more time to create other avenues or workarounds for these needed opportunities is difficult and challenging even under the best of circumstances.

Matthew's district is a good potential example of this workaround problem. In his district, there is an overlap in the technology knowledge base and skill set between the district's librarians and technology teachers, which has resulted in a history of tension between the two camps. Library research skills inevitably overlap with technology instruction, as basic information technology skills are a prerequisite to engaging in modern library research. However, the real contention has to do with how the library/media positions have been defined. For example, librarians do not have a fixed schedule of classes. Their time, unlike that of the technology teachers, is their own. If a teacher wants a class to engage in library research, they contact the librarian and set up a time. The instruction is led by the librarian, with the classroom teacher remaining as a partner in instruction. The technology teachers, the K–8 technology coordinator, and the superintendent all consider this to be the ideal model for technology instruction and have contemplated reconfiguring the technology teacher's position to more closely resemble this. However, they also all agree that if this were the case, there would no longer be the current guarantee that all students would receive technology instruction. In this scenario, only those students whose teachers are interested in using technology will actually be given computer instruction. As a workaround, this could cause more problems (e.g., inequity of technology instruction) than it solves.

In the end, it took Roberta two years of advocating her vision to the district's administrative council and school board before her notion of pairing the classroom teacher and technology teacher was finally established. At one point, she went so far as to remove the discussion from the table for fear the school board was headed in a different direction. In the end, through negotiations between the middle school and elementary principals, the contractual teacher planning time was found another way, and all elementary classroom teachers were required to remain with their students in the lab. Using time in this way satisfies a variety of conditions. For one, it solves the time dilemma. It places teachers in the position of having more regular contact with the technology itself, observing another teacher modeling technology use in practice, and having opportunities to learn the technology right alongside their students, if need be. In addition, teachers are available to assist their students, offering them another opportunity to interact directly with the content while emphasizing and strengthening the academic purpose of the technology use. It also offers teachers opportunities to improve their own understanding by engaging in professional discussions and planning activities with the technology teacher.

There is evidence in this district, in the form of informal teacher conversations held during observation, that when time is used in this way, teachers are learning new skills and gaining confidence and knowledge. The middle school technology teacher related a story of one sixth grade teacher who, for the first two years of bringing her students to the computer lab, used technology projects that had previously been designed by the technology teachers with, and for other sixth grade teachers. This year, however, she felt comfortable and confident enough to come with her own ideas and together they worked out a plan incorporating those ideas into the students' projects. A fourth grade classroom teacher credits technology with changing the way she teaches. Now, when she brings her students down to the computer lab it is not to learn computer skills but rather, as she says, "It's science!" She has organized her instruction to use the computer lab to teach parts of her science curriculum.

External Conditions that Impede Integration

These superintendents view the public's hesitation to spend public money on building teachers' technology capacity, i.e., building teachers knowledge and skills, as an obstacle. It was evident from the technology profiles that the lion's share of the technology resources in these districts has gone towards creating and managing infrastructure (technical and instructional) in the service of offering access and a coherent technology curriculum to students. However, there is a hint in the stories of these superintendents that placing computer technology into the hands of students before teachers was not always the intended plan. In fact, each superintendent had a story to tell and a lesson learned about how the tax-paying public expects public money to be spent. Based on their early administrative experiences and observations, it became clear that using public money that would place technology directly into the hands of teachers, especially if they are also able to use this technology for personal, i.e., home, use, before placing it into the hands of students was, and remains, a touchy political proposition. The public seems more comfortable placing technology into the hands of students before—and perhaps at the expense of—teachers learning how to use it (Rhodes, 1998). It has proven easier, over the years, to obtain funding to build computer labs and hire technology teachers for students than to build teacher technology capacity. Addressing teacher technology skills and understanding still remains a crucial issue to be confronted.

DISCUSSION

When painted with a broad brush, the literature on integration suggests that little impact on student learning will be evident unless and until teachers evolve a clear and comprehensive understanding of technology and its role in instruction. This is nothing less than one would expect of any teacher using any other instructional tool.

The models of technology integration discussed earlier suggest that in order to learn how to effectively think about and use technology, teachers go through a process that is essentially progressive in nature, where progress is dependent on skill and understanding, and that each level of progress poses unique challenges to the individual as well as to the system—that is, the school district. The implications of recognizing that different groups of adopters are at varying levels of use and understanding implies a systemic response that is comprehensive, multi-leveled, and able to support beginning and exemplary technology-using teachers alike. This calls district leadership to the task of creating conditions that facilitate the process that may lead teachers to a more robust technology conception.

Interestingly, the technology profiles constructed for this study suggest that these districts' technology resources are not necessarily organized to facilitate technology integration for teachers. They seem organized to better create, implement, and support a coherent curriculum of technology skills for students. However, if the goal of technology in education is to positively impact student learning and achievement, then as the literature on integration suggests, teachers must achieve a clear and comprehensive understanding of, and facility with, the many faces of technology. If effective use is a function of a sophisticated understanding, then addressing the conditions that facilitate the process that fosters that sophisticated understanding becomes important. And it is the superintendent's decisions, and the policies that flow from those decisions, that creates the conditions within which teachers work—at the district level. At the same time, these superintendents have learned over time that the public doesn't always have much interest, or patience, in spending public money to build teacher capacity, whether it be purchasing computers to put directly into teachers' hands or trying to build more contractual professional time without students into the school year.

Radlick (1998) offers the closest suggestion to a "typology" of superintendent approaches to technology—the ideal, the technology-avoiding or technology-reluctant, and the "heat-seeker." The latter is most interested in the cachet that technology can bring and views technology as a way to enhance their legacy of leadership in the short term. This can be damaging to technology credibility and long-term success. The technology-reluctant superintendent is hesitant to be proactive for fear of making a fatal career decision. The "ideal" presupposes a superintendent with a solid understanding of the many issues surrounding technology and education, who understands its pros and cons, views it as a tool, and is capable of viewing it critically, as one would any education solution.

The purposeful sample of three New Hampshire school superintendents highlighted in this study reflects, but to varying degrees, the ideals of the ideal. They exhibit leadership behaviors that attempt to resolve the constraints and complexities of the local context and work to solve teachers' technology knowledge deficit. They recognize this as an issue, and one that they must address directly if they are to see technology positively impact student learning. Driven by their dissatisfaction with teachers' current level of technology implementation and the shared conception that having a separate technology curriculum in the upper grades is a waste of valuable resources, these superintendents have all reexamined the use and purpose of existing technology structural elements (instructional and technical) in their districts, decided it was important to institute changes that better accommodate the innovation, and realized that doing so required their personal involvement. Two districts required superintendent intervention in instituting structural changes. The third superintendent recognized the potential need to revisit earlier contractual agreements, most notably with regards to the use of computer time in exchange for a professional planning period.

Many of the behaviors and thoughts reflected by these "technology-informed" New Hampshire superintendents are similar to Petersen's (1999) research on the behaviors of five California superintendents identified as instructional leaders. Petersen identified professional development, opportunities for shared decision making, expecting the leadership and involvement of building principals, building school board support, the hiring, transfer and/or replacement of personnel (structural and position changes), and personal responsibility and involvement in the form of crafting a vision, taking risks, and articulating the vision around the district as behaviors of instructional leaders. Similarly, the actions of the superintendents in this study also exhibited personal involvement, risk taking that required using the power of the superintendency to restructure the organization, reconfigure old positions, and hire and define new positions and programs to realize a vision, articulation of that vision, and commitment to it through shared decision-making opportunities, the building community and school board support, and the expectation of engagement and active leadership by building principals to help implement the innovation and vision. Technology intgration is essentially asking district leaders to be nothing less than instructional leaders with a comprehensive understanding of technology as an instructional tool.

Although it is clearly possible to be an instructional leader of curriculum and instruction without technology, it is more difficult to be a technology leader without being an instructional leader and not fall into Radlick's "heat-seeker" characterization. This also brings to mind Wasser's (1996) caution about the possibility of superintendent disengagement bringing about the loss of technology's curricula focus. If technology's effectiveness lies in its use as an instructional tool, it should come as no surprise to realize that behavior that creates conditions that facilitate the embedding of this instructional tool into curriculum and instruction would be similar to instructional leadership behavior that creates conditions that promotes curriculum and instruction without technology. This is particularly true in the case of one superintendent (Natalie) who held the belief that many of the conditions that are important for good schooling without technology are equally good for schooling with technology.

Superintendents must find it in their conceptions to make technology a tool to enhance the curriculum and to allocate resources that help teachers in areas that are directly connected to student learning. Strategic application or misplacement of limited resources could make or break a facilitative environment. If education is to have meaningful proof of a wise and effective investment in technology, district leaders must develop robust conceptions of technology in education. This becomes paramount as chief school officers "struggle with being behind rather than at the leading edge of school reform across the country" (Petersen, 1999, Introduction section, ¶1). Ely's conditions may have a central role to play, serving as a broad roadmap that helps focus superintendent attention on the needs and concerns of teachers in ways that create conditions that facilitate the implementation process.

IMPLICATIONS FOR FUTURE RESEARCH

There is simply not enough known to say with any confidence what the larger body of superintendents thinks about technology and integration. Although this study begins to address this lack of data, a broader, deeper national understanding of how superintendents conceive of technology is overdue—particularly in light of the implications their conceptions have on the policies that drive or impede the integration process. In addition, research that sketches out how districts have organized their technology resources and restructured various technology positions, and to what purpose, may provide insight and guidance for practicing administrators and policymakers. Educational leadership programs and targeted professional development that introduce the diffusion of literature and offer district administrators, and administrators-to-be, opportunities to focus and reflect on their district's current organization of technology resources may help to move the process and their thinking forward, and prepare districts for the onslaught of teachers who have yet to feel, and be, well prepared to use technology in their instruction—many of whom are poised to take the next step.

In addition, data in this study raise the question as to whether there is any relationship between a superintendent's technology understanding and either the institutional conditions that facilitate teacher technology implementation or, at the very least, how a district organizes its technology resources? However, a comparison of the LoTi results between two districts in this study (Borough Park and Sheepshead Bay, NH) gives one pause. (See Figure 6.) Remember that one district (Sheepshead Bay, NH) had no technology management or oversight piece in place at the time of this study (2001/02). Although both districts report similar numbers of teachers hovering at LoTi Levels 1 and 2, the district with no district-wide technology management had a disproportionate number of teachers at Level 0 (Non-use) compared to the other district, the state, and nationally. (Learning Quest, 2002). This could use further research.

LoTi Level	0	1	2	3	4A	4B	5	6
National	14%	23%	36%	11%	10%	4%	2%	1%
NH	21%	16%	32%	12%	14%	3%	2%	0
Borough Park	18%	18%	34%	19%	8%	2%	1%	0
Sheepshead Bay	31%	20%	32%	10%	4%	3%	0	0

Figure 6. Levels of Technology Implementation (LoTi)

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